University of Alberta
Bulletin No. 60

Research Council of Alberta
Report No. 74

RECONNAISSANCE

Soil Survey of the Grande Prairie and Sturgeon Lake Sheets

BY

WM. ODYNSKY, A. WYNNYK

AND

J. D. NEWTON

Report No. 18—Alberta Soil Survey

Research Council of Alberta
Canada Department of Agriculture
and the University of Alberta
1956

University of Alberta
Bulletin No. 60

Research Council of Alberta
Report No. 74

RECONNAISSANCE

Soil Survey
of the
Grande Prairie and Sturgeon Lake Sheets

BY

WM. ODYNSKY and A. WYNNYK
Research Council of Alberta
Soil Survey Section

AND

J. D. NEWTON
University of Alberta
Department of Soils

Distributed and Published by:
Department of Extension, University of Alberta
Edmonton, Alberta, Canada

ALBERTA SOIL SURVEY COMMITTEE

Dr. J. D. Newton, University of Alberta, Chairman.

Mr. W. E. Bowser, Canada Experimental Farms Service.

Mr. W. Odynsky, Research Council of Alberta.

Dr. A. Leahey, Canada Experimental Farms Service.

This report is published with the approval of the Committee on Agricultural Extension and Publications of the University of Alberta

CONTENTS

CONTENTS—Continued

List of Tables

List of Illustrations

ACKNOWLEDGMENT

The soil survey of the Grande Prairie and Sturgeon Lake Sheets was conducted as a joint project of the Research Council of Alberta, the Canada Department of Agriculture and the University of Alberta. The work was done under the general supervision of the Alberta Soil Survey Committee.

The Research Council of Alberta supplied the funds for the field work, for drawing and printing the soil map, and part of the funds for the laboratory work. The Experimental Farms Service, Canada Department of Agriculture, supplied part of the funds for the laboratory work and provided the aerial photographs of this area. The University of Alberta provided the office and laboratory accommodation, and supplied funds for printing the report.

The township plans and the base maps for this area were supplied by the Technical Division, Alberta Department of Lands and Forests and by the Surveys and Mapping Branch, Canada Department of Mines and Technical Surveys.

During the course of this survey able assistance was given by Messrs. F. Belcourt, E. B. Cooper, F. J. Disney, D. Graveland, A. W. Henley, A. M. F. Hennig, R. A. Hill, J. Markovich, M. G. Morin, K. B. O'Neill, H. O. Ritchie, M. D. Scheelar, D. W. Smith, K. Stewart, R. P. Stone, and Wm. F. Van Tyne. In addition, appreciation is extended to members of the staff of the Experimental Farms Service and particularly J. N. Leat and S. Pawluk, who made many of the chemical and physical analyses reported in this publication. Mr. S. J. Groot prepared the final copies of the Soil and Rating maps. Miss D. Cogan and Mrs. V. House assisted in the compilation and proof reading of this report.

Much useful information, dealing with the subject matter of this report, was contributed by personnel of the Canada and Alberta Departments of Agriculture, by many farmers within the surveyed area, and by members of the staff of the University of Alberta.

INTRODUCTION

This is the third of a series of reconnaissance soil survey reports describing portions of the Peace River Land District in Alberta. The Rycroft-Watino report published in 1950, the High Prairie-McLennan report published in 1952, and this report, cover parts of an area previously described in the Research Council of Alberta Report No. 31 entitled "Preliminary Soil Survey of the Peace River-High Prairie-Sturgeon Lake Area". The latter was published in 1935 and was based on information obtained by exploratory soil surveys conducted in the years 1928 to 1931.

The field and laboratory work required in the preparation of this publication was started in 1950 and completed in 1954. The report and the accompanying maps are supplementary to each other and both should be referred to in seeking information regarding the soils of the mapped area.

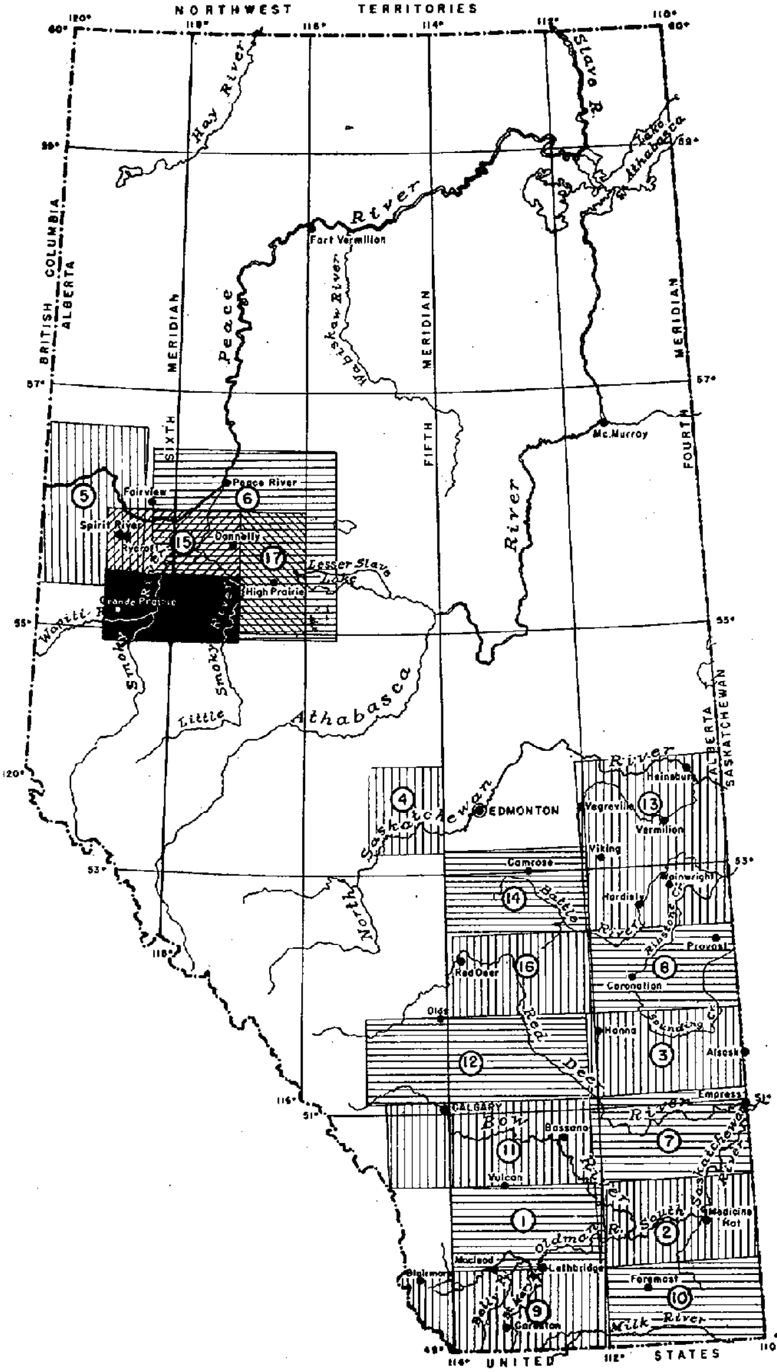
The *report* is divided into a number of sections and the topics dealt with in each are listed in the table of contents. Included in this report are sections dealing with the topography, drainage, climate, vegetation, parent material and other factors that have a bearing on soil development, settlement, and crop production. The greater part of the report deals with a description of the characteristics and agricultural adaptations of the various soil series shown on the soil map. The sections devoted to outlining the systems of soil classification and soil rating should be carefully studied by those using the accompanying maps. A glossary is included giving the definitions of some of the more frequently used descriptive soil terms.

The *soil map*, printed on the scale of three miles to the inch, shows the towns, railroads, post offices, schools, churches, lakes, rivers, and the location and extent of the different soil areas. The designated soil areas are separated by either solid or broken boundary lines and identified by the use of differing colors, letter combinations and symbols. Topography is indicated by means of hatchuring. The topographical separations are described in the report and the method used to indicate the separations is referred to in the map legend. In addition, all map abbreviations, symbols, color schemes, and conventional signs are listed in the map legend. The township and range numbers are shown at the margins of the map and a diagram of a township is included with the legend to assist those unfamiliar with the system used in numbering sections within a township.

Three other maps accompany this report; one shows the distribution of tree cover, another shows the distribution of the cultivated, abandoned and virgin land in the area at the time of survey, and the third shows a suggested productivity grouping based on a rating of the soils mapped in this area. They are small scale maps that are published in black and white and provide information supplementing that given on the soil map. The tree cover map distinguishes areas on the basis of the extent to which tree cover may be an impediment to land improvement, the cultivation map indicates the extent of agricultural development in the area, while the soil rating map distinguishes the better land from the poorer land and suggests the possible utilization of the area.

The rating and classification indicated on the maps should be regarded as average for the areas rather than specific for individual land parcels. The information of the survey is not given in sufficient detail to show all soil variations in individual farm units. However the maps and report can furnish information of valuable assistance in determining the characteristics of the soils encountered in the various portions of this area. It is pointed out, in the following pages, that many different soils are encountered in this area. A recognition of their characteristics will aid in planning land use practices that are essential in establishing a profitable and permanent agriculture.

Figure 1—LOCATION MAP



Sketch map of Alberta showing locations of surveyed areas for which reports have been published: (1) Macleod sheet, (2) Medicine Hat sheet, (3) Sounding Creek sheet, (4) St. Ann sheet, (5) Dunvegan area, (6) Peace River, High Prairie, Sturgeon Lake area, (7) Rainy Hills sheet, (8) Sullivan Lake sheet, (9) Lethbridge and Pincher Creek sheets, (10) Milk River sheet, (11) Blackfoot and Calgary sheets, (12) Rosebud and Banff sheets, (13) Vermilion and Wainwright sheets, (14) Peace Hills sheet, (15) Rycroft and Watino sheets, (16) Red Deer sheet, (17) High Prairie and McLennan sheets. **(IN BLACK)** Grande Prairie and Sturgeon Lake sheets.

NOTE: Reports for areas 1 to 8 inclusive are out of print, but may be obtained on loan from the University Extension Library, University of Alberta, Edmonton.

Soil Survey of the Grande Prairie and Sturgeon Lake Sheets

GENERAL DESCRIPTION OF THE AREA

LOCATION AND EXTENT

The Grande Prairie and Sturgeon Lake sheets are in the southern portion of the Peace River district. They include portions of the former Dunvegan, Smoky River, Wapiti and Iosegun sheets and consist of all or portions of townships 69 to 75 in ranges 20 to 27 west of the 5th meridian and ranges 1 to 7 west of the 6th meridian. More exactly their boundaries are as follows: on the east, west longitude 117°00′; on the west, west longitude 119°00′;on the south, north latitude 55°00′; and on the north, north latitude 55°30′.

Included in the mapped area for this report however, is an additional strip, south of the previously described area that consists of the remainder of township 69 and all of townships 68 and 67. The total mapped area therefore consists of an area approximately 78 miles east and west and 51 miles north and south. It extends from a point 8 miles west of Grande Prairie to a point 11 miles east of Valleyview, and represents about 2,500,000 acres. The general location of the mapped area is indicated on the sketch map in Figure 1.

SETTLEMENT AND AGRICULTURAL DEVELOPMENT

The first settlement and agricultural development in this area occured adjacent to the missions and fur trading posts. In 1910 there were small scattered settlements in the vicinities of Bear lake and Sturgeon lake. Most of the first traders, missionaries or settlers coming into this area came in from the east via the Grouard and Athabasca trails. On completion of the railroad to Edson, an overland trail was surveyed and constructed in 1911 from Edson to Sturgeon lake and west to the vicinity of Grande Prairie. The first large influx of settlers came into this area by way of the Edson trail. By 1914 a substantial proportion of the area west of Bezanson was settled and small settlements were started near Debolt and Valleyview. The major portion of the agricultural development in this area has taken place since the completion of the railroad to High Prairie in 1914 and to Grande Prairie in 1918. Subsequently the graded dirt road was completed from Grande Prairie to Calais in 1929 and from High Prairie to Calais in 1933.

According to the Census of Canada the population of the mapped area was 850 in 1911, of whom about 600 were in the Grande Prairie district. By 1916 the population of the area had increased to 1,668 with 337 living in the town of Grande Prairie while in 1921 the total population of the mapped area was 3,107 with 1,061 in Grande Prairie. In 1931 the population of the entire mapped area was 6,383, that of Grande Prairie 1,464 and that of Sexsmith 304. Then there was a fairly steady increase until 1941, followed by decreases in 1946 and 1951. The total population was 7,074 in 1936, 7,535 in 1941, 7,428 in 1946 and 6,903 in 1951. The population of Sexsmith has not increased appreciably, while that of Grande Prairie was 1,478 in 1936, 1,724 in 1941, 2,267 in 1946 and 2,664 in 1951.

Table 1 gives, in summary, the number of farms, the occupied and the improved acreage in the surveyed area for each of the census years from 1916 to 1951. The data, compiled from the Canada

Figure 2—The Edson trail near Sturgeon Heights. This trail served as one of the main transportation routes to the Grande Prairie area until about 1914.

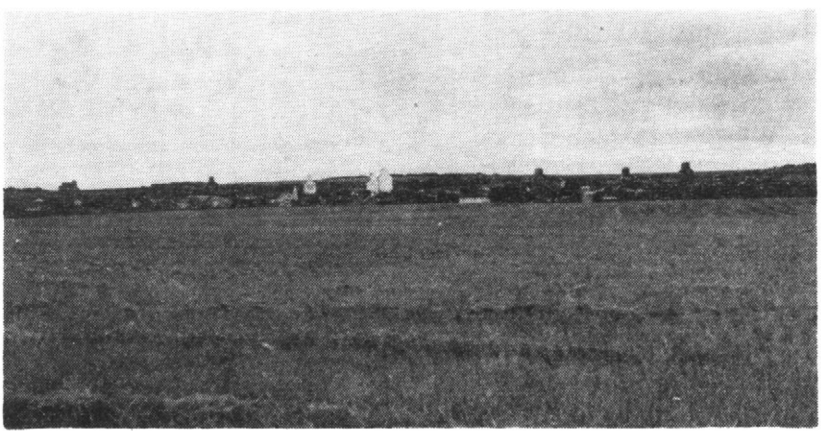


Figure 3—Sexsmith—acclaimed as the "Grain Capital of the British Empire."

Census returns, show a marked increase in the number of farms between the years 1926 and 1931. However, except for 1941, there has been a decrease in the number of farms since 1931. This might suggest a period of consolidation in which the farmers remaining in the area have gradually increased the size of their farm holdings and of their acreage of improved land. Similarly the percent of land improved increased from 22.4 in 1916 to 53.7 in 1951.

TABLE 1—Number of Farms, Acres Occupied, and Acres Improved in the Grande Prairie and Sturgeon Lake Sheets, 1916-1951.

Year	Number of Farms	Areas Occupied	Acres per Farm	Acres per Farm Improved	Percent of Occupied Land Improved
1916	365	101,300	277	62	22.4
1921	972	256,465	264	84	32.0
1926	754	254,440	337	123	36.5
1931	1,674	469,233	280	107	38.1
1936	1,657	492,164	297	126	42.4
1941	1,715	538,468	314	145	46.1
1946	1,506	534,947	355	178	50.2
1951	1,590	600,914	378	203	53.7

The cultivation map (see Fig. 4) shows the distribution of those farms on which cultivation was observed at the time of survey. It will be seen that the greatest proportion of the cultivated acreage is in the west-central portion of the mapped area west of the Smoky river. Smaller concentrations are found east of the Smoky river adjacent to the settlements at Goodwin, Debolt, Crooked Creek, Clarkson Valley, Sturgeon Heights, Calais, Valleyview and New Fish Creek.

The acreage sown to field crops increased correspondingly as more land was improved. Grain farming is the prevalent type of farming in the mapped area. As indicated in Table 2, wheat, oats and barley occupy by far the largest proportion of the cultivated land. Wheat is generally the dominant grain grown in this area but in some years the acreage sown to oats exceeds that sown to wheat. The acreage sown to hay crops has shown a very marked increase since 1931. This trend is considered very desirable in this region.

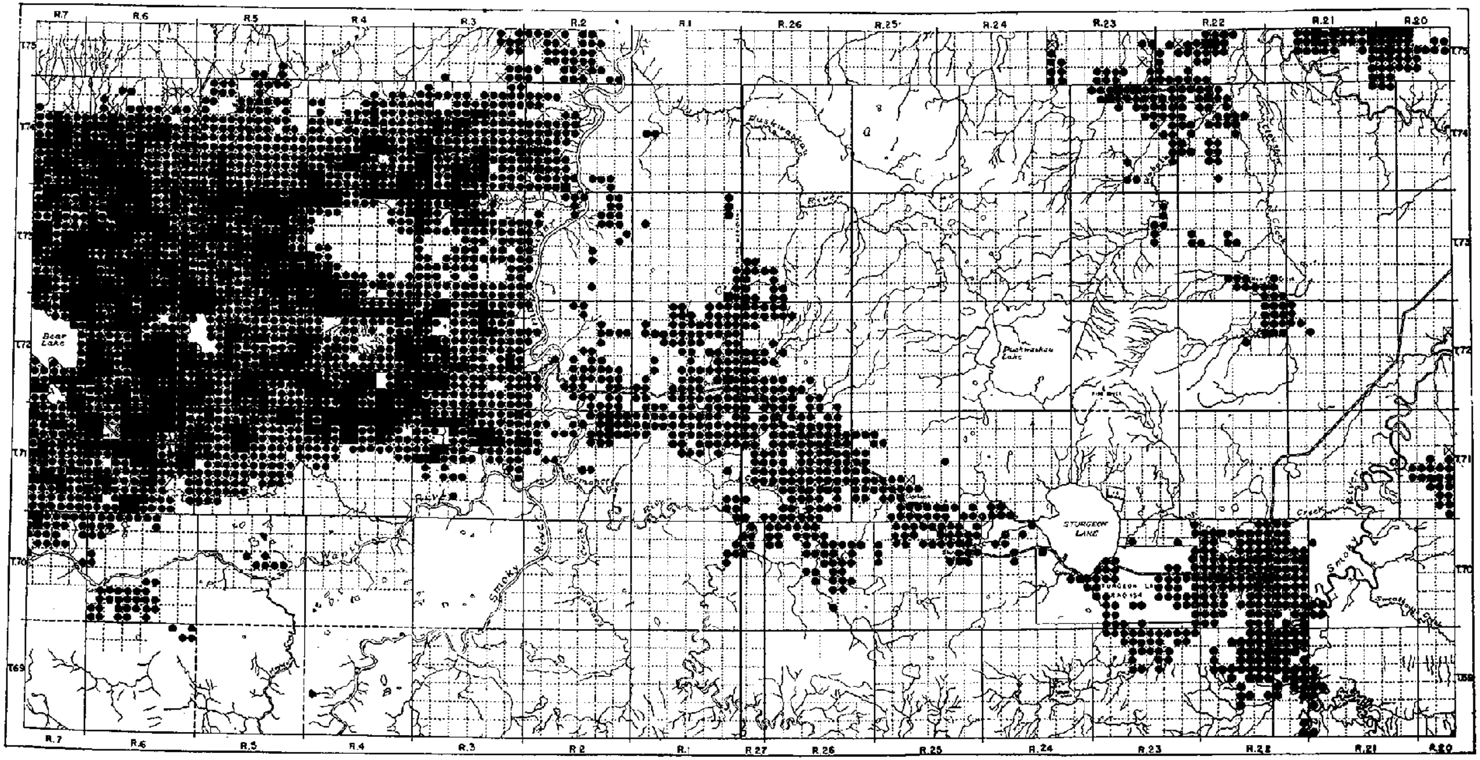
TABLE 2—Total Acreage Cropped and Acreage by Principal Crops in the Grande Prairie and Sturgeon Lake Sheets.

Year	Total Field Crops ac.	Wheat ac.	Barley ac.	Oats ac.	Rye ac.	Flax ac.	Hay* ac.
1916	16,506	7,074	1,008	7,476	....	185	730
1921	55,841	21,466	3,510	26,263	226	264	1,793
1926	65,749	37,655	2,353	21,260	585	20	2,609
1931	129,418	80,944	2,905	39,706	189	....	2,583
1936	145,535	79,310	6,557	49,183	284	45	5,740
1941	161,016	83,040	10,644	53,398	608	1,554	8,087
1946	186,448	93,748	7,218	63,290	1,223	1,319	16,452
1951	244,950	76,146	26,821	82,271	7,403	6,895	40,004

*Includes clover, alfalfa and culitvated grasses.

From available records it is estimated that the average yields in the mapped area are as follows: Wheat about 22 bushels per acre,

Figure 4—Map Showing Present Cultivated, Abandoned and Virgin Lands in the Mapped Area.



Completely cultivated (120-160 acres) .... ■

Partially cultivated (10-120 acres) .... ●

Abandoned cultivation (10-160 acres) ...... ☒

Virgin lands (Idle and Pasture) .... ☐

barley about 27 bushels per acre and oats about 38 bushels per acre. These estimates include yields produced on many soil types and under many different types of farm practice. Some of the better soils give higher yields and many individual farmers have exceeded these averages by considerable margins.

The census returns also show that, while the livestock population increased as more farms were established, this increase was not always proportionate to the rate of land improvement. In 1916 there were 2,135 head of cattle, 3,593 hogs and 46 sheep and by 1936 the numbers had increased to 14,074 for cattle, 11,458 for hogs and 2,154 for sheep. However by 1941 the number of cattle had declined to 10,549, and the number of sheep had dropped to 1,432 while the hog population had more than doubled to 23,459. This increase in hog population was short lived, for by 1946 it had dropped to 8,158 while the population of cattle was 11,985 and sheep 986. The number of cattle, hogs and sheep in 1951 was much the same as in 1946.

TRANSPORTATION

The main line of the Northern Alberta Railway traverses the northwest portion of the mapped area. It enters the area in township 75 range 5 and then proceeds in a southerly direction to Grande Prairie via Webster, Sexsmith and Clairmont. From Grande Prairie it extends west and leaves the area in the vicinity of Dimsdale in township 71 range 7 en route to Dawson Creek, B.C. The shipping distance from Grande Prairie to Edmonton is 406 miles.

The main highway from Edmonton enters the mapped area in township 73 range 20 and then proceeds to Grande Prairie via Valleyview, Sturgeon Lake and Debolt. From Grande Prairie the highway extends west to join up with the Alaska highway at Dawson Creek, B.C. Another highway proceeds north of Grande Prairie via Clairmont and Sexsmith and leaves the mapped area in township 75 range 5 en route to Fairview and Peace River. At Valleyview the distance from the nearest shipping point at High Prairie is 48 miles, while the distance from Edmonton is approximately 295 miles. At Grande Prairie the distance from Edmonton by highway is 365 miles. However with the opening of the new highway extending south from Valleyview to Whitecourt, the distance from Edmonton to Valleyview and to Grande Prairie via Carvel has been shortened by about 70 miles. The heavily settled western portion of the mapped area is well supplied with market roads. In most of the sparsely settled eastern, northern and southern portions there are very few roads and in many cases the areas are accessible only by wagon or pack trails. Many new trails and some new, well graded roads have been built during the last few years in connection with the activities of numerous oil companies.

Bridges span the rivers and streams along the routes of the main highways and most of the secondary roads. South of Grande Prairie, the Wapiti river can be crossed by a ferry in section 23 township 70 range 6.

Figure 5—New roads, made in connection with oil exploration activities, have made various portions of the surveyed area much more accessible.

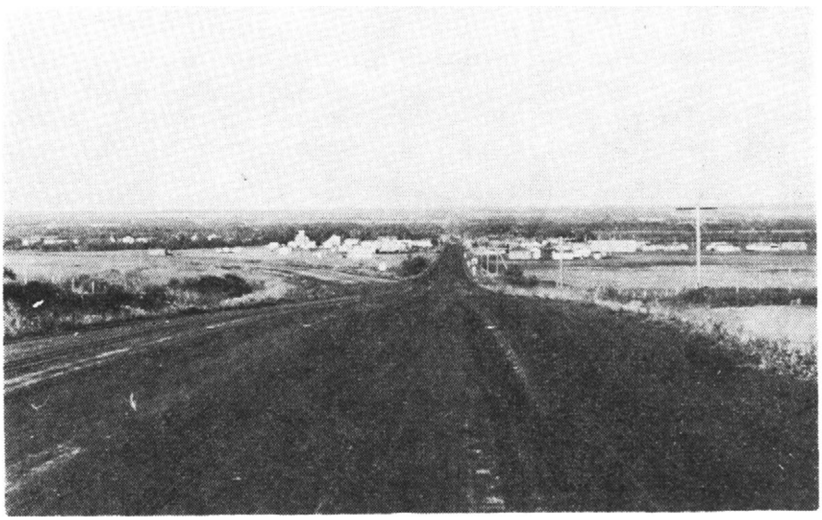


Figure 6—Highway at Valleyview. New highway between Valleyview and Whitecourt, completed in 1955, will provide a shorter and more direct route to Edmonton.

RELIEF

The surveyed area consists mainly of the remnants of a former till plain and of lower lying laking basins, some of which have undergone considerable alteration adjacent to the main drainage channels.

Till plain remnants are found in the eastern and northern parts of the area at elevations of from 2,400 feet to about 3,300 feet above sea level. In the eastern portion of the area the till plain has a maximum elevation of 2,900 feet in the vicinity of the fire tower north of Sturgeon lake and 2,850 feet northeast of Debolt in section 3 township 73 range 26. In the western portion of the area, the Kleskun hills east of Sexsmith reach an elevation of 2,500 feet in sections 21 and 30 township 72 range 4, while in the Saddle hills an elevation of 3,300 feet is found in section 16 township 75 range 6. Occasional variable benches, low ridges and knolls are characteristic of this otherwise relatively level till plain. The slopes from the till plain remnants to the lower lying basins or valleys are generally long and fairly uniform. In the greater part of the area these slopes seldom exceed a gradient of 6 per cent. Some of the remnants, particularly those near Valleyview, those northeast of Debolt, those north of Smoky Heights in township 75 range 2, and those forming the Kleskun hills, are composed of bedrock with a thin covering of till.

The lower lying basins occupy the eastern and west-central portions of the mapped area, adjoining the main drainage channels. They vary in elevation from 1,900 feet to about 2,400 feet above sea level. The lower elevations are found in the northeast portion of the mapped area in the vicinity of Whitemud Creek and adjacent to the Little Smoky river. The higher elevations are found at the outer edges of the basins adjoining the till plain remnants and in the western part of the mapped area adjacent to Sexsmith, Clairmont and Dimsdale. The latter areas have a variable relief featured by the occurrence of numerous ridges and fairly high knolls.

Some portions of the laking basins have undergone considerable alteration. Between Goodwin and Bezanson, adjacent to the Smoky river, there are numerous low, steep-sided knolls whose crowns frequently have doughnut shaped depressions. The sand area south and east of Grande Prairie adjacent to the Wapiti, Smoky and Simonette rivers has a very variable relief featured by the occurrence of numerous low boggy areas that are bounded by dunes that have a striking appearance particularly when viewed from an aeroplane or on aerial photographs. The dunes often tend to be hairpin shaped, with a fairly high, somewhat steep sided central or crescent portion from which extend two horns that gradually decrease in size and elevation with distance from the central portion. The central portion is often up to 40 feet higher than the adjacent low boggy areas and some of the horns are several hundred feet in length. Most of these hairpin shaped dunes form a definite pattern with an easterly alignment that has a bearing of about 8° north of east. (See Fig. 24.)

DRAINAGE

Drainage in the mapped area is effected by numerous streams and rivers forming part of the Peace river drainage system.

Figure 7—Gently rolling area north of Sturgeon lake.

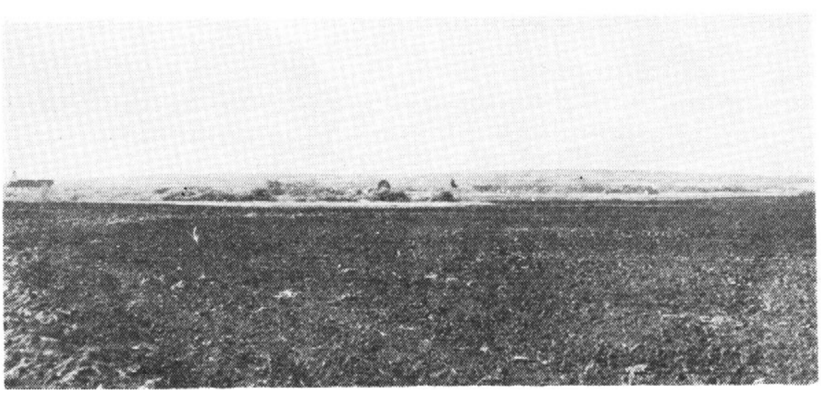


Figure 8—Level to undulating area and the Kleskun hills in the west-central portion of the mapped area.

The eastern part of the area is drained by the Little Smoky river and its tributary streams, the chief of which are Clouston, Wabatanisk, Sturgeon and Sweathouse creeks. Except for Sturgeon creek these tributary streams are seasonal in character and are often nearly dry during the later summer months. The Little Smoky river is a permanent stream and one of the main tributaries of the Smoky river, which it joins near Watino about 15 miles north of the mapped area.

The Smoky river and its tributaries, the chief of which are the Wapiti and Simonette rivers, and Economy, Cornwall, Bear and Big

Mountain creeks, drain the western and most of the southern portions of the mapped area. Economy, Cornwall and Big Mountain creeks are seasonal in character, whereas the others are all permanent streams. The Smoky river flows north through the western part of the mapped area, then proceeds in a north easterly direction to be joined by the Little Smoky river, and then empties into the Peace river in township 83 range 22 about 55 miles north of the mapped area.

Lakes are of common occurrence in the mapped area. The largest of those indicated on the soil map are as follows: Sturgeon, Puskwaskau, Goose, Clairmont, Bear, Hermit, Hughes and Flyingshot lakes. Of these, only Sturgeon lake and Bear lake are fed by permanent streams and springs, while the remainder and most of the other small lakes appearing on the soil map, are replenished

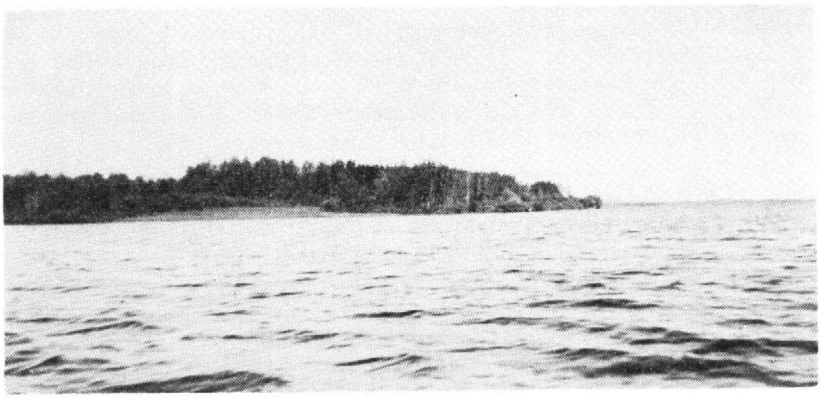


Figure 9—Sturgeon lake — good fishing.

Figure 10—Simonette river, its valley and flood plain.

chiefly by run-off waters from the surrounding areas. Throughout much of the year they are stagnant.

Local drainage conditions vary greatly throughout the mapped area. The most satisfactory drainage conditions, from the standpoint of agriculture, are found in those areas that have long very gentle slopes. Much of the rolling and hilly land is excessively drained through loss of moisture by excessive surface run-off. Low-lying flats and depressions are characterized by varying degrees of flooding as the result of restricted drainage.

CLIMATE

Meteorological data compiled from the Canada Meteorological Records and the Canada Experimental Farm records are given in Tables 3 to 6. In the mapped area such records are available only for Grande Prairie. Those for High Prairie and Beaverlodge are included for purposes of comparison. However, the records for Grande Prairie are an average of only 9 years' observations and those of High Prairie represent a 15 year average while those of Beaverlodge are an average of 36 years' observations, and are perhaps more indicative of the long time averages than any other records available in this part of Alberta. The station at Beaverlodge is at the Canada Experimental Farm about 15 miles west of the mapped area while the station at High Prairie is about 30 miles east of the northeast portion of the surveyed area.

Table 3 gives the average monthly, seasonal and annual precipitation at the three recording stations. In this table the year is divided into three sections, namely: the previous fall, winter, and spring and growing season. This is done because it is believed that the precipitation of the winter months is relatively ineffective in so far as growing crops are concerned, while that of the fall, spring and growing season is closely related to the crop growth obtained.

The data in Table 3 indicate that the total annual precipitation in at least the western portion of the mapped area is very similar to that at Beaverlodge. If the record of High Prairie is indicative of conditions prevailing in some of the eastern portion of the area, it would appear that the total annual precipitation may be somewhat higher in the eastern portion of the mapped area. However it should be borne in mind that averages based on records of less than about 25 years duration may not be truly representative of the long time average. A further comparison of the data indicates that the moisture distribution may be somewhat more favorable in the eastern part of the area than in the western. At Grande Prairie and Beaverlodge 64 percent and 66 percent of the annual precipitation occurs during the fall, spring and growing season, whereas High Prairie receives 73 percent of its precipitation during that time. The distribution in the mapped area is not as favorable as that in the Edmonton and Lacombe area, where about 80 percent of the annual precipitation occurs during the fall, spring and growing season.

TABLE 3—Average Precipitation in Inches. Monthly and Seasonal Distribution for Stations in or near the Grande Prairie and Sturgeon Lake Sheets.

Average	Grande Prairie 9 years		High Prairie 15 years		Beaverlodge 36 years	
August	1.60		1.91		1.87	
September	1.39		1.69		1.71	
October	0.81		1.05		1.13	
Previous Fall		3.80		4.65		4.71
November	1.10		1.22		1.27	
December	1.08		0.96		1.21	
January	1.29		0.91		1.31	
February	1.50		0.77		1.06	
March	0.78		0.95		1.12	
Winter		5.75		4.81		5.97
April	0.79		0.89		0.85	
May	1.43		1.58		1.57	
June	2.26		2.98		1.96	
July	1.94		3.02		2.51	
Spring and Growing Season		6.42		8.47		6.89
Total		15.97		17.93		17.57
Percent of Total Occurring in Fall, Spring and Growing Season		64		73		66

At the stations reported in Table 3, June and July are the months of greatest rainfall. These are the important growing months in this area. The total precipitation received in these two months averages 4.20 inches at Grande Prairie, 4.46 inches at Beaverlodge and 6.00 inches at High Prairie. Thus it would appear that there is usually sufficient moisture to produce at least a fair crop in the mapped area. However, there must be sufficient reserve moisture to carry the crop into June. Moisture can be a limiting factor to crop production in this area, and more attention should be given to implementing conservation measures that will save much of the fall and spring precipitation.

Meteorological records also show that the average annual snowfall is about 54 inches at High Prairie, 70 inches at Grande Prairie and 73 inches at Beaverlodge. January is the month of greatest snowfall and snow has been recorded in every month but July. Much of the winter snow is lost in the spring run-off, particularly on cleared or burned over land, and is relatively ineffective in so far as the growing crops are concerned.

The climate of the surveyed area is characterized by moderately warm summer and relatively cold winter temperatures. As indicated in Table 4, there is little difference in the yearly mean or average temperature at the three recording stations. It would appear that an average temperature of 34.5°F. to 35°F. should be fairly representative of the surveyed area. The mean growing season temperature is about 51°F. while the mean winter temperature in the surveyed area is about 13°F.

In so far as crop production is concerned, the length of growing season is very important in determining the type of crops that can be grown successfully. Similarly, the length of the frost-free period has a considerable bearing on the risk of producing certain crops and on the variety of crops that can be grown. The frost-free period is generally not as long as the growing season. Most farm crops are not damaged when the temperature reaches 32°F. A killing frost is considered as 29°F. It should also be borne in mind that the amount of frost will vary locally with changes in topography. Many low-lying areas often have fall frost considerably earlier than nearby higher land. Similarly, a dense tree cover that impedes natural air drainage appears to increase the hazards of frost. Table 5 gives the growing season and the frost-free period as reported for the stations in or near the surveyed area. The data indicate an appreciable difference in the length of growing season at the recording stations adjacent to the mapped area. While the averages reported for High Prairie and Grande Prairie are for a comparatively short period and may not be representative of the long time average, it would appear that frost might make crop production a considerably more hazardous undertaking in the mapped area than in the area farther west in the vicinity of Beaverlodge. The Experimental Farm records further indicate that at Beaverlodge, over the period 1916 to 1951, inclusive, the average date of the last killing spring frost has been May 10, while the average date of the first killing fall frost has been September 19.

TABLE 4—Average Monthly, Seasonal and Annual Mean Temperatures (Degrees F.) for Stations in or near the Grande Prairie and Sturgeon Lake Sheets.

Average	Grande Prairie 9 years	High Prairie 15 years	Beaverlodge 36 years
August	58.0	58.1	57.69
September	50.9	48.6	49.80
October	39.4	38.2	39.28
Previous Fall	—— 49.4	—— 48.3	—— 48.9
November	19.7	21.6	23.79
December	7.3	7.9	11.73
January	9.3	5.4	8.67
February	6.7	8.4	12.41
March	20.3	20.8	22.04
Winter	—— 12.7	—— 12.8	—— 15.7
April	37.4	37.8	37.33
May	50.6	50.8	49.26
June	56.4	55.3	55.76
July	60.6	60.4	60.02
Spring and Growing Season	—— 51.3	—— 51.1	—— 50.6
Annual Mean Temperature	34.7	34.4	35.65

TABLE 5—Average Growing Season and Frost-Free Period for Points in or near the Grande Prairie and Sturgeon Lake Sheets.

	Years Averaged	Growing Season (days over 29°F.)	Frost-Free Period (days above 32°F.)
Grande Prairie	12	112	95
High Prairie	12	103	82
Beaverlodge	36	130	97

Records of wind mileage are available for the years 1943 to 1951 at Grande Prairie, and for the years 1936 to 1951 at the Beaverlodge Experimental Farm. These records show that at Grande Prairie the

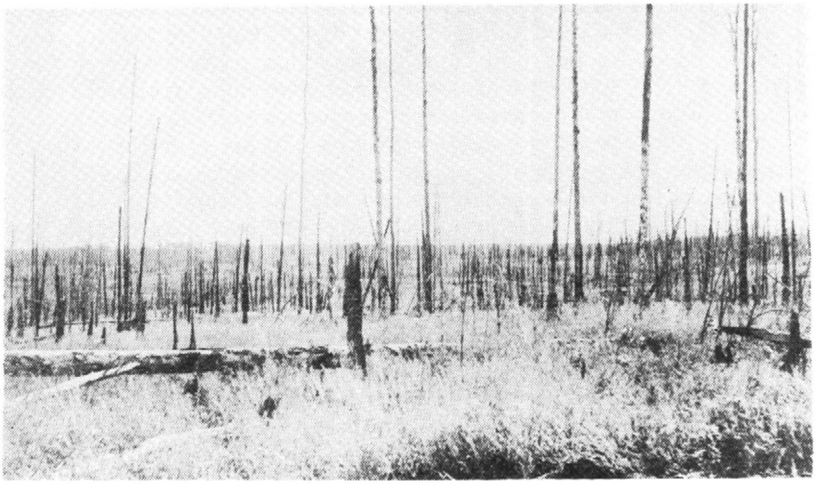


Figure 11—Light cover is common in many of the burned over areas adjacent to Valleyview. (See Fig. 13.)

Figure 12—Heavy cover, some of which is of commercial importance, is found in some of the northern and southern portions of the mapped area. (See Fig. 13.)

average total annual wind mileage is 80,859 miles. Most of the winds come from a west and northwest direction. The wind velocity averages 8.7 miles per hour and varies from an average of about 7.5 miles in the winter months to a peak average of about 12 miles per hour in May at a time when spring seeded crops are most vulnerable. The average wind duration is about 720 hours per month. At Beaverlodge, the average total annual wind mileage is 71,172 miles, with most of the winds coming from a west and northwest direction at a velocity that averages about 8.2 miles per hour, and varies from an average of about 7 miles per hour in the winter months to a peak of 10.5 miles per hour in May. The average wind duration at Beaverlodge is about 705 hours per month. By way of comparison, the Lacombe Experimental Farm has an average total annual wind mileage of only 43,000 miles and April is the windiest month. Calgary has an average of about 79,000 miles per year and the Lethbridge Experimental Farm has an average of about 104,000 miles per year.

VEGETATION

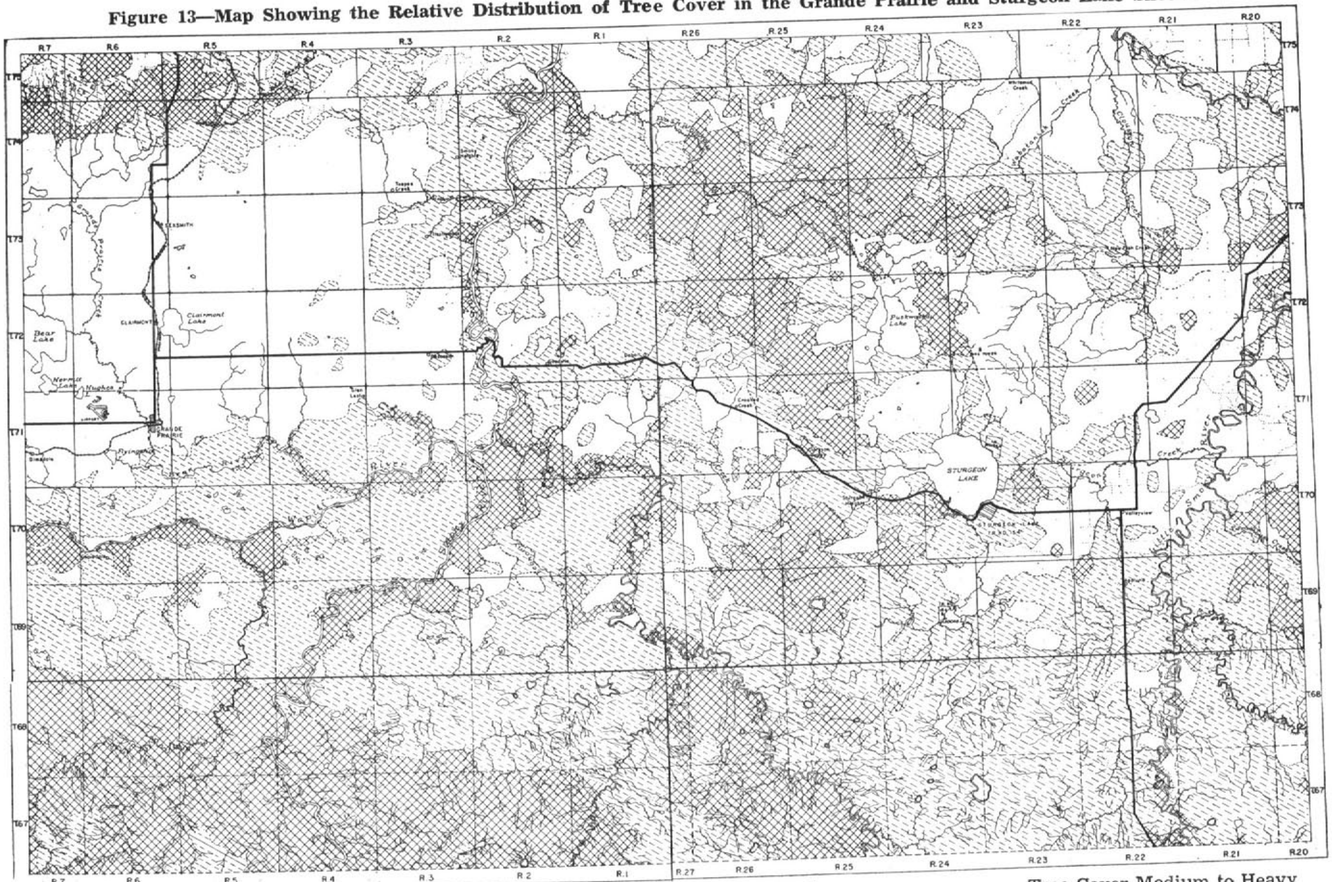
Throughout most of the area, the dominant native vegetation consists of a mixed tree cover in which aspen poplar is of most frequent occurrence. Balsam poplar, spruce, pine, birch, willow, and alder occur either in mixtures or as the dominant cover of local areas. Such shrubs as the rose, gooseberry, raspberry, cranberry, chokecherry, saskatoon and hazelnut occur in mixtures particularly in the more open portions of the mapped area. Black spruce, tamarack, scrub birch, labrador tea, sedges, rushes, reeds, coarse grasses and mosses occur in the many low-lying, poorly drained portions of the area. Fir is of common occurrence in the understory of many of the mature stands of spruce in the area.

Much of the native cover has been destroyed as the result of land improvement and forest fires. The relative distribution of tree cover is shown in Figure 13. Merchantable stands of spruce and pine occur only in some of the northern and southern parts of the mapped area and in the central portion adjacent to Puskwaskau lake and Crooked creek.

In addition to the wooded areas, however, there are fairly extensive parkland areas that consist of wooded bluffs, low shrub cover and varying amounts of open grassland. Such parkland conditions appear to have prevailed in the settled areas adjacent to Whitemud Creek, Valleyview, and in much of the western portion of the area adjacent to Sexsmith and Grande Prairie.

The existence of these and other parkland areas within the wooded Peace River region has been a source of major interest for a long time. Early settlers, traders and explorers referred to these areas and attributed their existence to repeated forest fires. Investigations by E. H. Moss, Dept. of Botany, University of Alberta, reported in "The Botanical Review" 21-9-1955, indicate that the native vegetation of these northern parklands is similar in many re-

Figure 13—Map Showing the Relative Distribution of Tree Cover in the Grande Prairie and Sturgeon Lake Sheets.



—Tree Cover Absent or Light (Presents little impediment to land development.)

—Tree Cover Light to Medium (Some impediment to land development, may require power clearing.)

—Tree Cover Medium to Heavy (Serious impediment to land development, power clearing may be too costly.)

spects to that of the foothills and some of the other parklands of Alberta, but that it lacks some of the leading grass species of the latter areas. Further studies will be required to determine the species native to the northern parklands and their relationship to the soil in these areas. It is noteworthy that many of these parklands are found on soils that have developed on a heavy, somewhat saline parent material, and are distinguished by a clay pan that is relatively near the surface. Such a clay pan might tend to be unfavorable to the development of a good tree growth and it is suggested that, as a result, trees never did become well established in such areas.

THE SOILS' PARENT MATERIAL

The uppermost unconsolidated deposits form the parent material from which the present soils were developed. Consequently, a consideration of their origin and a knowledge of their nature is essential in the study of soils.

The surface deposits and the surface features of the mapped area are the result of erosion and deposition during pre-glacial, glacial and post-glacial times. The general effect of pre-glacial erosion was to remove the beds that may have been deposited subsequent to the Upper Cretaceous period. The beds exposed as the result of this erosion consist mostly of shales and sandstones belonging to the Montana group of the Upper Cretaceous period. Maps and reports published by the Geological Survey, Research Council of Alberta, show that except for a small area bordering the Little Smoky river and extending as far south as the north half of township 74 in ranges 20 and 21, that is underlain by the Smoky River formation, all of the remainder of the mapped area is underlain by the Wapiti formation.

The following excerpts from the reports referred to will serve to indicate some of the characteristics of the dominant formations in the mapped area:

"The greater part of this formation (Smoky River) is of Colorado age, but the upper part is of Montana age (Lower Pierre). There is no recognizable lithological difference between the upper and lower parts of the marine shale formation . . . They are thin bedded, dark to black shales with occasional ironstone and pyrite nodules." (Allan, J. A., and Rutherford, R. L., Research Council of Alberta Report No. 30).

"Lithologically the Wapiti formation consists of sandstones and shales of fresh water deposition . . . Light grey to buff are the prevailing colors, and on the whole, fine grained textures are most common . . . The shales are poorly stratified, a characteristic common to shales of fresh water deposition." (Rutherford, R. L., Research Council of Alberta Report No. 21). The Wapiti formation is over 1,100 feet thick and includes all the beds of the Upper Cretaceous period that lie above the upper part of the Smoky River formation.

Further investigations lead Allan and Rutherford (Research Council of Alberta Report No. 30) to suggest a separation of the Wapiti into the Belly River and Edmonton formations. "In the Peace River districts of Alberta and eastern British Columbia, the top of the Belly River has been placed at a horizon within the upper part of the Wapiti formation where a lithological change occurs . . . The Edmonton formation is composed of light to dark colored shales, bentonitic clays and sandstones, coal seams and carbonaceous bands, and frequent layers of clay-ironstone nodules. . . The Edmonton formation is extended west across the Smoky through the Grande Prairie district where the upper part of the Wapiti is correlated with the Edmonton on a lithological basis." Their map indicates a separation of the Wapiti formation into the Belly River to the north, and the Edmonton to the south, of a line extending from about the northeast corner of township 69 range 20 to Sturgeon lake, then to Debolt, Goodwin, the Wapiti river in range 4, and then north to the east and north sides of the Kleskun hills, from where it extends in a westerly direction to Bear lake.

During the Pleistocene epoch this region was overridden by the Laurentide ice sheet advancing from the northeastern part of the continent. In passing over the area, the ice sheet mixed the materials accumulated from the underlying bedrock and produced large areas with a relatively flat surface by filling in the depressions left as the result of pre-glacial erosion. The materials from the underlying bedrock made up the greater proportion of the drift in this area.

Two different glacial deposits were recognized in the mapped area. The first consists of a greyish brown to yellowish brown, sandy clay loam to clay till, that is somewhat stony, has numerous coal flecks and may be largely derived from both the Smoky River and Wapiti formations. This till underlies many of the subsequent deposits in the mapped area and is exposed most extensively in the southeastern, east-central and northern parts of the area. It forms the parent material of Braeburn, Saddle and Sexsmith soils.

The second glacial deposit, frequently lying immediately above the preceding one, consists of a well sorted, grey to dark greyish brown clay that has few stones, numerous gypsum crystals and may be derived largely from the weathered products of the Smoky River shales. This deposit is remarkably uniform and may have been laid down in a glacial lake. Pending further investigations to determine its origin, the term "lacustro-till" is used in this report in reference to this deposit. It forms the parent material of Donnelly, Esher and Landry soils and occurs on the lower slopes of the till plain remnants at elevations rarely exceeding about 2,300 feet in the eastern part to about 2,500 feet in the western part of the mapped area.

In the lower basins, at elevations usually below 2,200 feet, much of the soils' parent material appears to be of post-glacial origin.

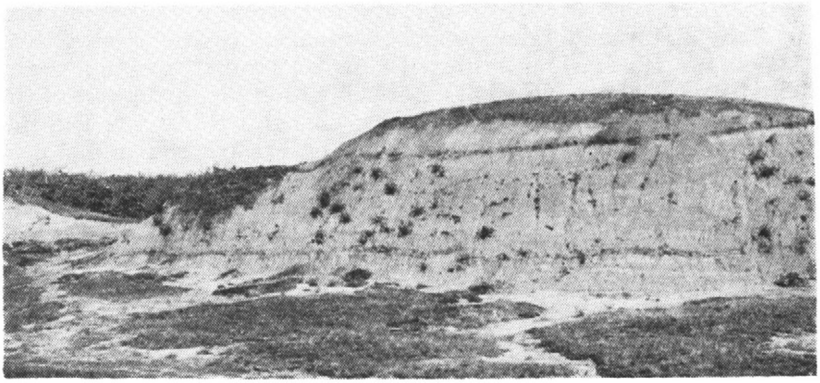


Figure 14—Wapiti formation exposures are found in the Kleskun hill and in the vicinity of Valleyview.

Figure 15—Quartzite gravel and bentonite beds in a small area near the crown of the Saddle hills in section 7, township 75, range 6 west of the sixth meridian.

Lacustrine, grey to dark grey, heavy clays are found adjacent to the Little Smoky river in the northeastern part of the mapped area and adjacent to Bear lake in the western part. They are stone free, very firm, unctuous clays that appear to be derived largely from the Smoky River shales. Except for the fact that these clays are stone free, somewhat more uniform and generally darker colored, they differ very little from the previously described clays. Rycroft, Falher and Nampa soils are developed on this dark colored, somewhat saline, lacustrine material.

Adjacent to some of the major stream courses, the parent materials are brownish colored and appear to be of alluvial origin. The more recent of these deposits are found on the lower terraces and flood plains. They form the parent material of High Prairie and Enilda soils and are of common occurrence in the eastern portion of the mapped area adjacent to the Little Smoky river. The older alluvial deposits, adjacent to the Smoky, Simonette and Wapiti rivers, consist of sandy and silty materials that in many cases appear to have been reworked by wind. Judah, Davis and Tangent soils are formed on the silty materials and are often characterized by a humpy topography that may be the result of frost action. Culp, Leith and Heart soils are formed on the sandy materials. Adjacent to the Wapiti and Simonette rivers these sandy materials have been reworked by wind with the result that much of this area has a characteristic hairpin shaped dune topography.

In addition to the foregoing, there are other types of parent material that are of local importance in various portions of the mapped area. These are the gravelly outwash and shoreline materials found in association with some of the till and lacustro-till areas, the material developed on or in very close association with the underlying bedrock, other alluvial or wind blown materials deposited as relatively thin beds overlying other deposits, and the recent alluvium deposited on the river flats. Near the crown of the Saddle hills however, in section 7, township 75, range 5, west of the sixth meridian, there is a gravelly deposit in which stones are predominantly quartzites, and which contains an 18 inch layer of what appears to be bentonite. This deposit is not characteristic of the glacial or more recent deposits in this area, but appears to resemble the Tertiary deposits that cap the Cypress hills in the southeastern part of Alberta.

SOILS

SOIL DEVELOPMENT

Soils consist of variable mixtures of weathered rocks and minerals, organic matter, water and air. They are the products of the environmental conditions under which they have developed and their characteristics are dependent upon (1) the climate and vegetation, (2) the nature of the parent material, (3) the relief and drainage, (4) the biological activity (living organisms), and (5) the length of time that these forces have been in operation.

Soil development is a continuous process that goes on, to a lesser extent, even after the soils have reached a state of near equilibrium with their environment. The rocks and minerals of the parent material weather and decompose into a finely divided condition. Percolating waters carry down the soluble and finely divided materials and re-deposit them at lower depths. Concurrent with this there is a return of plant materials by way of the grass and tree roots from the lower portions of the profile. When the plant dies its remains decay and the humus formed tends to collect on or near the surface giving it a dark color. During decomposition plant nutrients are liberated and may be carried down by percolating rain water or re-used by the growing plants and other living organisms. Under natural conditions, therefore, soil development is a complex and continuous process. On cultivation, however, a completely new environment may be established and as a result, the whole process may undergo a change and have to attain a new equilibrium.

The characteristics that a soil acquires, as the result of the interaction of the various soil-forming factors, are reflected in the development of more or less distinct layers or horizons. A cross section of these horizons from the surface to the relatively unaltered parent material is known as a soil profile. (See Fig. 16.). The A horizon is the portion of the profile from which materials are leached by the percolating rain water and in which, in most soil profiles, the organic matter accumulates. The B horizon is the portion in which the materials carried down from horizon A are deposited. As a result of this accumulation, the B horizon often tends to be somewhat heavier textured and more compact than the A horizon. Taken together, the A and B horizons form the solum, which represents the true soil formed by the soil building agencies. The C horizon is the relatively unaltered parent material. Where the underlying material is different from that in which the solum has formed, it is designated as the D horizon. Soil profiles developed under the influence of excessive moistening may have a greyish, more or less sticky, G horizon in the lower part of the solum.

The degree of profile development is dependent on the intensity of the activity of the different soil forming factors, on the length of time they have been active, and on the nature of the materials from which the soils have developed. Characteristic horizons are not the result of chance. Mature soils developed on similar parent material under the influence of similar conditions of climate, vegetation and relief, will have horizons of similar thickness possessing similar characteristics. Soils developed from similar materials that have been acted upon by environmental factors that are different in kind or intensity will have different profiles.

In the Grande Prairie and Sturgeon Lake sheets, the interaction of the various soil forming factors has resulted in the development of many different soil profiles. Each profile has its own specific characteristics and offers its own agricultural problems and potentialities. Some of the principal profile types are illustrated in Fig. 17. The following summary shows the relation of some of the soil forming factors to the major profile types found in the mapped area. The first three profiles are typical of zonal soil types. The remainder are modifications of zonal soils. They are the result of various local differences due to topographic positions (drainage) or to parent material.

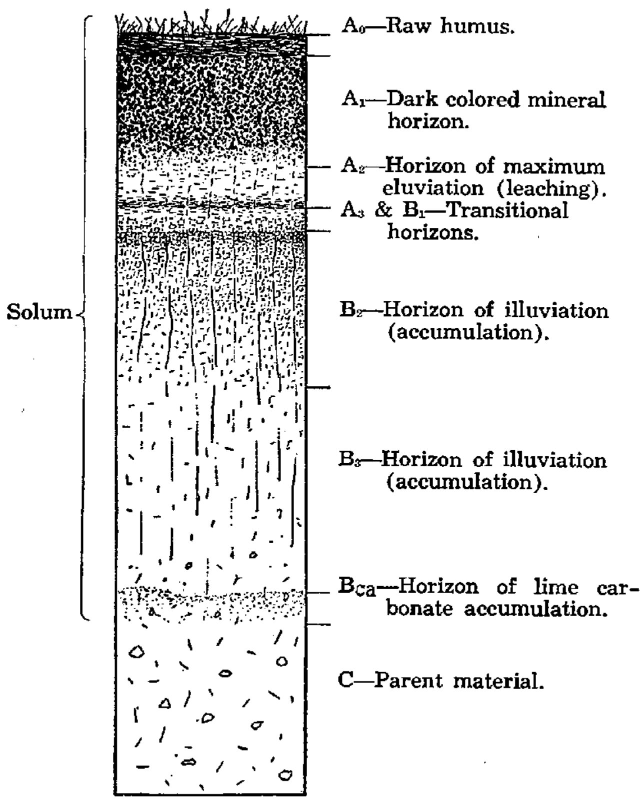


Figure 16—Diagram of a soil profile showing various horizons. (Some profiles may not have all these horizons clearly developed.) Where it is necessary to subdivide a horizon a second digit is used, for example, the B-2 horizon may be subdivided into B-21, B-22, etc.

A. Vegetation and Relief

1. Well drained to moderately well drained topographic positions.

(a) *Black Soil Profiles*: Developed on non-saline parent materials in areas characterized by a long continued absence of tree cover. The profiles have a very dark brown to black A horizon and a prismatic or granular structure in the B horizon. The lower portion of the B horizon has an accumulation of lime carbonate. (See Fig. 17.) Such profiles are of infrequent occurrence in the mapped area.

(b) *Degraded Black Soil Profiles (Grey Black or Transition):* Developed in areas in which the woodland vegetation has not been as dense nor as well established as that of the Grey Wooded soil areas. The woodland may be a comparatively recent development on former grassland areas. The profiles have a dark grey to brown A_1 horizon that is well developed and usually several inches thick. The underlying A_2 horizon is grey to greyish brown in color, and rarely exceeds a thickness of six inches in this area. The B horizon generally has a nuciform structure, and lime carbonate is usually present in the lower part of this horizon. (See Fig. 17.)

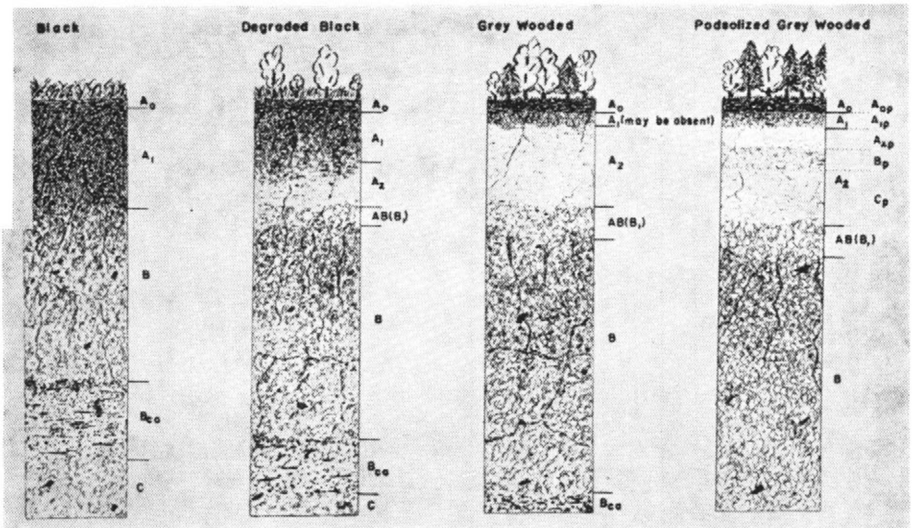


Figure 17—Sketch showing the characteristics of some of the principal profiles found in the mapped area.

(c) *Grey Wooded Soil Profiles*: Developed under a mixed deciduous and evergreen woodland vegetation on calcareous parent materials. The profiles have a thin or almost imperceptible A_1 horizon, a thick, ashy, grey to very pale brown A_2 horizon, and a well developed textural B horizon. Lime carbonate is usually present in the C horizon and may occur in the lower portion of the B horizon. (See Fig. 17.)

(d) *Podzolized Grey Wooded Soil Profiles*: These profiles are characterized by the development of what appears to be a secondary, Podzol-like profile in the A horizons of soils that otherwise resemble Grey Wooded soils. The secondary profile is readily distinguished by its white to pinkish white A_2 horizon that is usually thin and much lighter colored than the remainder of the A_2 horizon of the primary profile. There is often a slightly compacted, brown to reddish brown B horizon which is underlain by the grey to very pale brown remnants of the former Grey Wooded A_2 horizon. (See Fig. 17.) The B horizon of the primary profile usually undergoes some alteration with a resultant deterioration of its pronounced textural characteristics. Such profiles are of infrequent occurrence in the mapped area, being found only in some of the more sandy portions and in some parts of the Saddle hills.

2. Moderately well drained to poorly drained topographic positions.

(a) *Meadow Soil Profiles*: These profiles have a fairly thick, dark colored A horizon and a lighter colored, often iron-stained B or G horizon. The A horizon is rich in organic matter, and in heavy textured soils it has a fine granular structure.

(b) *Depression Podzol Soil Profiles*: These profiles are distinguished by their thick, grey A_2 horizon underlain by a heavy "sticky" B horizon. Rusty streaks and mottling are found in the B horizon and often in the A_2 horizon. Frequently the uppermost horizon consists of a fairly thin, dark colored accumulation of peat.

(c) *Peat Soil Profiles*: These profiles have an accumulation of organic material (peat) overlying a mottled and often rusty streaked mineral subsoil. They are identified by the depth and nature of the peat accumulation. *Thin Peat profiles* usually have less than 12 inches of peat, and are often classified according to the nature of the underlying mineral subsoil. Thick Peat profiles are typical of true *Organic* soils, and the underlying mineral horizon may be regarded as a D horizon. Depending on the kind of organic material in the accumulation, they are referred to in this report as *Sedge Peat* or *Moss Peat soil profiles.*

B. Nature of the Parent Material

The following profile types are of fairly common occurrence in the mapped area and are believed to be the result of the predominating influence of a saline to somewhat saline parent material.

(a) *Solonetz Soil Profiles*: May occur as the dominant soil profiles of fairly large areas or in association with other Degraded Black or Black Soils. These profiles have a dark grey to greyish brown A_1 horizon and sometimes a thin, grey A_2 horizon. The upper part of the B horizon is very hard and compact and has a distinct columnar structure. The columns often have a well rounded, cauliflower-like top that is capped with a grey, dense, very hard layer. Dark colored, organic staining is common in the upper part of the B horizon, while lime carbonate and salts are usually present in the lower part of the B horizon.

(b) *Solodized Solonetz Soil Profiles*: Similar to the previously described profiles, except that the upper part of the B horizon is not as hard nor as dark colored, and there is usually a thick grey

A_2horizon. The lower B horizons are often much more friable than the upper. Depending on the characteristics of their A_1 horizon, they are further designated as Black, Degraded Black, or Grey Wooded Solodized Solonetz profiles. Such profiles are of extensive occurrence in the mapped area.

(c) *Solod Soil Profiles*: Appear to be remnants of Solodized Solonetz profiles. They generally have a fairly thick A horizon of which the grey, platy A_2 horizon is usually well developed. There is often an A_3 or B_1 horizon that consists of fairly loose, blocky to nuciform aggregates. The B_2 horizon does not have the pronounced columnar characteristics of the former profiles but is more friable and has a small blocky to nuciform structure. While the distinguishing features of Solod soil profiles are not as apparent as those of the two preceding profiles, there is usually a fairly abrupt break between the A and B horizons. Depending on the characteristics of their A_1 horizons, they are referred to as Black, Degraded Black, or Grey Wooded Solod soil profiles.

SURVEY METHODS, CLASSIFICATION AND MAPPING

Survey Methods

The soil survey of the Grande Prairie and Sturgeon Lake sheets was essentially a reconnaissance survey carried out by making traverses at intervals of one mile wherever possible. Traverses were made by car, on foot and, where necessary, by saddle horse. In the last case, both the traverse interval and the route was very irregular and the information thus obtained was of an exploratory nature. The boundary lines between different soil areas were determined along the lines of traverse and then projected between the lines of traverse. In many cases, boundary lines were projected with the aid of aerial photographs. Further inspection should be made if information of a more detailed nature is required.

Test holes were dug at frequent intervals in order to determine the texture, color, depth and structure of the various soil horizons. Additional notes were made on the nature and density of tree cover, stones, topography and other features believed pertinent to the agricultural development of the area. This information was supplemented by laboratory analyses of representative profile samples. The classification adopted to describe the various features noted on the field map and referred to in the descriptions to follow, is given in the appendix to this report. The color descriptions used in the field and in this report are those given in the Munsell Soil Color Name Charts. All the descriptions and analyses referred to in this report are of virgin soils.

Classification

The soils of the Grande Prairie and Sturgeon Lake sheets were classified and grouped according to the scheme outlined in Table 6. Soils developed from similar parent material and having similar profile characteristics received a *soil series* name. The name was taken from the locality in which those soils were found, and includes the names of rivers, lakes, towns and districts. Features that were believed of importance to the growth of native or crop plants formed the principal basis of soil series separation. Those which affected mainly the external characteristics of the soil, but not the principal profile characteristics, were separated as phases. Thus, soils belonging to the Braeburn series, for example, are assumed to have similar characteristics relative to crop production. If some of them are excessively stony or gravelly, or have a significantly different topography, they may be indicated or outlined on the soil map as appropriate phases of the Braeburn series. Further separations based on the texture of the surface soil or A horizon were not made in this area. Soils developed on similar parent material usually have a narrow range of texture, and beyond indicating the range common to each series, further separations into soil classes were believed unnecessary. Moreover, in leached soils, the most significant textural references are those of the B and C horizons.

The various soil series in Table 6 are grouped according to the type of parent material on which they have developed. Such groups of soils, whose different characteristics are believed to be due to differences in relief and drainage, are called *catenas*. The classification proposed in Table 6 might therefore be considered as essentially a catenary classification. It will be noted that in some cases, soils of the same series are included in two or more catenas. Soils formed in poorly drained areas acquire profile characteristics that show little difference over a fairly wide range of parent materials. In the descriptions to follow, and in the map legend, such soils are assigned specific parent materials merely for convenience of reference.

TABLE 6—Classification of Soils in the Grande Prairie and Sturgeon Lake Sheets.

A. Soils developed on glacial till:

1. Till yellowish brown to greyish brown, slightly calcareous, somewhat sandy, loam to clay loam.
   - (a) **Braeburn** (Bb.)—Grey Wooded loam to clay loam.
   - (b) **Saddle** (Sa.)—Degraded Black (Solodic) loam to clay loam.
   - (c) **Sexsmith** (Sx.)—Black (often Solodic) loam to clay loam.
   - (d) **Snipe** (Sn.)—Depression Podzol, often peaty (poorly drained) clay loam to clay.

B. Soils developed on lacustro-till or glacial lacustrine material:

1. Grey to dark greyish brown, slightly to moderately calcareous, somewhat saline, clay loam to clay with few stones.
   - (a) **Donnelly** (Do.)—Grey Wooded (Solodic to Solodized Solonetz) clay loam to clay.
   - (b) **Esher** (Es.)—Degraded Black (Solodic to Solodized Solonetz) clay loam to clay.
   - (c) **Landry** (La.)—Black (Solodic to Solodized Solonetz) clay loam to clay.

(d) **Snipe** (Sn.)—Depression Podzol, often peaty (poorly drained) clay loam to clay.

(e) **Goose** (Go.)—Meadow (somewhat poorly drained) clay loam to clay.

(f) **Prestville** (Pr.)—Thin Peat (poorly drained) silty clay loam to clay.

C. Soils developed on lacustrine deposited materials:

1. Slightly to moderately calcareous, somewhat saline, unctuous, grey to dark grey clay.

   (a) **Nampa** (Np.)—Grey Wooded (Solodic to Solodized Solonetz) silty clay loam to clay.

   (b) **Falher** (Fa.)—Degraded Black (Solodized Solonetz) silty clay loam to clay.

   (c) **Rycroft** (Ry.)—Black (Solodized Solonetz) silty clay loam to clay.

   (d) **Kleskun** (Kk.)—Black (Solonetz) silty clay loam to clay.

   (e) **Goose** (Go.)—Meadow (somewhat poorly drained) clay loam to clay.

   (f) **Prestville** (Pr.)—Thin Peat (poorly drained) silty clay loam to clay.

2. Moderately calcareous, brown, friable, silty clay loam to silty clay.

   (a) **Kathleen** (Kt.)—Grey Wooded silty clay loam to silty clay.

   (b) **Judah** (Ju.)—Degraded Black silty clay loam to silty clay.

D. Soils developed on alluvial and aeolian deposited materials:

1. Very calcareous, variable, silty parent material.

   (a) **Davis** (Dv.)—Grey Wooded loam to silt loam.

   (b) **Tangent** (Ta.)—Degraded Black loam to silt loam.

2. Moderately calcareous, variable, sandy parent materials.

   (a) **Culp** (Cu.)—Grey Wooded loamy sand to sandy loam.

   (b) **Leith** (Le.)—Degraded Black loamy sand to sandy loam.

   (c) **Codner** (Cn.)—Meadow (somewhat poorly drained) sandy loam to silt loam.

3. Slightly to moderately calcareous, fairly loose sand parent material.

   (a) **Heart** (Ht.)—Grey Wooded and Podzolized Grey Wooded sand to loamy sand.

4. Slightly calcareous, comparatively recent river and flood plain deposited materials.

   (a) **Spirit River** (S.R.)—Black (weakly structured) sandy loam to silt loam.

   (b) **High Prairie** (H.P.)—Dark colored (moderately well drained) sandy loam to clay loam.

   (c) **Enilda** (En.)—Poorly drained, often peaty, sandy loam to clay loam.

   (d) **Alluvium** (A.)—Undifferentiated river flat and river bench deposits.

5. Relatively thin, slightly calcareous, light to medium textured deposits that overlie other heavier textured deposits.

   (a) **Codesa** (Co.)—Grey Wooded (weakly structured) sandy loam to silt loam.

   (b) **Peoria** (Pe.)—Degraded Black to Black (weakly structured) sandy loam to silt loam.

   (c) **Belloy** (Be.)—Degraded Black to Black (weakly structured) sandy loam to loam.

   (d) **Codner** (Cn.)—Meadow (somewhat poorly drained) sandy loam to silt loam.

E. Soils developed on coarse outwash and shoreline materials:

(a) **Clouston** (Cl.)—Grey Wooded (weakly structured) gravelly or stony loamy sand to sandy loam.

(b) **Grouard** (Gr.)—Degraded Black to Black (weakly structured) gravelly or stony loamy sand to sandy loam.

F. Soils developed on residual and modified residual materials:

1. Yellowish brown to brownish yellow sandstone.
   (a) **Teepee** (Tp.)—Grey Wooded and Polzolized Grey Wooded sandy loam to loam.
2. Somewhat modified, saline, sandy shales.
   (a) **Debolt** (Db.)—Grey Wooded (Solonetz to Solodized Solonetz) clay loam.
   (b) **Valleyview** (Vv.)—Degraded Black to Black (Solonetz to Solodized Solonetz) clay loam to clay.
   (c) **Kavanagh** (Kv.)—Degraded Black to Black (Solonetz) clay loam.

G. Organic soils:

(a) **Eaglesham** (Eg.)—Peat fine and mainly of sedge origin.
(b) **Kenzie** (Kz.)—Peat coarse and mainly of moss origin (muskeg).

Classification of Topography

Percent Slope	Mapped Phases
0.0 - 0.5, 0.5 - 1.5	Level and Undulating
0.5 - 1.5, 2 - 5, 6 - 9	Gently Rolling
6 - 9, 10 - 15	Rolling
16 - 30	Hilly
Irregular, often steeply sloping banks adjacent to drainage courses	Rough and Broken

The topographic classes, representing additional elements of the classification and mapping system are appended to Table 6. The classification of topography involves the appreciation of important variations in surface features. These include steepness of slope, which is related to differences in elevation between the highest and lowest points; and the shape and frequency of various slopes, which determine the comparative roughness of the surface. The more important types of topography have been grouped into five mapping units and these are indicated by appropriate symbols on the soil map. The relationship of these groups to the slope classes recommended by the National Soil Survey Committee is shown in Table 6. The overlapping indicates the range of slopes found in the topography classes referred to in this report.

About 66 percent of the mapped area is classed as level to undulating. This class includes the level areas, some of which are poorly drained, and those whose slopes are fairly uniform and rarely exceed 1 percent. The long smooth slopes may be broken at infrequent intervals by minor irregularities whose slopes do not exceed 2 percent.

The gently rolling areas are generally more irregular and often have a "humpy" appearance. The irregular portions have variable slopes, usually not exceeding 9 percent, whereas the smooth portions have slopes that rarely exceed 6 percent. Long, smooth slopes are characteristic of many of the gently rolling areas indicated on the soil map. Approximately 25 percent of the mapped area is classed as gently rolling.

Rolling land is characterized by a succession of ridges and knolls whose slopes are between 8 and 15 percent, or by long uniform slopes having a gradient of between 6 and 15 percent. If other conditions are favorable, rolling land is considered as arable. About 6 percent of the mapped area, chiefly in the northeast and southern portions, consists of land whose topography has been classed as rolling.

Hilly land makes up about 1 percent of the mapped area. Such land is characterized by slopes that exceed 15 percent and is considered as non-arable.

Rough broken land makes up about 4 percent of the mapped area. It consists of the rough land, with variable slopes, that borders and forms the valley banks of drainage courses.

Mapping

Abbreviations and symbols are used to designate the predominant soil series and some of the characteristics of each of the areas outlined on the accompanying soil map. Rarely does one soil series occur to the practical exclusion of all other soil series. Soils having different profile types occur in close association throughout most of the mapped area. In some cases this is due to local differences in relief and drainage, while in others it is due to the close association of different parent materials. Donnelly and Esher soils are good examples of the former, whereas Judah and Davis soils are good examples of the latter association. Separation of such intimate mixtures was not always practical or possible on the scale of mapping used in this survey. Thus most of the soil areas outlined on the soil map consist of two and sometimes three soil series. The first named is believed predominant, and in naming the soil areas, only the dominant soil series are indicated. Those that make up less than about 20 percent of the outlined areas are rarely indicated in the area designations.

The soil map is colored on the basis of similar parent materials. Areas consisting of more than one soil series receive the color designating the parent material of the predominant series. In the mapped area only the larger areas of Organic soils are outlined. They are indicated by color. No attempt is made to indicate the relative distribution of the many small peat areas that were not possible to outline on this scale of map. The same considerations apply to other small areas which cannot always be accurately established or suitably designated on a map of the scale of three miles to the inch. Thus in all cases, further inspection should be made in determining the soils on individual quarter sections.

SOIL RATING

In describing the soils of the Grande Prairie and Sturgeon Lake sheets, reference is made to a comparative rating as regards their inherent productivity. This rating is based on a consideration of such factors as the type of soil profile, the degree of stoniness, and the topography. It is an interpretation of the morphological features as they may affect plant growth and agricultural use. On the basis of this numerical rating, the soils are tentatively grouped according to their suitability for grain production, especially wheat. The past performance of somewhat similar soils under the prevailing grain cropping systems of management is also used as a guide in determining this productivity grouping. It serves only to compare the inherent productivity of the soils in this area, and is not intended to indicate present or potential capabilities. Changing methods of management and cultivation, and the steadily increasing use of commercial fertilizers will greatly affect the future productivity of any of the soils discussed in this report.

In view of the fact that most of the soil areas that appear on the soil map consist of more than one soil series, and that each of these series may have a different soil rating, it is necessary to indicate averages when referring to the rating of the various soil areas outlined on the soil map. Thus the accompanying rating map must be regarded as giving an average rating for an area rather than a specific rating for individual land parcels. It is prepared on the scale of four miles to the inch and divides the mapped area into five productivity groups: one pasture and four arable. The groups are indicated by numbers that appear on the legend of the rating map. Since the density of the native tree cover is quite variable, no attempt is made to subdivide the pasture lands according to their carrying capacity. The following is the approximate acreage of each of the five groups outlined on the accompanying soil rating map:

Group 1.	Pasture and Woodland (non-arable)	554,000
Group 4.	Poor to Fair Arable Land	180,000
Group 5.	Fair to Fairly Good Arable Land	902,000
Group 6.	Fairly Good to Good Arable Land	686,000
Group 7.	Good to Very Good Arable Land	188,000

In considering the rating and productivity grouping of the soils in the mapped area, it must be borne in mind that this area has had a relatively brief agricultural history with the result that long time average yields of crops grown in the recommended crop rotations are not yet available. However, wheat has been grown for a considerable length of time on some of these soils and on some similar soils in other areas, and it is believed that a rating and grouping related to average wheat yields will serve to indicate the inherent productivity of these soils. On this basis, Group 4 soils in other areas have produced less than 10 to 12 bushels of wheat per seeded acre; Group 5 soils from 12 to 15 bushels; Group 6 soils from 15 to 20 bushels, and Group 7 soils have produced 20 to 25 bushels of wheat per seeded acre. These are tentative limits suggested to give an approximate relationship between the various groups. They are not to be used to indicate the productive capacity of the soils

Figure 18—Good to very good arable land in the vicinity of Grande Prairie.

Figure 19—Flax crop in a Saddle soil area north of Bezanson. September 1953.

in this area. It is generally recognized that Grey Wooded soils are not as well adapted to good quality wheat production as they are to a variety of other crops. Furthermore, while their inherent fertility may be quite low, they respond very favorably to good management practices supplemented, when necessary, with amendments of commercial fertilizer. The continued improvement of farming, and the introduction of new varieties of farm crops, will raise the productive capacity of these soils, and may shift the dividing line between pasture and arable land.

DESCRIPTION OF SOILS

A. Soils Developed on Glacial Till

1. Till yellowish brown to greyish brown, slightly calcareous, somewhat sandy, loam to clay loam.

Braeburn, Saddle, and *Sexsmith* soils are the better drained soils formed on this material which appears to be derived largely from the weathered products of the Wapiti and Smoky River formations. Soils of the *Snipe*, Goose, Prestville, Eaglesham, and Kenzie series are often found on similar but somewhat altered till parent material in the depressions and poorly drained lowlands that are frequently associated with areas of better drained till soils. In addition, Donnelly and Codesa soils are commonly found in close association with Braeburn soils on many of the lower slopes of the till areas. The following is a description of the four principal soil series formed on this till:

(a) Braeburn Series (Bb.): Grey Wooded loam to clay loam.

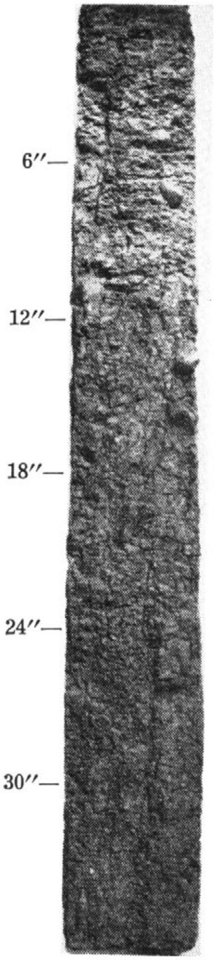
Extent and Occurrence: In the northern and southern parts of the mapped area, there are about 430,000 acres in which Braeburn soils are predominant. They are found on the higher elevations which might be the remnants of a former till plain.

Topography: Approximately 87 per cent of the Braeburn soils have an undulating to gently rolling topography, 12 per cent have a rolling topography and about 1 per cent have a hilly topography. In the northwest portion of the mapped area Braeburn soils have complex slopes, whereas in most of the remaining portion these areas have long, uniform, simple slopes. The various topographic phases are indicated on the accompanying soil map.

Drainage: Braeburn soils are moderately well drained and frequently have a somewhat excessive surface run-off.

Native Vegetation: Tree cover consisting predominantly of aspen poplar with varying mixtures of spruce, pine, birch, and various shrubs.

Profile Description: Braeburn soils have a moderately thick, greyish, leached A_2 horizon, and a yellowish brown to greyish brown fairly heavy textured B horizon in which a lime concentration horizon is often found at depths of 36 to 48 inches. Occasional stones of variable sizes are found throughout the profile. The accompanying illustration and the following description are typical of an average Braeburn soil profile.



Horizon	Thickness in inches	Description
A_0	1	Dark greyish brown to very dark brown decomposed and semi-decomposed leaf litter. pH 6.8.
A_1	1	Greyish brown loam with very little definite structure. Usually too thin to be sampled and often absent. pH 6.6.
A_2	4	Light yellowish brown very fine sandy loam that is often gritty and sometimes contains iron concretions. Friable, and has a fairly well developed platy structure. pH 5.5.
$A_3(B_1)$	3	Yellowish brown silt loam, fairly loose, somewhat porous, medium nuciform. pH 5.2.
B_2	10	Dark yellowish brown clay loam to clay, weakly columnar, nuciform with some staining on the cleavage faces. pH 5.0.
B_3	16	Dark yellowish brown to greyish brown loam to clay loam that has occasional streaks or pockets of sandy loam or silty clay loam. Fairly loose, nuciform aggregates that are somewhat smaller than those in the B_2 horizon, and frequently contain imbedded coal flecks. pH 5.5.
Bca	at 34-48 below surface	Greyish brown loam to clay loam with occasional bands of dark grey clay. Often spotted or streaked with lime. pH 7.5.
C		Greyish brown to yellowish brown clay loam till. pH 6.8.

Soil Rating: The undulating to gently rolling portions are fair to fairly good arable land. The rolling portions are poor to fair arable land, while the hilly portions are non-arable.

Agricultural Use: Only a very small proportion of the Braeburn soils are being farmed at the present time. (See Cultivation Map, Fig. 4.)

Braeburn soils are relatively low in natural fertility. As a result of the leaching process by which these soils have been formed, many of the soluble plant nutrients have been removed from the upper horizons and redeposited in the lower horizons. Consequently the B horizons are generally better supplied with mineral plant nutrients than are the leached A horizons. Furthermore, the organic matter developed under a woodland vegetation is not as fibrous nor as stable as that developed under a grass cover. The addition of organic matter, and occasional supplementary applications of commercial fertilizer, appear to be the prime requirements associated with the successful cropping of Braeburn soils.

The reluctance to farm these soils has probably been due to the presence of a relatively heavy native tree cover, and to their lower fertility. Stones are not usually present in sufficient numbers to be a serious hinderance to cultivation. Little experimental work has been done to determine the fertility requirements of these soils. However, the results of experiments on somewhat similar soils indicate that very favorable responses can be expected from good management practices.

(b) Saddle Series (Sa.): Degraded Black (Solodic) loam to clay loam.

Extent and Occurrence: Soils of the Saddle series predominate in about 43,000 acres of the mapped area. They occur on some of the better drained, sparsely wooded portions of the area in association with Braeburn, Debolt, and with some Davis soils in the northwestern portion of the area. No estimate is made of the extent of their occurrence in those areas in which they are not predominant.

Topography: The greater portion of the Saddle soils have an undulating and gently rolling topography, consisting of long simple slopes.

Drainage: Generally they are well drained soils that in some cases may have a somewhat excessive surface run-off.

Native Vegetation: Saddle soils appear to have developed under a more open, parkland type of cover, consisting mainly of grass, shrubs, and fairly open stands of aspen poplar.

Profile Description: These soils have a well developed dark colored A_1 horizon and a yellowish brown A_2 horizon that is rarely more than 6 inches thick. In addition, the upper part of the B horizon is often more compact than that of Braeburn soils. The following is a description of an average Saddle soil profile:

Horizon	*Thickness in inches*	*Description*
A_0	1	Dark brown to black leaf litter. pH 7.0.
A_{11}	2	Dark brown to black loam, weakly prismatic, crushes easily to small crumbs. pH 6.6.
A_{12}	2	Greyish brown loam, weakly prismatic. pH 5.6.
A_2	3	Yellowish brown very fine sandy loam, platy in upper 2 inches to vesicular nuciform in the lower 1 inch. pH 5.3.
$A_3(B_1)$	3	Yellowish brown clay loam, vesicular nuciform. Aggregates occur in clusters and may be the tops of old columns. pH 4.6.
B_2	10	Dark yellowish brown clay loam to clay, weakly columnar, nuciform to blocky, firm. pH 4.5.
B_3	10	Dark yellowish brown to brown clay loam, weakly prismatic, nuciform to blocky, friable. pH 5.1.
B_{ca}	at 30-36 below surface	Brown to greyish brown clay loam, small nuciform to blocky friable, moderate lime. pH 7.8.
C		Greyish brown clay loam till. pH 7.0.

Soil Rating: The undulating and gently rolling portions are good arable soils whereas the rougher portions are fair to fairly good depending on the variability and percentage of slope.

Agricultural Use: Except for some of the rougher phases, most of the Saddle soil areas are under cultivation. (See Cultivation Map, Fig. 4.) Grain crops are being grown to the practical exclusion of all others.

These soils are quite desirable for agricultural purposes. However, every precaution should be taken to see that their native fertility is maintained. Preference should therefore be given to a mixed farming agriculture which includes legumes and grasses in the crop rotation. Since many of these soils are on sloping land they are subject to water erosion. The inclusion of organic matter in the surface and the elimination of cultivation up and down the slopes should both receive consideration.

(c) Sexsmith Series (Sx.): Black (often Solodic) loam to clay loam.

Extent and Occurrence: in the northwest portion of the area, there are about 14,000 acres in which Sexsmith soils are predominant. They are found in association with Landry and Valleyview soils, and occur on some of the south slopes adjacent to the Braeburn soil areas and on the higher ridges or knolls adjacent to Sexsmith. No estimate is made of their occurrence in those areas in which they are not predominant.

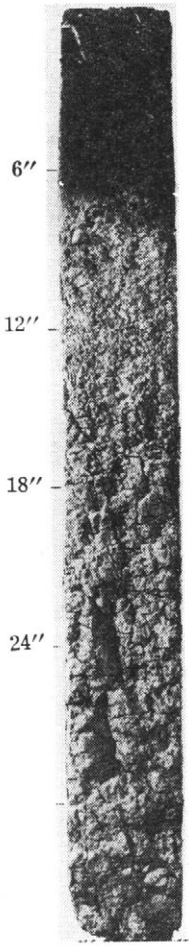
Topography: Undulating to gently rolling simple slopes or on the crowns of gently rolling and rolling ridges or knolls.

Drainage: Generally they are well drained soils that in some cases may have a somewhat excessive surface run-off.

Native Vegetation: Parkland type of cover, consisting of sparse stands of aspen poplar and various shrubs.

Profile Description: Sexsmith soils have a well developed dark brown to black A_1 horizon and often a yellowish brown A_2 horizon that is rarely more than 3 inches thick. The B and C horizons are very similar to those of the Saddle and Braeburn soils. The accompanying illustration and the following description are typical of an average Sexsmith profile.

Horizon	*Thickness in inches*	*Description*
A_1	6	Dark brown to black silt loam, weakly prismatic, crushes easily to small crumbs. pH 6.1.
A_2	2	Pale brown to light yellowish brown very fine sandy loam, platy in the upper inch to vesicular nuciform in the lower inch. pH 6.0.
$A_3(B_1)$	2	Yellowish brown clay loam, vesicular, nuciform. Friable macrostructure, firm microstructure. pH 5.0.
B_{21}	6	Dark grey brown to dark yellowish brown clay, weakly columnar, nuciform to blocky, firm. pH 5.6.



Horizon	Thickness in inches	Description
B_{22}	6	Dark yellowish brown clay loam to clay, weakly prismatic, nuciform to blocky, firm. pH 5.6.
B_3	8	Brown to dark yellowish clay loam, weakly prismatic, nuciform to blocky, friable. pH 5.7.
B_{ca}	at 30-34	Greyish brown to brown clay loam, small nuciform to blocky, friable, moderate lime. pH 7.2.
C		Greyish brown to brown clay loam, small nuciform to blocky, friable. pH 7.0.

Soil Rating: Depending on topography, Sexsmith soils rate as good to very good arable soils.

Agricultural Use: Most of the Sexsmith soil areas are under cultivation. (See Cultivation Map, Fig. 4.) Grain crops are being grown to the practical exclusion of all others.

According to the chemical analyses, reported in a latter section of this report, these soils have a high reserve of mineral plant nutrients. Therefore it would seem that every precaution should be taken to maintain their native fertility. However, these soils are often found on slopes that are subject to water erosion. Permanent management practices should include contour cultivation and the return of organic material and nutrient elements.

(d) Snipe Series (Sn.): Depression Podzol, often peaty (poorly drained) clay loam to clay.

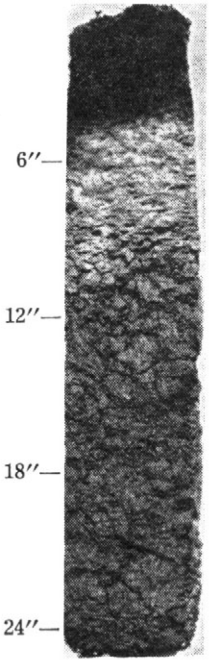
Extent and Occurrence: Snipe soils are of extensive occurrence throughout most of the mapped area. However, areas in which they predominate are outlined only in the eastern and southern portions of the mapped area and make up a total of about 55,000 acres. No attempt is made to determine the extent of their occurrence in those areas in which they are not believed to be predominant. They are found in many of the low, poorly drained areas associated with soils developed on till and other medium and heavy parent materials.

Topography: Level and depressional.

Drainage: Poor, and may be ponded for considerable periods.

Native Vegetation: Coarse grasses and sedges, occasional willows, scrub birch, and black poplar.

Profile Description: Snipe soils are distinguished by a peaty A_0 horizon, and by a fairly thick, iron stained, A_2 horizon. Rarely is the iron staining particularly apparent in the B horizon. The following is a description of a profile typical of the Snipe series:



Horizon	Thickness in inches	Description
A_{00}	4	Brown to dark brown sedge peat. May be destroyed in burned over areas. pH 5.9.
A_0	1	Very dark brown to black decomposed sedge peat. pH 6.2.
A_1	1	Dark greyish brown loam to silt loam, high in organic matter, with very little structure. pH 5.6.
A_2	5	Light grey to very pale brown very fine sandy loam to silt loam with brownish yellow streaks or mottling, platy, friable. pH 5.2.
B_1	2	Grey to dark grey clay, nuciform, firm when dry. pH 4.9.
B_{2g}	11	Grey to dark grey clay that has a waxy or glazed appearance when dry, fine blocky, fairly firm. pH 5.3.
B_{3g}	11	Dark grey clay, nuciform, friable. pH 6.9.
B_{ca} at 32 to 36		Greyish brown to dark greyish brown clay loam to clay, blocky, till. pH 7.3.
C		Greyish brown to yellowish brown clay loam till. pH 7.5.

Soil Rating: Snipe soils are suitable for pasture crop production, but until their drainage is improved they are not suitable for grain crop production.

Agricultural Use: Most of the larger areas of Snipe soils remain uncultivated. Small areas that are associated with better drained soils are usually cultivated along with the other portions of the field, if drainage has been sufficiently improved to permit such a practice. However, the crops grown in such lower areas are much slower in maturing as compared to those grown on the adjacent better drained soils. Heavy applications of manure, supplemented by occasional applications of phosphate fertilizer, have proven beneficial.

In many of the larger areas the removal of tree cover by clearing and burning and the construction of roads has resulted in a marked improvement in drainage, and has permitted agricultural development of these soils. However, even with the improvement of drainage, it is doubtful if grain crops can be grown successfully for at least several years after breaking. Grasses, legumes and coarse grains should receive first consideration. The successful utilization of these poorly drained soils will depend upon the ability to improve their fertility and their physical condition.

Much remains to be done in finding the best methods of handling Snipe and other poorly drained soils, and in determining the most desirable crops for such soils. Many farmers have had marked success with alsike clover. The possibility of improving the quality of forage on some of the native hay flats is receiving the attention of the Experimental Farm at Beaverlodge. Additional work of this nature is needed to determine the successful utilization of these soils.

B. Soils Developed on Lacustro-till

1. Grey to dark greyish brown, slightly to moderately calcareous, somewhat saline, clay loam to clay.

Donnelly, Esher, and *Landry* soils are the principal soils formed in the better drained positions, while soils of the Snipe, *Goose,* Prestville, Eaglesham, and Kenzie series may be formed in the poorly drained positions on this parent material. Lacustro-till parent material is similar to the lacustrine deposited material except that it is somewhat browner, less compact and has some stones. It is often stratified, and frequently the sandy clay loam to silt clay strata are somewhat stony. This material covers the till on the lower slopes and is found at elevations of about 2,200 to 2,500 feet.

The following are descriptions of the principal soil series formed on this parent material:

(a) Donnelly Series (Do.): Grey Wooded (Solodic to Solodized Solonetz) clay loam to clay.

Extent and Occurrence: Donnelly soils are found on the lower slopes of the till plain at elevations below 2,500 feet, and in the many basins and valleys adjacent to the stream courses. Large areas are found in the eastern and southern part of the mapped area. There are about 420,000 acres in which Donnelly soils are predominant. No estimate is made of the extent of their occurrence in the many areas in which they are not predominant.

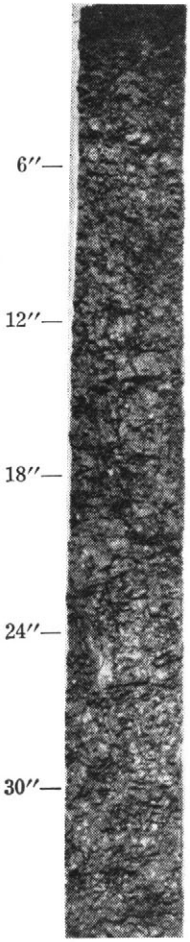
Topography: They have an undulating to gently rolling topography that consists mainly of long, fairly uniform slopes.

Drainage: Imperfectly or somewhat poorly drained. In some cases they may have an excessive surface run-off.

Native Vegetation: Aspen poplar, in which there are variable proportions of black poplar, spruce, willow, alder, birch, and various shrubs.

Profile Description: Donnelly soils usually have a thin A_1 horizon, a grey A_2 horizon that seldom exceeds a thickness of about 4 inches, and a grey to greyish brown, nuciform A_3 or B_1 horizon.

The remainder of the solum consists of a dark yellowish brown grading to dark greyish brown clay that is fairly compact. The lower part of the B horizon is often much darker colored than the upper part, and this color change may be quite abrupt. The following is a description of an average Donnelly soil profile:



Horizon	*Thickness in inches*	*Description*
A_0	1	Dark brown leaf litter. pH 6.7.
A_1	1	Dark greyish brown to dark grey heavy loam to clay loam with little definite structure. This horizon may be absent. pH 6.0.
A_2	3	Light yellowish brown very fine sandy loam, medium to coarse platy, easily crushing to small irregular fragments. pH 5.4.
$A_3(B_1)$	2	Light yellowish brown loam to clay loam, medium nuciform, vesicular, friable. pH 4.9.
B_{21}	6	Dark yellowish brown clay, medium columnar, fine nuciform to blocky, firm to very firm. pH 5.1.
B_{22}	6	Dark yellowish brown to dark brown clay, fine to medium blocky, firm. pH 5.4.
B_3	8	Greyish brown to dark grey clay, fine to medium blocky, firm. pH 6.2.
B_{ca}	at 24-36 below surface	Greyish brown to dark grey clay with occasional yellowish brown sandy clay loam strata that may be somewhat stony. Moderate lime. pH 7.2.
B_{SO_4}		As above, but with an accumulation of salts. pH 7.8.
C		Grey clay with occasional strata of yellowish brown sandy clay loam in which small stones are common. pH 7.8.

Soil Rating: Donnelly soils are fairly good to good arable soils.

Agricultural Use: Only a relatively small proportion of the Donnelly soil areas is under cultivation at the present time. (See Cultivation Map, Fig. 4.) While grain crops are the principal crops grown, increasing attention is being given to the growth of legumes in various portions of the area. Yields of 200 pounds alfalfa seed or 800 pounds sweet clover seed per acre are not uncommon.

Donnelly soils are relatively low in organic matter and their subsoils tend to have a restricting influence on the penetration of water and of plant roots. Consideration must therefore be given to the inclusion of organic matter in the surface and to the improvement of the rate of percolation in the subsoils. Crop rotations that include deep-rooted crops such as legumes will help to open up and thereby improve the structure of these soils.

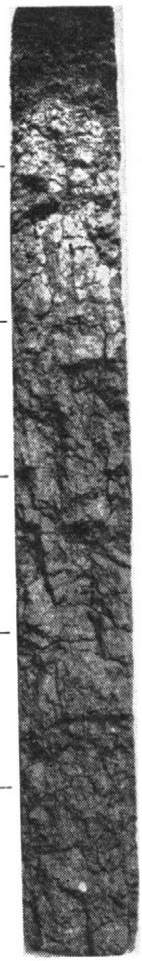
Fertility experiments are being conducted on similar soils by the Beaverlodge Experimental Farm. While these experiments have not been continued long enough to be conclusive, they do indicate a marked response to applications of manure and to applications of phosphate fertilizers.

(b) Esher Series (Es.): Degraded Black (Solodic to Solodized Solonetz) clay loam to clay.

Extent and Occurrence: There are approximately 90,000 acres in which Esher soils are predominant. They are mainly found in association with Donnelly soils in the vicinity of Whitemud Creek, with Valleyview soils in the vicinity of Valleyview, and with Debolt soils in the vicinities of Debolt and Smoky Heights.

Topography: Generally undulating to gently rolling, consisting of long fairly uniform slopes that rarely exceed a gradient of 5 percent.

Drainage: Moderately to imperfectly drained soils usually found in positions that are somewhat better drained than those of the Donnelly soils. Surface run-off may tend to be excessive on some of the long slopes.



Native Vegetation: Apparently similar to that of Donnelly soils, but much less dense and tending to parkland.

Profile Description: Esher soils are distinguished by their well developed dark colored A_1 horizon that is usually from 2 to 6 inches thick. The B horizon is often very compact although it tends to break fairly readily into fine blocky to nuciform aggregates. The following is a description of an average Esher soil profile:

Horizon	*Thickness in inches*	*Description*
A_0	1	Dark brown to black decomposed to semi-decomposed leaf litter. pH 7.3.
A_1	4	Dark brown to brown silt loam to clay loam, weakly prismatic breaking readily to weakly nuciform aggregates. pH 5.7.
A_2	3	Light yellowish brown silty loam, platy in the upper portion, coarse platy to nuciform in the lower portion. pH 5.5.
$A_3(B_1)$	3	Light yellowish brown silt loam to silty clay loam, nuciform, vesicular, friable. May be tops of old columns. pH 4.9.
B_{21}	5	Dark yellowish brown clay, often silty. Medium columnar breaking into fine blocky to nuciform aggregates. Cleavage faces stained a dark brown. pH 4.7.
B_{22}	6	Dark yellowish brown to dark brown clay, compact, weakly nuciform to massive. pH 5.0.
B_{31}	6	Greyish brown to dark grey clay, compact, weakly nuciform to massive. pH 5.8.

Horizon	Thickness in inches	Description
B_{32}	5	Greyish brown to dark grey clay with occasional somewhat stony strata of yellowish brown clay loam. Friable, fine nuciform. pH 5.9.
B_{ca}	at 30-36 below surface	Greyish brown to dark grey clay loam to clay. Moderate lime content. pH 7.9.
C		Greyish brown to yellowish brown clay loam to clay frequently mixed with strata of dark grey clay in which salt pockets are of common occurrence. pH 8.1.

Figure 20—Alfalfa crop in a Donnelly soil area near Whitemud Creek. August 1951.

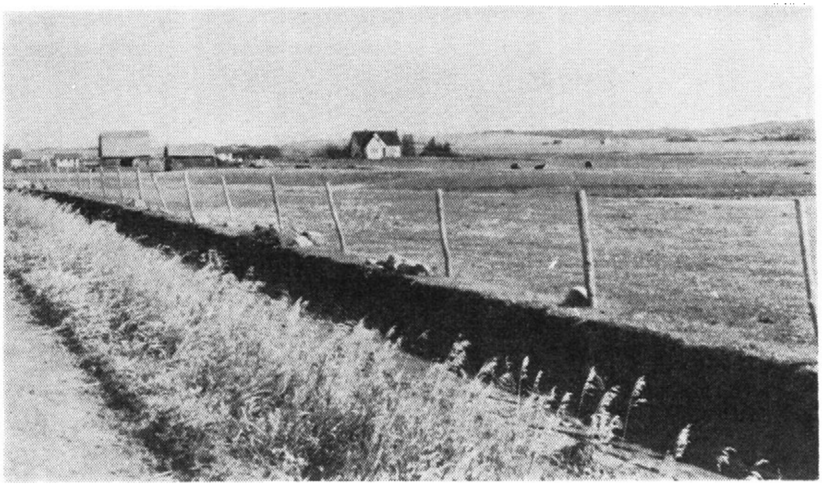


Figure 21—Landry soil area north of Bear lake.

Soil Rating: Good arable soils.

Agricultural Use: Esher soils are among the more desirable soils of this area and are being cultivated extensively. (See Cultivation Map, Fig. 4.)

The maintenance of organic matter and improvement of the permeability and structure of these soils are essential considerations to continued successful cropping. Water erosion losses are becoming serious in many of the older settled areas, and unless the organic matter and fibre content of these soils is maintained or improved, these losses may seriously curtail crop production. Rotations that include grasses and legumes and the elimination of cultivation up and down slopes would appear to be basic to the development of a successful cropping plan on these soils.

(c) Landry Series (La.): Black (Solodic to Solodized Solonetz) clay loam to clay.

Extent and Occurrence: There are approximately 123,000 acres in which Landry soils are predominant. They occur principally in the vicinity of Grande Prairie and Valleyview.

Topography: Generally undulating to gently rolling long simple slopes but some gently rolling to rolling complex slopes occur in the vicinity of Sexsmith.

Drainage: Imperfectly drained soils found in well drained positions that often tend to have an excessive surface run-off.

Native Vegetation: Fairly open parkland type of vegetation consisting of native grasses and shrubs with bluffs mainly of aspen poplar.

Profile Description: Very similar to that of an Esher soil except that A_1 horizon is usually thicker and darker in color. It is very dark brown to black and its average thickness is about 6 inches. The following is a description of an average Landry soil profile:

Horizon	*Thickness in inches*	*Description*
A_1	6	Very dark brown to black silt loam to clay loam, crushes easily to fine crumbs. pH 5.8.
A_2	2	Dark greyish brown grading to yellowish brown silty loam, fine to medium platy, very friable. pH 5.7.
$A_3(B_1)$	2	Yellowish brown clay loam, nuciform, vesicular, fairly firm, often occurs in loose clusters. pH 5.3.
B_2	10	Dark yellowish brown to dark brown clay, often silty. Medium columnar breaking into very firm nuciform to small blocky aggregates that often have a waxy or glazed appearance. pH 6.2.

Horizon	Thickness in inches	Description
B_3	7	Very dark greyish brown and dark brown clay, coarse nuciform to blocky, firm. While the vertical cleavage lines are usually indistinct, there are often very pronounced horizontal cleavage lines at varying intervals in this and the succeeding horizons. pH 6.3.
B_{ca}	at 26-36 below surface	Dark grey clay in which yellowish brown sandy clay loam strata are of common occurrence. Moderate concentrations of lime and some stones are found in these lighter colored strata, and salt inclusions are common in the lower part of this horizon. Sharp, angular stone fragments are often found imbedded in the dark colored clay aggregates of this and the preceding horizons. pH 7.8.
C		Dark grey and yellowish brown stratified clay to clay loam till-like material. pH 7.8.

Soil Rating: Good to very good arable soils.

Agricultural Use: Landry soils are among the most productive soils in the mapped area and among the first to be farmed. Grain crops are being grown to the practical exclusion of all others.

These soils have a fairly high natural fertility and every precaution should be taken to ensure that their natural fertility be maintained. Unfortunately, however, it would appear that the best soils are the last to receive conservation attention. Whereas, in the newer areas, Landry soils have yielded in excess of 25 bushels of wheat per acre, the same soils in the older settled districts are not averaging much over 15 bushels per acre. The prevalent grain-summerfallow system of farming has resulted in a very marked decline in fertility, and serious consideration should be given to the early inclusion of legumes and grasses in the crop rotation.

(d) Goose Series (Go.): Meadow (somewhat poorly drained) clay loam to clay.

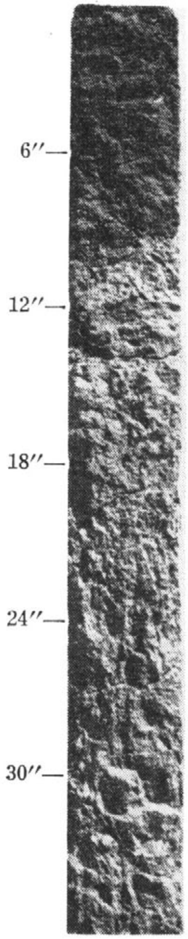
Extent and Occurrence: In the eastern portion of the area adjacent to the Little Smoky river and Goose river, and in the southern portions of the mapped area, there are approximately 76,000 acres in which Goose soils predominate. Elsewhere they are found in many of the poorly drained areas associated with soils that are developed on medium to heavy textured parent materials.

Topography: Level and depressional.

Drainage: Poorly drained soils that are usually wet in the spring of the year.

Native Vegetation: Meadow grasses, willow, scrub birch, and occasional black poplar.

Profile Description: Goose soils are variable with respect to the thickness of the surface horizons and the characteristics of the sub-surface horizons. Usually the surface horizons are greyish and often mottled. Frequently the upper part of the grey subsoil is yellowish in color and becomes quite hard on drying. These soils are often found in what appear to be old beaver meadows, and their profile sometimes appears to be the result of a more recent clay deposition overlying a grey, heavy textured, somewhat mottled material. The following is a description of an average Goose soil profile:



Horizon	*Thickness in inches*	*Description*
A_0	2	Dark brown organic debris, often peaty. pH 5.6.
A_1	6	Very dark grey to black silt loam to silty clay loam, fairly high in organic matter. The upper portion has a weak crumb structure which grades into loose, fine granular or shot-like structure in the lower portion of this horizon. pH 5.9.
B_g	10	Dark grey and very dark grey silty clay to clay, fine nuciform, loose. The thickness of this horizon is quite variable and the colors may occur as splotches or as streaks. pH 5.7.
G	10	Yellowish brown mottled with dark grey silty clay to clay, massive, very firm when dry. The uppermost part of this horizon and some of the cleavage faces are often stained a very dark grey. Occasional iron staining may be apparent throughout this horizon. pH 6.1.
C_g		Grey to dark grey clay with occasional yellowish brown mottling, massive tending to medium blocky, occasional pronounced horizontal cleavage, firm. pH 7.1.
C	at 24 to 36	Dark grey to very dark grey clay. On drying breaks readily into blocky fragments that are somewhat friable. pH 7.6.

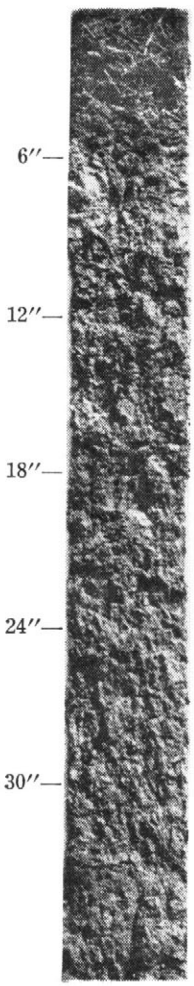
Soil Rating: Goose soils may be rated as very good for pasture crop production, but until their drainage is improved they are not suitable for grain crop production.

Agricultural Use: Little agricultural use is being made of the Goose soils in the mapped area. However, rather extensive areas in which Goose soils are of significant or predominant occurrence are being settled south of Valleyview. Experience elsewhere has shown that such soils, even after draining, are "cold" and not immediately suitable for grain crop production. After raising greenfeed, grasses or deep-rooted legumes for a few years, the aeration and drainage can be improved and coarse grains can then be grown very successfully. In many cases the removal of native vegetation and the levelling off of old beaver dams are the major steps in improving the drainage of these soils.

C. Soils Developed on Lacustrine Deposited Material

1. Slightly to moderately calcareous, somewhat saline, unctuous grey to dark grey clay.

Nampa, Falher, Rycroft, Kleskun, and *Prestville* are the principal soils formed on this material in the mapped area. Frequently associated with and formed on similar parent material, are soils of the Snipe, Goose, Eaglesham, and Kenzie series.



(a) Nampa Series (Np.): Grey Wooded (Solodic to Solodized Solonetz) silty clay loam to clay.

Extent and Occurrence: In the eastern part of the mapped area there are about 15,000 acres in which Nampa soils are predominant.

Topography: Level and depressional.

Drainage: Imperfectly to poorly drained with a low to very low surface run-off.

Native Vegetation: Fairly open stands of poplar in which willows, alders, and coarse grasses are of common occurrence.

Profile Description: Similar to that of Donnelly soils except that the B horizon tends to be more compact and usually not as brown in color. The following is a description of an average profile typical of the Nampa series:

Horizon	*Thickness in inches*	*Description*
A_0	1	Dark brown leaf litter. pH 5.8.
A_1	1	Greyish brown heavy loam to clay loam, fine nuciform, friable. pH 6.3.
A_2	3	Light brownish grey very fine sandy loam to silt loam, medium to coarse platy, friable, often iron stained. pH 5.4.
$A_3(B_1)$	3	Light brownish grey to light yellowish brown silt loam to silty clay loam, nuciform, vesicular, fairly firm. Aggregates often occur in clusters and may be the tops of old columns. pH. 5.2.
B_{21}	6	Dark greyish brown to dark yellowish brown clay to silty clay, weakly columnar, medium nuciform to blocky, very firm. pH 5.3.
B_{22}	6	Dark greyish brown to dark grey clay, coarse nuciform to blocky, very firm. pH 5.6.

Horizon	Thickness in inches	Description
B_3	8	Dark grey clay, fine to medium blocky, firm. pH 5.6.
B_{ca}	at 28	Dark grey to very dark grey clay to silty clay loam, fine to medium blocky, friable. Lime in pockets or in thin silty strata when these are present. pH 7.6.
B_{SO_4}	at 32	As above, but with gypsum accumulation. pH 8.0.

Soil Rating: Nampa soils are generally fairly good arable soils.

Agricultural Use: An appreciable portion of the Nampa soil areas is not yet cultivated. (See Cultivation Map, Fig. 4.) While grain crops are being grown on Nampa soils it would appear that increasing emphasis is being given to grain-legume rotations.

These soils tend to be low in organic matter and they have an unfavorable subsoil that tends to retard the penetration of water, and of plant roots. Water penetration is slow and during heavy rains the surface of Nampa soil areas often becomes submerged. Deep breaking, followed by the periodic inclusion of deep-rooted legumes in the crop rotation should help to open up and materially improve the structure and the permeability of these soils.

Field trials on Nampa soils are being conducted at the Canada Illustration Station near McLennan. Substantial increase in yields of grain crops have been obtained from the applications of farmyard manure and from the application of nitrogen-phosphorus commercial fertilizers.

(b) Falher Series (Fa.): Degraded Black (Solodized Solonetz) silty clay loam to clay.

Extent and Occurrence: There are about 41,000 acres in which Falher soils are predominant. They are found chiefly in the northeastern portion in the vicinity of Whitemud Creek and adjacent to Puskwaskau creek. No estimate is made in those areas in which Falher soils are not predominant. They are usually associated with Rycroft and Nampa soils.

Topography: Level and undulating.

Drainage: Imperfectly or somewhat poorly drained soils that are found in better drained positions than those of the Nampa soils.

Native Vegetation: Sparsely wooded, consisting of native grasses, willow, alder, and occasional poplar bluffs.

Profile Description: Falher soils are distinguished by a well developed dark colored A_1 horizon that seldom exceeds a thickness of 6 inches. The depth to the B horizon is quite variable and the break between the A and B horizons is wavy, very abrupt and very distinct. They are Degraded Black soils having a well developed Solodized Solonetz type of profile that is relatively free of stones. The following is a description of an average Falher soil profile:

Horizon	Thickness in inches	Description
A_0	1	Dark brown leaf litter. pH 7.6.
A_1	4	Dark brown to dark greyish brown silt loam to clay loam, granular, loose. pH 6.4.
A_2	2	Yellowish brown to light yellowish brown very fine sandy loam to silt loam, platy, friable. pH 5.3.
$A_3(B_1)$	3	Greyish brown silt loam to silty clay loam, nuciform, vesicular but fairly firm. Aggregates sometimes have a dark brown staining on the under sides. pH 5.5.
B_{21}	6	Dark greyish brown clay, medium to coarse columnar, nuciform to blocky, hard. pH 5.7.
B_{22}	8	Dark greyish brown to dark grey clay, massive, hard when dry, and has a waxy or glazed appearance. pH 7.2.
B_3	6	Dark grey clay, massive, firm. pH 7.6.
B_{Ca} at 28 to 36 below surface		Dark grey clay with occasional silty laminae. Lime content low to medium, spotty, often mainly in lighter laminae. pH 8.0.
B_{SO_4}		As above with gypsum accumulation. pH 8.1.

Soil Rating: Good arable soils.

Agricultural Use: The more accessible areas are largely under cultivation at the present time. (See Cultivation Map, Fig. 4.) While grain crops are predominant, increasing attention is being given to legume crop production.

Falher soils require careful management. Their loose surface soil is vulnerable to both wind and water erosion—particularly sheet erosion. The relatively tight subsoil absorbs water very slowly with the result that during heavy rains the surface may become water-logged. The incorporation of organic matter and the growing of deep-rooted legumes will help to improve the structure and increase the rate of percolation in the B horizons of these soils. While there is usually a salt concentration layer in the lower part of the solum, alkali does not appear to be a problem in the management of Falher soils.

(c) Rycroft Series (Ry.): Black (Solodized Solonetz) silty clay loam to clay.

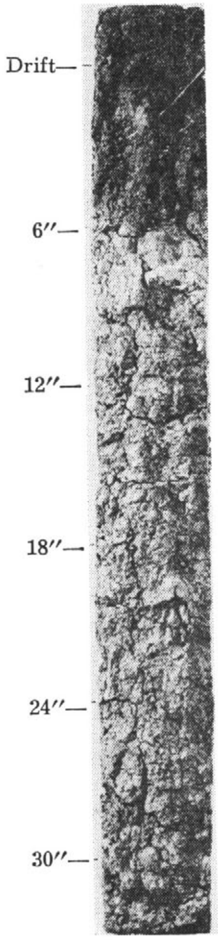
Extent and Occurrence: Rycroft soils predominate in about 21,000 acres of the mapped area. They are found in association with Valleyview soils near Valleyview and with Kleskun soils in the vicinity of Bear lake.

Topography: Level to undulating—slightly wavy.

Drainage: Imperfectly or somewhat poorly drained soils that are found in better drained positions than those typical of Falher and Nampa soils.

Native Vegetation: Sparsely wooded, consisting of native grasses, willow, alder, or occasional poplar bluffs.

Profile Description: Rycroft soils are stone-free and have a darker colored solum than that of Landry soils. They are very similar to Falher soils except that they have a deeper A_1 horizon that is dark brown to black in color. The following is a description of an average Rycroft soil profile:



Horizon	*Thickness in inches*	*Description*
A_1	6	Very dark brown to black silty clay loam, weakly prismatic, crushes readily to small granular structure. pH 6.2.
A_2	1	Greyish brown to yellowish brown silt loam, platy, friable. pH 6.0.
A_3 (B_1)	2	Yellowish brown clay loam to silty clay loam, vesicular, nuciform, fairly firm — often occurring in loose clusters. pH 5.6.
B_2	10	Very dark greyish brown to very dark grey clay, columnar to massive, very firm, medium blocky mesostructure. pH 6.4.
B_3	6	Dark grey to very dark grey clay, massive, very firm. Has a waxy or glazed appearance when dry. pH 6.8.
Bca	12	As above with occasional yellowish brown silty laminae. Moderate lime, spotty, pH 7.7.
B_{SO_4}	at 31	As above with salt accumulation. pH 8.0.

Soil Rating: Very good arable soils.

Agricultural Use: The Rycroft soil areas are all under cultivation. (See Cultivation Map, Fig. 4.) While grain crops are predominant, increasing attention is being given to legume crop production. For the most part a grain-summerfallow system has been followed on these soils since they were brought under cultivation twenty or thirty years ago. Many fields drift badly each spring and fall and water erosion is becoming a serious problem. Furthermore, yields have dropped appreciably, in many cases by as much as 50 per cent. Rycroft soils are adaptable to a fairly wide range of crops and are responsive to good mixed farming practices.

(d) Kleskun Series (Kk.): Black (Solonetz) silty clay loam to clay.

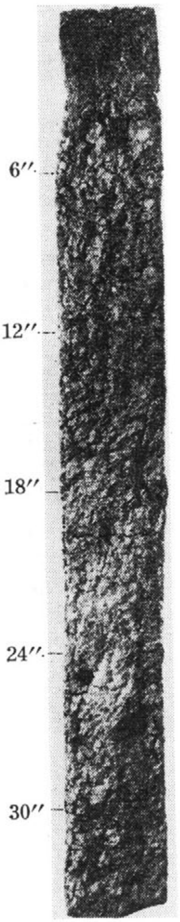
Extent and Occurrence: In the western portions of the mapped area, near Teepee Creek and Bear lake, there are about 23,000 acres in which Kleskun soils predominate. However, they are found with, and make up significant proportions of, areas in which Rycroft, Landry, Kavanagh, and Prestville soils are predominant.

Topography: Level and often depressional.

Drainage: Imperfectly to poorly drained soils.

Native Vegetation: Sparsely wooded—usually willow and occasional aspen poplar. Grasses, coarse grasses and sometimes salt grasses.

Profile Description: Kleskun soils are distinguished by a shallow A horizon on a heavy, columnar, usually dark colored B horizon. As compared to the Rycroft soils, they have a much shallower A horizon and very little or no greyish A_2 or B_1 horizon. In the depressional areas they may have a slight salt accumulation on the surface. They are Black soils that have a fairly well developed Solonetz type of profile that is usually fairly free of stones. The following is a description of a fairly typical Kleskun profile:



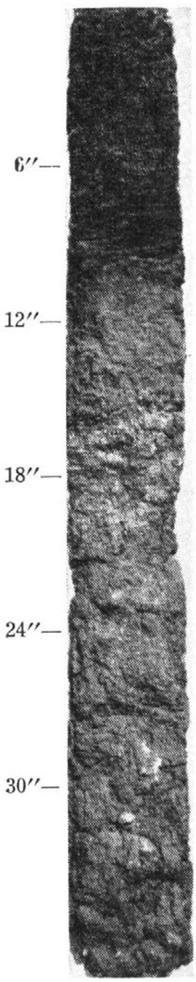
Horizon	*Thickness in inches*	*Description*
A_1	2	Very dark brown to very dark grey clay, loose granular structure. pH 6.0.
B_{21}	6	Very dark brown to black clay, medium columnar, nuciform to blocky, hard with dark stained, waxy or glazed surfaces. pH 5.6.
B_{22}	7	Very dark grey brown clay, fine to medium blocky with occasional dark grey stains on the cleavage faces and frequent root mats. Medium blocky to nuciform, very firm to hard. pH 6.3.
B_3	6	Very dark grey grading to dark grey clay, medium blocky, fairly firm, occasional root mats. pH 7.9.
B_{ca}	8	Dark grey brown clay with brown silty patches or pockets that have moderate lime accumulations, nuciform, fairly firm. pH 7.8.
C		Dark grey clay, fine blocky to nuciform, fairly firm, occasional brown silty salty pockets. pH 8.0.

Soil Rating: Fair and fairly good arable soils depending on surface drainage.

Agricultural Use: Kleskun soils, on slopes that permit some surface drainage, are being farmed with some success in the mapped area. On such slopes, while there is usually a salt concentration layer in the lower part of the solum, alkali does not appear to be a problem in the management of these soils. However, their very firm dark colored subsurface horizon is relatively impervious to both water and root penetration. Farmers in the area have found that cultivation must be made at the time that these soils are neither too wet or too dry and that occasional deep plowing or the periodic rotations of deep-rooted legume crops can improve the tilth of these soils. Sweet clover can be grown to very good advantage since the long tap roots tend to penetrate the hard layer and improve the drainage and aeration. The addition of green manure and the gradual mixing in of the surface soil will improve, in time, the structure of this undesirable subsoil.

(e) Prestville Series (Pr.): Thin Peat (poorly drained) silty clay loam to clay.

Extent and Occurrence: Prestville soils are of common occurrence in the many poorly drained areas of the mapped area. However, areas in which they predominate are outlined only in the eastern and southwestern portions of the area and make up a total of about 20,000 acres. No attempt is made to determine the extent of their occurrence in those areas in which they are not believed predominant. They are found in association with other poorly drained soils such as Goose, Snipe, and Eaglesham soils, and are developed on medium to heavy parent materials, particularly the parent material of the Rycroft-Nampa and Landry-Donnelly catenas.



Topography: Depressional.

Drainage: Poor, and may be ponded for considerable periods.

Native Vegetation: Coarse grasses and sedges with occasional bluffs of willow and scrub birch.

Profile Description: Prestville soils have an accumulation of sedge peat that rarely exceeds a depth of 12 inches. They usually have an A_1 horizon but seldom an A_2 horizon. The following is a description of a profile typical of the Prestville series:

Horizon	*Thickness in inches*	*Description*
A_{00}	7	Brown to dark brown sedge peat. pH 5.8.
A_0	3	Dark brown semi-decomposed sedge peat. pH 6.8.
A_1	2	Very dark brown to black silt loam to clay loam with little definite structure. pH 7.2.
B_g	1	Dark greyish brown clay loam, fairly firm. pH 7.4.
G	6	Dark grey clay, firm, iron stained, massive, breaking into blocky fragments. pH 7.8.
C_g	8	Grey clay which on drying tends to have a loose granular to shot-like structure. pH 7.6.
C_{ca} at 26 to 30 below surface		Grey to dark grey clay, nuciform, friable, spotted with lime concentrations. pH 8.0.

Soil Rating: In their native state they are suitable for pasture crops. With improved drainage they may be developed into good arable soils.

Agricultural Use: Prestville soils are among the first of the peat soils to be cultivated. They do not have a deep accumulation of peat, and with their lack of tree cover they can be prepared for cropping very economically. However, after draining, they are "cold" soils that are not immediately suitable for grain production. Elsewhere in the Peace River district, the general practice on such soils is to raise oats for greenfeed, or sweet clover for the first few years after breaking. With increased aeration and improved drainage, legume-grain rotations have proved very satisfactory. After they have been cropped for a number of years, fields of Prestville soils are difficult to distinguish from fields of Falher soils.

2. Moderately calcareous, brown, friable, silty clay loam to silty clay.

The parent material of Kathleen and Judah soils is found at elevations that are usually somewhat lower than those of the previously described lacustrine deposits. It frequently adjoins the latter and often occurs adjacent to the main drainage courses on what appear to be the uppermost terraces. The material is stratified and the greater proportion of the strata consist of brown to greyish brown silty clay loam to silty clay. The other, generally thin strata, consist of yellowish brown silt loam to very fine sand. Till, lacustro-till or dark grey lacustrine material usually underlies these deposits at variable depths.

These and other brown colored silty areas are often characterized by a humpy and dune-like topography consisting of irregular and variable slopes whose gradient sometimes exceeds 10 per cent. Usually the slopes are short and from a distance the areas appear to be part of an undulating plain. In some of the knolls of such areas stratification is much less apparent in the parent material, and it may be that some of these deposits have been reworked and re-deposited by wind. In recent studies* of the soils and vegetation of Alaska, somewhat similar topography is described and attributed largely to frost-heaving. It may be that at some former time, conditions favorable to a similar phenomenon prevailed in the mapped area and found their best expression in some of the brown, friable, silty to very fine sandy deposits that are described in a following section.

The soils formed on this silty clay loam to silty clay material have a distinctive brown colored solum whose structure is granular to nuciform. They sometimes occur in association with Nampa, Falher, Donnelly and Esher soils and often with soils formed on similar but more variable parent material. In addition, Thin Peat and Organic soils are commonly found in many of the lower positions of these areas. Following is a description of the dominant soils formed on this brown, friable, lacustrine material:

---

*The Principal Soils Groups of Alaska. C. E. Kellogg and I. V. Nygard. U.S.D.A. Agricultural Monograph No. 7, 1951.

*Frost Action and Vegetation Patterns on Seward Peninsula, Alaska. D. M. Hopkins and R. S. Sigafoos. U.S. Geological Survey Bulletin, 974.C, 1950.

(a) Kathleen Series (Kt.): Grey Wooded silty clay loam to silty clay.

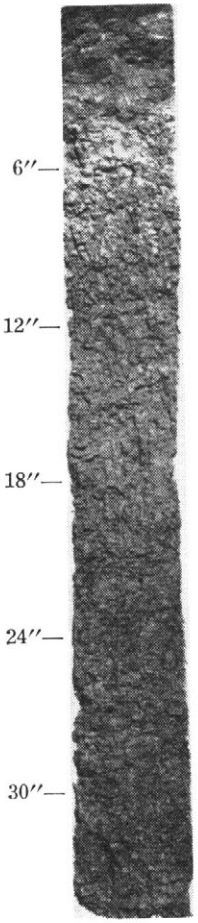
Extent and Occurrence: There are about 11,000 acres in which Kathleen soils are predominant. They are found in association with Donnelly and Snipe soils in the eastern part of the area adjacent to Sturgeon lake and to the highway northeast of Valleyview.

Topography: Generally quite variable, complex slopes, often humpy. Some of the knolls have depressed centre crowns that resemble doughnuts.

Drainage: Moderately well drained soils which often have a moderately high surface run-off.

Native Vegetation: Mixed woodland in which aspen poplar is predominant.

Profile Description: Kathleen soils are distinguished by their pale brown A_2 horizon and brown B horizon. While the latter is often fairly compact in the upper portion, it is more friable and browner in color than that of either the Nampa or Donnelly soils. The following is a description of an average Kathleen profile found in the mapped area.



Horizon	*Thickness* *in inches*	*Description*
A_0	1	Dark brown to dark greyish brown leaf litter. pH 6.4.
A_1	2	Dark greyish brown to greyish brown loam, granular, friable. pH 5.0.
A_2	2	Pale brown to light brownish grey very fine sandy loam, medium platy. pH 4.5.
$A_3(B_1)$	2	Brown silt loam to silty clay loam, nuciform, fairly firm aggregates that have a light brownish grey coating on the top and sides. pH 4.4.
B_2	8	Dark greyish brown to brown silty clay, weakly columnar, medium blocky to nuciform, firm. pH 4.5.
B_3	6	Brown silty clay, medium blocky, fairly friable. pH 5.3.
Bca	at 24-30 below surface	Dark grey silty clay and light yellowish brown silt loam to very fine sandy loam laminae that vary in thickness and have little apparent continuity. Often laminations are not apparent, and the horizon consists of mixed grey and yellowish brown fine blocky aggregates. Lime concentrations, particularly in the lighter colored portions. pH 7.5.
D		Dark grey to grey clay, medium blocky, fairly firm. Often found at depths of 36 to 48 inches, and resembles the C horizon of Nampa or of Donnelly soils. pH 7.8.

Soil Rating: Generally fairly good arable soils.

Agricultural Use: At the present time very few of the Kathleen soil areas are under cultivation. (See Cultivation Map, Fig. 4.) This is probably due to their fairly heavy tree cover.

While these soils are somewhat low in native fertility, they should respond very favorably to good cropping and soil management practices. Crop rotations that include both grasses and legumes will not only increase the fibre and organic matter content of these soils but will also help to increase the available supply of some of the nutrient elements. Supplementary applications of manure or commercial fertilizers should result in significant increases in crop yields. The replenishment of the fibre and organic matter will also help to curtail serious losses from wind and water erosion. In connection with the latter, the elimination of cultivation up and down the slopes should become a basic practice of farm management.

(b) Judah Series (Ju.): Degraded Black silty clay loam to silty clay.

Extent and Occurrence: There are only a few areas (5,700 acres), chiefly in the central portion of the mapped area near the Smoky river, in which Judah soils are predominant. However, they are also found in association with Davis soils and often occur in very significant proportions in many of the Davis soil areas.

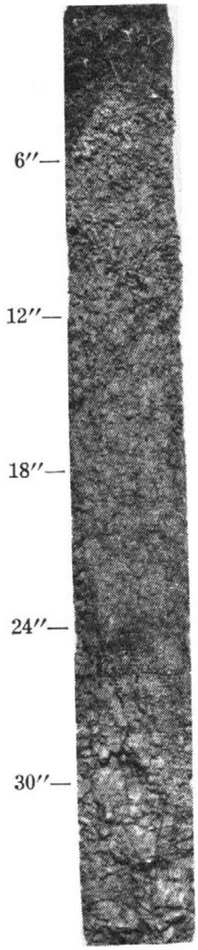
Topography: Generally quite variable, but an undulating to gently rolling somewhat humpy topography is typical of the larger areas of Judah soils. When associated with Davis soils they are usually found on the lower slopes while Davis soils are found on the upper portions and crowns of gently rolling and rolling areas.

Drainage: They are well drained soils in which both the internal and external drainage is usually good.

Native Vegetation: A mixed woodland in which aspen poplar and small shrubs are predominant.

Profile Description: Judah soils can be recognized by their brown colored surface horizon and by a brown, friable, fairly heavy textured, usually stone-free, subsoil. The structural aggregates of the subsoil lack the cohesion typical of most of the previously described soils. There is often a gradual greying of the lower part of the A horizon rather than a distinct A_2 horizon. With respect to both their color and their structure they are unlike other Degraded Black soils of this area. The following is a description of an average Judah soil profile:

Horizon	*Thickness in inches*	*Description*
A_0	1	Dark brown decomposed leaf litter. pH 7.4.
A_{11}	3	Dark brown to brown silt loam to silty clay loam, fine granular to crumb, friable. pH 7.0.
A_{12}	2	Yellowish brown very fine sandy loam to silt loam, fine granular to crumb, friable. pH 6.6.



Horizon	Thickness in inches	Description
B_1	6	Brown to dark yellowish brown silty clay loam to silty clay, granular to nuciform, friable. pH 6.0.
B_2	6	Dark yellowish brown silty clay loam to silty clay, nuciform, friable. Occasionally has thin yellowish brown silty and very fine sandy laminae. pH 7.2.
B_{ca} at 24 to 36 below surface		Brown to yellowish brown silty clay, nuciform, friable, frequently laminated, usually fairly high in lime. pH 8.1.
C		Greyish brown silty clay loam to silty clay, granular to nuciform, friable. Brownish yellow laminae of very fine sand or silt are often present. pH 7.9.

Soil Rating: Depending on topography, Judah soils rate as fairly good to good arable soils.

Agricultural Use: The areas in which Judah soils predominate are largely under cultivation and producing chiefly grain crops.

These soils tend to be low in plant fibre and organic matter. In other areas, water erosion—particularly gully erosion—is becoming increasingly troublesome. Judah soils are quite friable and it would appear desirable to replenish the fibre and organic matter in order to increase the adhesion of the soil aggregates. Cultivation on the contour wherever possible, the introduction of grass and legume crops into the crop rotation, and applications of fertilizer, when needed, appear to be the basic requirements for a successful management of Judah soils.

D. Soils Developed on Alluvial and Aeolian Deposited Materials

These water and wind sorted deposits are found in association with present or past water courses. They are often stratified. The strata are usually fairly thick and may consist of alternating beds of sand, silt and clay. Some of the strata are cross-bedded, and it would appear that wind may have been at least partly responsible for sorting and redepositing some of this parent material. The depth of these deposits over the underlying till or lacustrine materials varies, but is usually in excess of 3 feet. Frequently the best examples of the humpy, variable topography described on page 58 are found in areas in which this variable parent material is predominant.

The soils formed on this type of material may be grouped according to the dominant textural characteristics of their parent material. These groups are as follows:

1. Very calcareous, variable, silty, parent material.

Davis and *Tangent* soils are the principal better drained soils formed on this yellowish brown material. Poorly drained soils of the Eaglesham, Kenzie, and Codner series can be formed on similar stratified material. The strata are rarely less than 6 inches thick and vary considerably. Silt and silty clay strata generally predominate. Following is a description of the dominant soils formed on this variable material:

(a) Davis Series (Dv.): Grey Wooded loam to silt loam.

Extent and Occurrence: There are about 38,000 acres in which Davis soils are predominant. They are found near the Little Smoky river in the eastern part of the area, and in areas adjacent to the Smoky and Wapiti rivers in the western portion of the area. They are associated with Judah and Culp soils, and are found in significant portions of some Saddle soil areas adjacent to Bezanson.

Topography: Generally humpy, gently rolling to rolling. The knolls are low but often steep-sided. In the depressional areas associated with this humpy terrain, sedge and moss peat bogs are of common occurrence. Some of the topographic features characteristic of Davis soil areas in this region bear a striking resemblance to those described and attributed to frost action by Hopkins and Sigafoos in the United States Geological Survey Bulletin 974-C.

These frost mound characteristics are particularly apparent in Davis soil areas.

Drainage: Moderately well drained soils, that often have an excessive surface run-off.

Native Vegetation: A mixed woodland vegetation, consisting of aspen poplar, spruce, shrubs, and generally coarse grasses.

Profile Description: While Davis soils are classified as "Grey Wooded", their profiles are usually much browner in color than those of other Grey Wooded soils. Often the darkest part of the solum is the lower part of the B horizon lying immediately above the lime horizon. Thin, reddish brown strata sometimes occur at varying intervals in the B horizon. However, Davis soil profiles are quite variable. There is little uniformity as regards the depth to the different strata or as regards the thickness of the respective strata. In the areas adjacent to the sandy areas bordering the Wapiti river, the lime horizon may be found in some cases at depths of about 12 inches. Such profiles have been designated as shallow-phase Davis profiles and are indicated in some of the areas outlined. A solum that is predominantly silty is characteristic of these soils. Following is a description of a typical Davis soil profile:

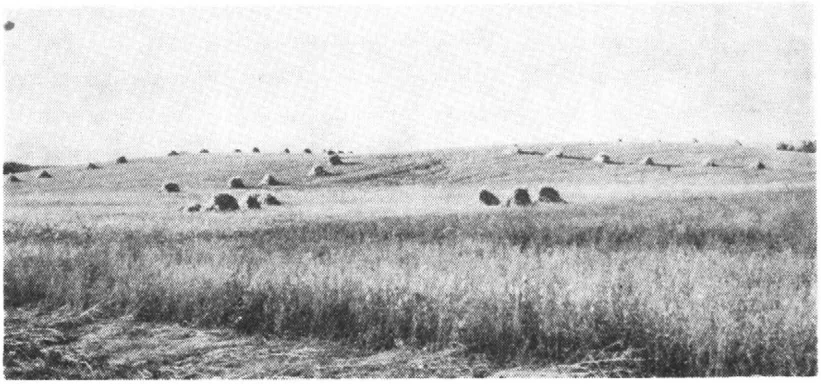
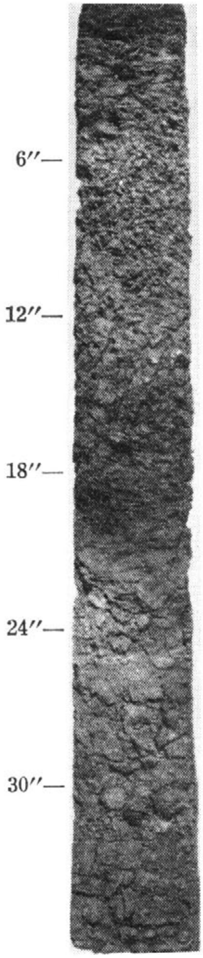


Figure 22—"Humpy" or doughnut-shaped mound in a Davis soil area near Bezanson.

Figure 23—Sweet clover crop in a Tangent soil area near Goodwin. September 1952.



Horizon	*Thickness in inches*	*Description*
A_0	2	Dark brown organic debris. pH 7.2.
A_1	1	Brown loam to silt loam, often absent. pH 7.0.
A_2	3	Light brown to very pale brown very fine sandy loam to silt loam, platy, very friable. pH 6.8.
B_{11}	3	Pale brown silt loam to silty clay loam, nuciform, vesicular, friable. pH 6.4.
B_{12}	8	Yellowish brown silt loam to silty clay loam, nuciform, friable. pH 5.6.
B_2	6	Brown to strong brown silty clay, somewhat more compact than the previous horizon. pH 6.5.
B_{ca} at 22 to 30 below surface		Light brownish grey silty clay and light yellowish brown silt and very fine sand strata, that often exceed 12 inches in thickness. Fairly high lime accumulation. pH 8.2.
C		Light yellowish brown very fine sandy loam to silt loam in upper 8 inches. Remainder very fine sand to silt with occasional bands of silty clay or silty clay loam. pH 8.1.

Soil Rating: Depending on topography, Davis soils rate as fair to fairly good arable soils.

Agricultural Use: At present, little agricultural use is being made of most of the Davis soil areas in the Grande Prairie and Sturgeon lake sheets. (See Cultivation Map, Fig. 4.)

These friable, medium textured soils are vulnerable to both wind and water erosion. In addition they are generally fairly low in organic matter, nitrogen and phosphorus.

Grasses and legumes must be included in the crop rotations to build up the fibre and organic matter content of Davis soils. Experience has shown that such grasses as brome, crested wheat, and creeping red fescue can be grown successfully. Alfalfa, sweet clover, and altaswede are very desirable soil improving crops, and legume seed production has met with marked success on many of the Davis soils of other areas.

Since these soils tend to have a low reserve of mineral plant nutrients, they should respond to fertilizer amendments. Field trials conducted on similar soils by the Beaverlodge Experimental Farm and by the Department of Soils indicate a very marked response to nitrogen-phosphate fertilizers.

(b) Tangent Series (Ta.): Degraded Black loam to silt loam.

Extent and Occurrence: There are about 40,000 acres in which Tangent soils are predominant. They are found in the northeast portion in the vicinity of the Little Smoky river, and in the central and southwestern portion near the Smoky, Wapiti, and Simonette rivers.

Topography: Variable, complex slopes, gently rolling to rolling, often humpy.

Drainage: Usually well drained soils that may have a somewhat excessive surface run-off.

Native Vegetation: A sparse woodland or parkland type of vegetation consisting predominantly of shrubs and aspen poplar.

Profile Description: Except for the thicker and darker colored A_1 horizon, Tangent soils are similar to Davis soils. The prevailing brown color of the solum is a distinctive characteristic of these soils, and in that respect they are unlike various other Degraded Black soils. As in the case of some Davis areas in the western portion of the mapped area, soils having a comparatively thin solum over lime are indicated as shallow-phase Tangent soils. Following is a description of a typical Tangent profile; the shallow-phase is much the same except the horizons are thinner and the lime is usually within 12 inches of the surface:

Horizon	*Thickness in inches*	*Description*
A_1	3	Very dark brown to brown fine sandy loam to silt loam with little definite structure. A thin A_0 horizon is often found above this horizon. pH 7.7.
A_2	2	Pale to very pale brown very fine sandy loam, weakly platy. pH 7.5.
$A_3(B_1)$	3	Light yellowish brown very fine sandy loam to silt loam, weakly platy to small granular, loose. pH 7.4.
B_2	8	Yellowish brown to brown silt loam to silty clay loam, weakly prismatic, weakly nuciform, friable. Lower 2 to 3 inches often darker colored. pH 7.6.
B_{ca} at 16 to 30 below surface		Grey to light brownish grey very fine sandy loam to silt loam. Fairly high in lime. pH 8.2.
C		As above, occasionally finely laminated or cross-bedded.

Soil Rating: Depending on topography, Tangent soils are fairly good to good arable soils.

Agricultural Use: Tangent soils are vulnerable to both wind and water erosion. Fibre and organic matter are needed to bind the loose soil aggregates and to increase the water-holding capacity of these soils. It is essential therefore that the organic matter and fibre content be maintained at a fairly high level. Tangent soils are fairly fertile soils that will respond profitably to good management.

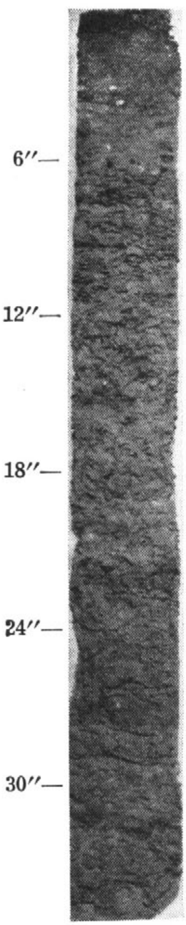
2. Moderately calcareous, variable, sandy parent material.

Culp, Leith, and *Codner* soils are the dominant soils formed on this yellowish brown stratified material which is somewhat similar to that of the preceding group. However, its strata are predominantly sandy. The sand to loamy sand strata are usually thick whereas the sandy clay to clay loam strata generally do not exceed a thickness of about 2 inches. The following is a description of the principal soils formed on this type of parent material:

(a) Culp Series (Cu.): Grey Wooded loamy sand to sandy loam.

Extent and Occurrence: There are about 56,000 acres in which Culp soils are predominant. They are found adjacent to some of the principal stream courses in the mapped area, and often occur in close association with Davis and with Heart soils.

Topography: Variable, gently rolling to rolling, often humpy.



Drainage: Well drained to somewhat excessively drained soils.

Native Vegetation: Woodland vegetation consisting of aspen poplar, occasional spruce and pine bluffs, shrubs and coarser grasses.

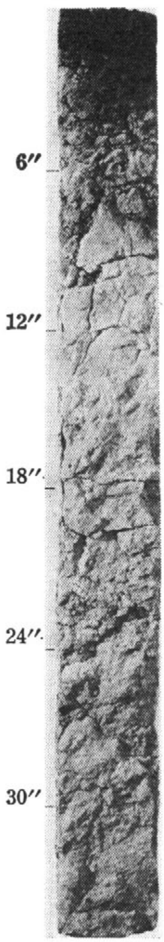
Profile Description: Culp soils are Grey Wooded soils that have a brownish colored sandy profile in which there is a fairly well developed, compact B horizon at depths of 12 to 18 inches below the surface. The following is a description of a typical Culp soil profile:

Horizon	*Thickness in inches*	*Description*
A_0 & A_1	2	Dark brown to dark greyish brown leaf litter with a thin greyish brown sandy loam horizon in the lower portion. The latter is often absent. pH 7.0.
A_2	6	Light brownish grey to light yellowish brown loamy sand, loose. pH 6.8.
$A_3(B_1)$	4	Light yellowish brown to yellowish brown loamy sand, darker colored and firmer than the A_2 horizon. pH. 6.1.
B_{21}	6	Yellowish brown to brown sandy clay loam to sandy loam, blocky, firm. pH 6.6.
B_{22}	6	Dark yellowish brown sandy clay loam to sandy loam, blocky to massive with sand along cleavage faces and in root channels, pH 6.7.
B_3	6	Yellowish brown sand to loamy sand with occasional clay loam laminae. pH 7.2.
B_{ca}	at 26-40 below surface	Similar to the preceding horizon but with a moderate concentration of lime particularly in the heavier textured laminae. pH 7.7.
	at 48 below surface	Similar to above but higher in lime. pH 7.8.

Soil Rating: Culp soils with a fairly uniform topography are rated as fair arable soils. However, in many cases they have a choppy topography consisting of fairly steep slopes. In such cases sedge and moss bogs are of very common occurrence in the depressions, and the areas should be withheld from cultivation or seeded permanently to grass.

Agricultural Use: Only a very small proportion of the Culp soil areas is under cultivation at the present time. They appear to respond favorably to management practices that include frequent legume crops and periodic applications of a nitrogen-phosphorus fertilizer.

Culp soils are sufficiently sandy to be very vulnerable to wind erosion. Organic matter and fibre must therefore be maintained at a fairly high level to cut down losses due to soil erosion. The steep, rough and patchy areas of Culp soils should be left in their virgin state or seeded down to permanent pasture.



(b) Leith Series (Le.): Degraded Black loamy sand to sandy loam.

Extent and Occurrence: There are about 33,000 acres in which Leith soils are predominant. They are found near Clouston creek, near Goodwin, and south of Grande Prairie. They occur in association with Davis, Culp, and Tangent soils and often with Organic or Meadow soils.

Topography: Variable, undulating to rolling, much of it has a dune-like appearance.

Drainage: Well drained to somewhat excessively drained soils.

Native Vegetation: A more open cover than that of Culp soils. Found under a parkland vegetation, particularly on the more exposed south slopes.

Profile Description: Leith soils are brownish colored, sandy soils that usually have a well developed compact B horizon. The following is a description of a typical Leith soil profile:

Horizon	*Thickness in inches*	*Description*
A_0	2	Dark brown organic debris. pH 7.0.
A_1	6	Brown to dark brown fine sandy loam, weakly blocky. pH 7.6.
A_2	6	Pale brown to yellowish brown loamy sand, loose. pH 7.8.
B_2	12	Yellowish brown to brown sandy clay loam to sandy loam, weakly columnar, nuciform, friable. Has occasional sandy lenses. pH 7.6.

Horizon	Thickness in inches	Description
B_{ca}	at 24-36 below surface	Greyish brown very fine sandy loam to silt loam. Fairly high in lime. pH 8.4.
C		Brown to yellowish brown loamy sand with occasional laminae—rarely over 2 inches thick—of sandy or silty clay loam. pH 8.2.

Soil Rating: Leith soils, on undulating to gently rolling topography, are fairly good arable soils.

Agricultural Use: Some of the Leith soil areas are under cultivation and producing fairly satisfactory crops of grain and legumes. (See Cultivation Map, Fig. 4.) Some of the areas are too boggy to be cultivated economically (north of Goodwin). Leith soils are vulnerable to wind erosion, and soil drifting is already quite apparent in the cultivated areas. Organic matter and fibre will need to be replenished and maintained at a fairly high level to help curtail the losses due to soil erosion. The maintenance of a trash cover and the elimination of much of the summerfallowing will also do much towards controlling soil drifting.

(c) Codner Series (Cn.): Meadow (somewhat poorly drained) sandy loam to silt loam.

Extent and Occurrence: There are about 63,000 acres in which Codner soils are predominant. They are found in association with Leith, Culp, and other light to medium textured soils and are found chiefly in the vicinities of Grande Prairie, Goodwin, and adjacent to the Little Smoky river.

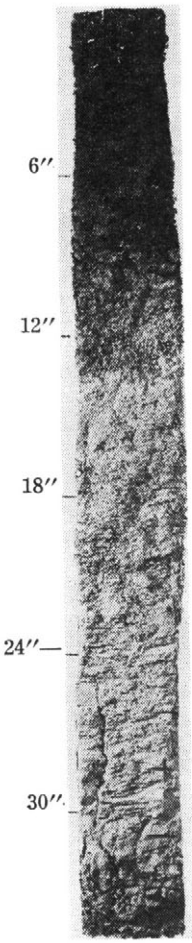
Topography: Level and depressional, generally low-lying basins.

Drainage: Imperfectly to poorly drained.

Native Vegetation: Coarse grasses and scattered bluffs of willow, black poplar, and occasional spruce.

Profile Description: Codner soils can be distinguished by their dark colored highly organic A horizons which are underlain by yellowish brown B horizons in which iron stains are of common occurrence. They are found in low-lying areas in which drainage deficiencies are quite apparent. The depth to the underlying heavier textured and darker colored substratum is variable, usually averaging about 30 inches. They are lighter textured Meadow soils than those of the Goose series, and have a distinctly browner and more variable B horizon. Following is a description of a profile typical of the Codner series:

Horizon	Thickness in inches	Description
A_0	5	Very dark brown to black semi-decomposed sedge peat. pH 6.8.
A_1	5	Very dark grey to very dark greyish brown loam, weak granular to crumb, friable. Some firmness due to organic fibre. pH 6.4.



Horizon	Thickness in inches	Description
B	3-5	Brown to yellowish brown loam to silt loam, weak granular. Variable thickness. pH 6.4.
B_g	12	Brown and greyish brown very fine sandy loam to loam, weak fine granular to fine nuciform, friable. Different colored and different textured materials often occur in streaks and the upper inch of this horizon is often grey in color and fairly firm. Iron stains may occur throughout this horizon. pH 6.9.
D_1	8	Dark grey and yellowish brown sandy loam with varves of clay and silt that rarely exceed a thickness of ¼ inch. This horizon varies in thickness and is often absent. pH 7.4.
D_{ca}	at 24 to 36	Greyish brown to dark greyish brown clay loam till that has a fine nuciform to blocky structure and is fairly friable. Numerous small stones and ironstone nodules. Medium lime. pH 7.5.

Soil Rating: Until drainage has been improved these soils are not desirable for grain crop production. They are very well suited for pasture crop production.

Agricultural Use: Little use is being made of Codner soils in the mapped area. They are found largely in some of the newer areas that are just coming under cultivation. In such areas, if the removal of tree cover and the construction of roads are adequate to improve the drainage of Codner soil areas, grain crop production should ultimately prove very satisfactory on these soils. If, however, the Codner soil areas continue to remain wet for varying periods, it would appear that such areas should be devoted to pasture crop production. Elsewhere in the Peace River area Codner soils appear to be particularly desirable for the production of alsike clover seed.

3. Slightly to moderately calcareous, fairly loose sand parent material.

Heart soils are the dominant soils formed on this water and wind sorted, highly siliceous, sandy material which is found adjacent to some of the main drainage courses. It varies from fine to coarse sand and is sometimes underlain by heavier textured materials at depths of 4 to 6 feet below the surface.

(a) Heart Series (Ht.): Grey Wooded and Podzolized Grey Wooded sand to loamy sand.

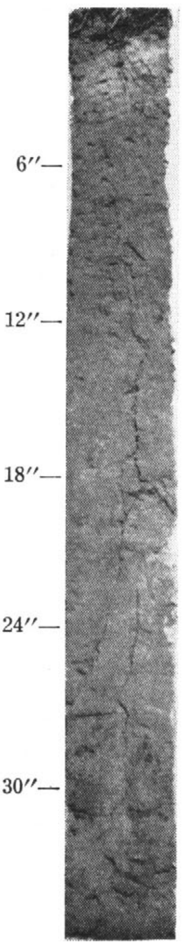
Extent and Occurrence: Adjacent to the Smoky, Simonette, and Wapiti rivers there are about 73,000 acres in which Heart soils predominate. They occur in close association with Culp and Organic soils. In some of the areas south of the Wapiti river, Organic soils predominate in many of the sand areas.

Topography: Undulating to rolling, consisting of complex slopes. Much of the area appears to consist of old dunes that are hairpin shaped and are now well stabilized with grass and tree vegetation.

Drainage: Well drained to excessively drained soils.

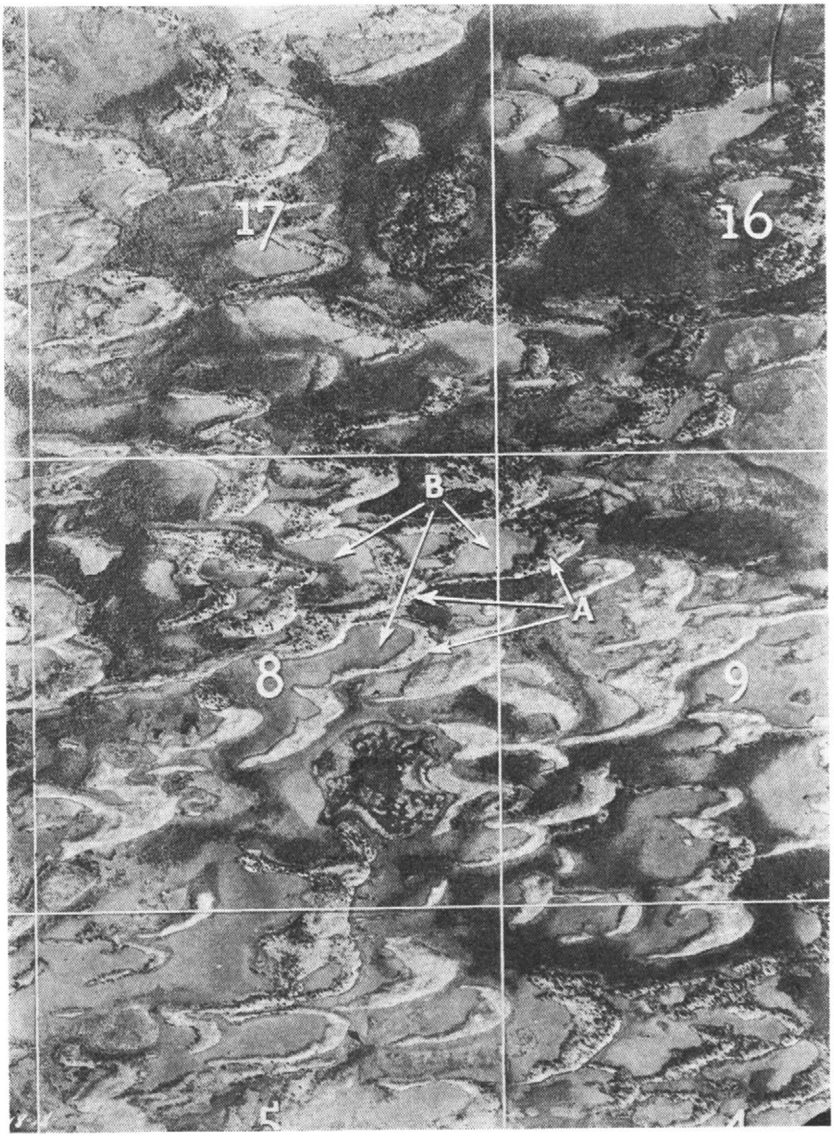
Native Vegetation: Woodland vegetation consisting of good stands of pine, spruce, and aspen poplar. Sedges and mosses are of common occurrence in many of the depressional, poorly drained portions of these areas.

Profile Description: Both Grey Wooded and Podzolized Grey Wooded profile types are found on sand in this area. Beyond recognizing the occurrence of both types, no attempts were made to make further series separations of the soils formed on this material. The following is a description of a Heart soil profile that is commonly found in the undulating to rolling, well drained portions of the sand areas. It is a Podzolized Grey Wooded profile in which the upper part of the profile has characteristics that appear to be typical of a Podzol profile. In the lower horizons, however, the heavier textured accumulations may be remnants of a former Grey Wooded B horizon.



Horizon	*Thickness in inches*	*Description*
A_0	1/2	Brown organic debris. pH 6.0.
A_{2_p}	3	White to pinkish white in upper portion, grading to light grey in lower portion, fine sand loose but held together by plant roots. pH 5.6.
B_p	7	Pale brown in upper portion grading to brownish yellow in lower portion, fine sand, slight evidence of compaction. pH 5.4.
C_p	6	Light yellowish brown fine sand, weakly blocky. pH 5.6.
$A_3(B_1)$	10	Very pale brown fine sand, weakly blocky with occasional soft spheroidal aggregates of loamy sand to sandy loam. pH 5.7.
B_2	13	Very pale brown fine sand to loamy fine sand with strong brown clusters of soft spheroidal aggregates of loamy sand to sandy loam. Lime flecks are sometimes found in the lowest part of this horizon. pH 6.4.

Generally more pronounced evidence of lime accumulation is found at depths of about 48 inches.



—Photo courtesy of the Royal Canadian Air Force.

Figure 24—Hairpin-shaped or U-shaped dunes in the sand areas adjacent to the Wapiti river. Note the distribution of the sand dunes (A) and the moss bogs (B) — typical of many portions of this sand area. (A complete square represents an area one mile square.)

Soil Rating: Heart soils are not arable.

Agricultural Use: Areas of Heart soils should not be cultivated. Any disturbance of the protective vegetation cover and binding will bring about rapid deterioration of the organic matter and result in serious soil drifting in these areas. There are at present practically no active dunes, and every effort should be made to preserve or re-establish the native tree cover and to withhold the sand areas from settlement. They should be set aside as timber and game reserves.

4. Slightly calcareous, comparatively recent river and flood plain deposited materials.

The dominant soils formed on recent river and flood plain material are those of the *Spirit River, High Prairie,* and *Enilda* series. Those formed on the *Alluvium* in river valleys have not been differentiated into series. These soils usually have weakly developed profiles in which there is little apparent evidence of horizons formed as the result of illuviation. However, there is usually a marked difference particularly in the color and depth of the A horizons of those soils found on the upper and older terraces and those found on the lowest and most recent flood plains. The former are often darker colored as the result of a greater accumulation of organic matter. The following are descriptions of the principal soils formed on this comparatively recently deposited parent material:

(a) Spirit River Series (S.R.): Black (weakly structured) sandy loam to silt loam.

Extent and Occurrence: There are two areas, comprising about 2,000 acres, in which Spirit River soils are predominant. They are found in the northeastern portion of the mapped area and are associated with High Prairie soils.

Topography: Level to undulating, very gently sloping.

Drainage: Usually well drained soils.

Native Vegetation: Fairly open parkland consisting of grasses and occasional bluffs of aspen poplar and various shrubs.

Profile Description: Spirit River soils are distinguished by a thick A horizon that is very dark brown to black in color. The brownish colored B horizon has little definite structure, and often consists of a sequence of depositional strata. The texture varies from a sandy loam to a silt loam, depending on the thickness and nature of the various strata. Following is a description of a typical Spirit River profile:

Horizon	*Thickness in inches*	*Description*
A	6	Very dark brown to black sandy loam to silt loam, weakly granular. Some firmness largely due to organic fibre. pH 7.2.
B	24	Brown to yellowish brown depositional strata that have very little definite structure but do have some evidence of leaching and accumulation. pH 6.8.

Horizon	Thickness in inches	Description
		The following are typical of these strata:
	4	Brown to yellowish brown silt loam.
	10	Yellowish brown very fine sandy loam.
	2	Light yellowish brown loamy sand.
	8	Brown to yellowish brown clay loam, weakly nuciform.
Bca	at 24-36 below surface	Yellowish brown silt loam, low to moderate lime content. pH 8.1.

Soil Rating: Very good arable soils.

Agricultural Use: Spirit River soils have a fairly high native fertility and are very desirable agricultural soils. However, they appear to be vulnerable to wind erosion, and soil drifting is becoming a problem. Rotations that include grasses and legumes should replace the present continuous grain-fallow rotations.

(b) High Prairie Series (H.P.): Dark colored (moderately well drained) sandy loam to clay loam.

Extent and Occurrence: On the flood plains adjacent to the Little Smoky river in the eastern portion of the mapped area, there are about 15,000 acres in which High Prairie soils predominate. Significant proportions are found in association with many of the Spirit River, Codner, and Enilda soils.

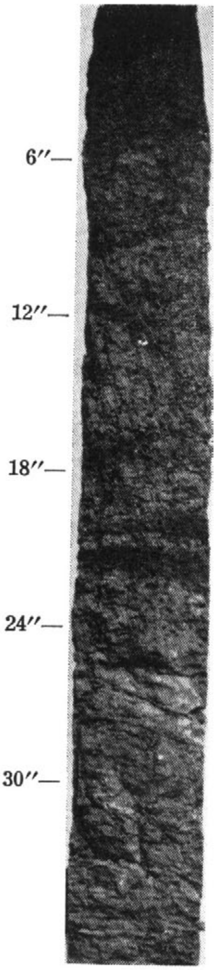
Topography: Level to gently undulating with long gentle slopes.

Drainage: Moderately well drained to somewhat poorly drained. Generally iron stains are found at depths of 12 to 18 inches, and it would appear that periodically there is a fairly high water table in these soils. Flooding may occur in various portions of the area, particularly those portions adjacent to the Little Smoky river.

Native Vegetation: Parkland, in which coarse grasses, black poplar, willow, and scrub birch are of common occurrence.

Profile Description: High Prairie soils are quite variable. Some are light textured and others are fairly heavy textured. The lighter textured members are often found at slightly higher elevations adjoining some of the drainage courses. They are stone-free soils that have a brown to very dark brown A horizon. The material below the A horizon is brown in color, consists of varying strata, and shows little evidence of horizon development. The following is a description of a medium textured High Prairie soil profile:

Horizon	Thickness in inches	Description
A_0	1-2	Dark to very dark brown leaf and grass litter. pH 7.2
A	4	Dark greyish brown with splotches of dark grey silt loam, medium blocky, friable. pH 7.0.



Horizon	Thickness in inches	Description
B	8	Brown to pale brown silt loam, weakly fine blocky to nuciform, friable. This horizon is usually not as compact as the A, and the upper portion is often splotched with dark grey stains. pH 6.3.
C & C_g		Pale brown to brown stratified material with little uniformity as to thickness or texture of the various strata. Buried profiles are common. The following are typical strata:
	4	Brown to pale brown silt loam, coarse plate-like strata, weakly nuciform, friable. pH 6.1.
	2	Brown very fine sandy loam to loam. pH 6.1.
	4	Brown to pale brown silt loam, coarse plate-like strata, weakly nuciform, friable. pH 6.0.
	3	Pale brown silt loam, weak medium nuciform with numerous iron stains. pH 6.3.
	1/2	Grey to dark grey loam to silt loam, high in organic matter. May be a buried A horizon. pH 6.8.
	3	Pale brown loam, weakly nuciform, numerous iron stains. pH 7.2.
	12	Pale brown very fine sandy loam to loam with very distinct horizontal cleavage, giving it a fine platy appearance. Iron stained and may occasionally have small lime concretions. pH 7.6.

Soil Rating: Generally good arable soils.

Agricultural Use: Some of the High Prairie soil areas are being cultivated. (See Cultivation Map, Fig. 4.) Grain crops are being grown to the practical exclusion of all others and very good yields are reported. However, these soils tend to be loose and low in plant fibre, and early consideration will have to be given to the addition of organic matter. Recent investigations indicate that a marked response can be expected from applications of nitrogen-phosphorus fertilizers.

A serious impediment to the agricultural utilization of these soils adjacent to the Little Smoky river is the presence of extensive, low lying, poorly drained and boggy areas.

(c) Enilda Series (En.): Poorly drained, often peaty, sandy loam to clay loam.

Extent and Occurrence: There are about 2,900 acres in which Enilda soils predominate. They are found in the depressional, poorly drained positions associated with or adjoining High Prairie soils.

Topography: Level and depressional, subject to periodic flooding.

Drainage: Poor, frequently wet for considerable periods.

Native Vegetation: Coarse grasses and some sedges, bluffs of willow and scrub birch.

Profile Description: Except for a dark colored surface horizon that is usually high in organic matter and often peaty, there is little horizon development in these soils. Below the dark surface the profile is a drab greyish color, consists of varying depositional strata and has iron stains. Enilda soils occupy the lower positions, and tend to have a somewhat heavier textured surface than do the High Prairie soils. The following is a description of an average Enilda soil profile:

Horizon	*Thickness in inches*	*Description*
A_{00}	1	Dark brown sedge peat. pH 7.2.
A_1	3	Very dark brown silt loam high in organic matter with occasional grey to dark grey splotches. Weak medium nuciform. pH 7.1.
B_g	3	Greyish brown to grey silty clay loam, weak fine granular to nuciform, fairly loose. pH 6.5.
C_g	3	Light brownish grey silt loam, weakly nuciform, friable, iron stained. Both the top and bottom portions of this stratum are bounded by thin, dark grey strata. pH 6.7.
	2	Grey to light brownish grey silt loam, weak fine granular, loose. pH 6.7.
	1	Dark grey to very dark grey loam high in organic matter. May be a buried A horizon. pH 6.4.
	5	Light brownish grey silty clay, weak medium blocky, friable. Thin mats of organic matter along some of the cleavage faces and numerous iron stains. pH 6.3.
	8	Pale brown to light yellowish brown loamy sand, weak fine to medium platy, friable, iron stained. pH 6.9.
	6	Pale brown and grey alternating strata of silt loam and clay loam with occasional thin lenses of fine sand. pH 6.9.
	6	Grey to greyish brown alternating strata of silt loam and very fine sandy loam, highly iron stained. pH 6.9.

Soil Rating: Until their drainage is improved Enilda soils are not suitable for grain crop production. They are suited to pasture crop production.

Agricultural Use: Native hay is cut on many of the Enilda soil areas—particularly those associated with or adjoining Organic soil areas.

On cultivation, early consideration should be given to maintaining the organic matter content of these soils. Applications of nitrogen-phosphorus fertilizers might be useful in hastening the maturity of grain crops. Alsike clover should receive early consideration in the crop rotation.

Areas in which Enilda soils are predominant have a good water supply for stock watering purposes, and appear to be particularly suited to pasture crop production. Livestock or dairying enterprises should receive consideration in the agricultural development of such areas.

(d) Alluvium (A.): Undifferentiated river flat and river bench deposits.

Alluvium refers to material, deposited by rivers, that occurs on the terraces and flood plains in the valleys of those rivers. This material is of fairly recent origin and has variable characteristics. Consequently a wide variety of immature soils is found in these valleys. Many are similar to those of the Spirit River, High Prairie, and Enilda series, but because the valley flats are usually very variable in size and often badly cut up by oxbows and old stream courses, no attempt is made to delineate the various different soil areas. Usually the soils in these flats are greyish brown to dark brown in color and vary in texture from a fine sandy loam to a silt loam. The subsoils are often sandy and sometimes gravelly. Since a wide variety of soils are found on this material and since a variety of conditions prevail on these river flats, the following is only a general description of some of the larger areas of alluvium outlined in the Grande Prairie and Sturgeon Lake areas.

Extent and Occurrence: In the river flats adjoining the Little Smoky, Smoky, Wapiti, and Simonette rivers, there are about 52,000 acres of Alluvium.

Topography: Usually level to undulating flats or benches that are often badly cut up by stream channels, oxbows, etc.

Drainage: Variable—usually good, often excessive.

Native Vegetation: Variable, often heavy cover consisting of spruce, black poplar, some aspen poplar, and a dense undergrowth of willows and alders. Some of the flats have a parkland vegetation consisting of coarse grasses and scattered bluffs of poplar and willow.

Profile Description: Soils developed on alluvium are quite variable. Usually they are sandy and often they have a gravelly subsoil. The following is a description of a profile found on one of the upper benches of the Little Smoky river.

Horizon	*Thickness in inches*	*Description*
A	6	Black grading to dark brown, silt loam to very fine sandy loam, weak nuciform. Some firmness largely due to organic fibre. pH 6.8.
C	12	Brown to yellowish brown silt and very fine sand strata. pH 5.7.
	at 18	Gravel.

Soil Rating: Usually fair to good arable soils.

Agricultural Use: Soils formed on alluvium are often excessively well drained and tend to be droughty. Organic matter has a high water-holding capacity and it would be desirable that the organic matter content of these soils be maintained at a fairly high level. While the larger, more uniform of these areas often consist of good agricultural land, the smaller and often cut up areas are not particularly desirable. Moreover, many of these small areas appear to be extremely vulnerable to water and wind erosion. It would therefore seem desirable to exercise extreme caution in the utilization of some of these flats and benchlands.

5. Relatively thin, slightly calcareous, light to medium textured deposits that overlie other heavier textured deposits.

The parent material of this group of soils consists of somewhat sandy material overlying other heavier textured material. The variabe sandy deposits are generally shallow and rarely exceed a depth of 30 inches. Frequently they are about 12 to 18 inches thick. They occur on many of the lower slopes of the till areas, or adjoining some of the drainage courses. Thus they may be either shallow beach or flood plain deposits. Sandy deposits that are somewhat gravelly and often stony are most frequently underlain by till, whereas the more uniform, often stone-free deposits are usually underlain by lacustrine material. Further study may show that some of the profiles developed on this type of parent material are the shallow counterparts of other profiles developed on similar but deeper deposits. For example, in many cases Peoria soils may be referred to a shallow phase Spirit River soils.

(a) Codesa Series (Co.): Grey Wooded (weakly structured) sandy loam to silt loam.

Extent and Occurrence: There are about 224,000 acres in which Codesa Soils are predominant. They are found in association with Braeburn and Donnelly soils and are of most extensive occurrence in the area between Sturgeon lake and Smoky river. No attempt is made to determine the extent of their occurrence in those areas in which they are not believed to be predominant.

Topography: Undulating to rolling topography, consisting predominantly of long simple slopes.

Drainage: Usually imperfectly drained soils in which drainage deficiencies are most apparent in the horizons immediately above the heavier textured substratum.

Native Vegetation: Woodland, consisting of variable stands of aspen poplar, black poplar, spruce, occasional pine and willows. There is frequently a dense undergrowth of native shrubs.

Profile Description: Codesa soils are sandy and may be gravelly or stony. They usually have a brownish grey to yellowish brown weakly developed profile in which the lighter colored A_2 horizon has a platy or weakly platy structure. At depths of 12 to 30 inches there may be a gravelly layer at the contact with the underlying heavier textured material.

In the area near Sturgeon lake the depth of the overlay is variable, consists of uniform sandy material that rarely has any gravelly

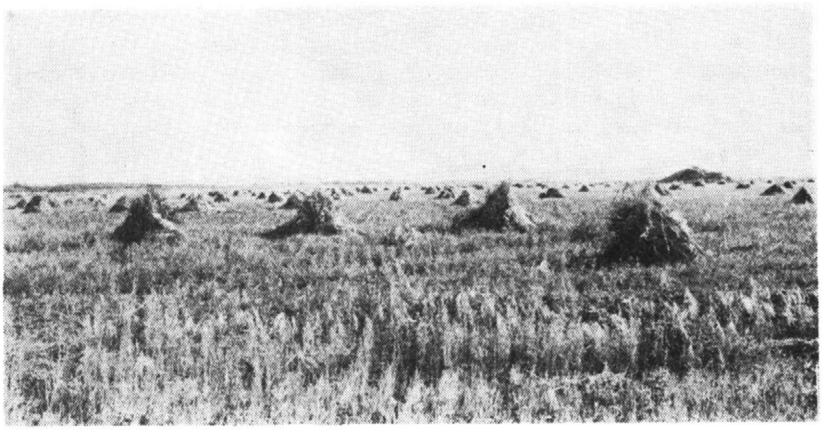


Figure 25—Barley crop in a Codesa soil area near Whitemud Creek. September 1954.

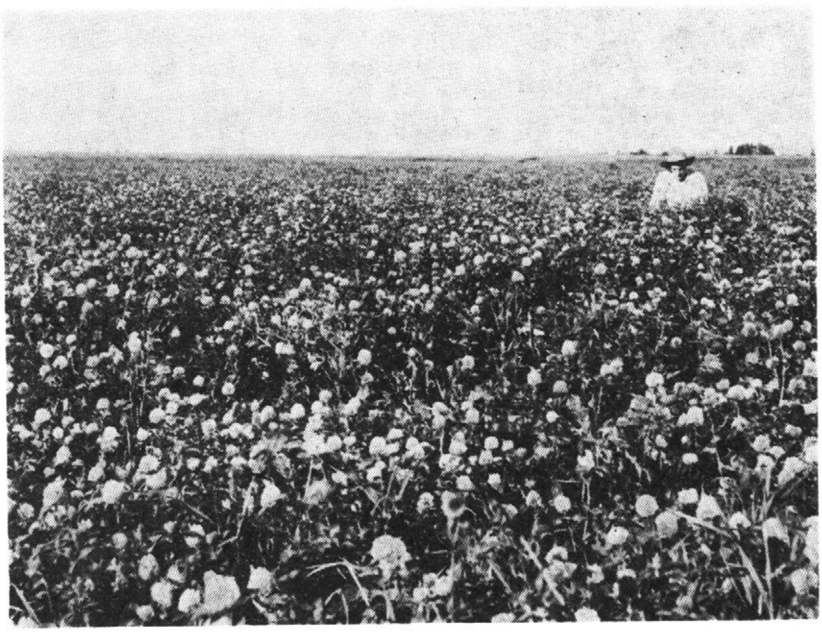


Figure 26—Altaswede clover crop in a Peoria soil area near Crooked Creek. August 1951.

contact layer overlying the D horizon. Following is a description of a profile typical of the Codesa series:

Horizon	*Thickness in inches*	*Description*
A_0	2	Dark brown to black organic debris. pH 6.1.
A_1	2	Light brownish grey loam to sandy loam having some firmness. Often absent. pH 6.4.
A_2	4	Light yellowish brown loamy sand to fine sandy loam, coarse platy to weakly platy. pH 5.3.
B-C	10	Yellowish brown loamy sand to sandy loam, weak blocky to nuciform, occasionally stratified and usually some evidence of compaction. Gravel lenses and stones may occur. pH 5.0.
D	at 18 below surface	Dark greyish brown to brown till in which lime is found at depths of 30 to 36 inches below the surface. pH 7.0.

Soil Rating: Generally fair to fairly good arable soils. The gravelly or stony phases are usually non-arable.

Agricultural Use: Comparatively few of the Codesa soil areas are under cultivation in the mapped area. (See Cultivation Map, Fig. 4.) Those that are very gravelly or stony should not be cultivated. Those that are being farmed in the vicinity of Sturgeon lake are producing satisfactory crops. Codesa soils are fairly loose and tend to have a low fertility reserve. It is essential therefore that the fibre and organic matter content of these soils be maintained. The heavy textured and often compact underlying material is usually better supplied with the required mineral plant nutrients than the sandier upper deposit. Deep-rooted legumes will help to open up this compact substratum, and will help to replenish the supply of plant nutrients in the upper deposit. Supplementary applications of fertilizer may also prove beneficial in establishing a mixed farming agriculture on these soils.

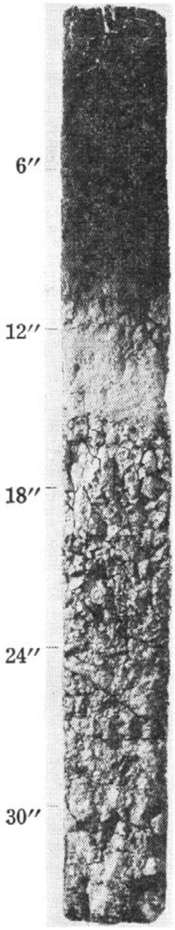
(b) Peoria Series (Pe.): Degraded Black to Black (weakly structured) sandy loam to silt loam.

Extent and Occurrence: There are about 46,000 acres in which Peoria soils are predominant. They are found, chiefly, in the vicinities of Grande Prairie and Goodwin.

Topography: Mainly level and undulating, chiefly with simple slopes.

Drainage: Generally moderately well drained soils but the underlying heavier textured material tends to restrict drainage, with the result that the lower part of the overburden often appears to be poorly drained.

Native Vegetation: Parkland consisting of grasses and scattered bluffs of black poplar, apsen poplar, willow, and occasional spruce.



Profile Description: A weakly developed profile on sandy to silty, fairly uniform parent material that is usually 12 to 24 inches thick and overlies lacustro till. In many cases it appears to be of loessic origin. The upper part of the A horizon is dark brown to black in color while the lower part is usually yellowish brown in color and may be weakly platy. Following is a description of a medium textured Peoria soil profile.

Horizon	*Thickness in inches*	*Description*
A_1	6	Dark brown to black loam, weakly prismatic. pH 6.7.
B	6	Yellowish brown to dark yellowish brown very fine sandy loam to silt loam. Slight evidence of platy structure in upper part of this horizon. pH 6.7.
C_{11}	6	Brown to yellowish brown fine sandy loam to loam, weakly blocky. pH 7.5.
C_{12}	8	Yellowish brown to reddish brown loamy sand, often iron stained and may have a thin gravelly lens in the lower portion. pH 8.0.
D below	at 26 surface	Dark grey clay, mottled and frequently laminated. Lime is often found in the upper 6 inches of this material. pH 8.2.

Soil Rating: Usually good to very good arable soils.

Agricultural Use: Most of the Peoria soils are being used for grain crop production. However, the inclusion of fibre and the maintenance of organic matter are essential to the continued successful utilization of these soils. Moreover, while the heavy textured substratum tends to improve the moisture-holding capacity of the deeper Peoria soils, it may restrict water and root penetration when it occurs within depths of about 18 inches below the surface. Deep-rooted legumes that will penetrate and open up this substratum should improve this soil.

(c) Belloy Series (Be.): Degraded Black to Black (weakly structured, often gravelly) sandy loam to loam.

Extent and Occurrence: There are several areas, making up a total of about 32,000 acres, in which Belloy soils are predominant. They are found chiefly in the vicinities of Sexsmith, Grande Prairie, and Sturgeon lake. They are often found on the slopes of the till areas.

Topography: Undulating to rolling consisting of long simple slopes.

Drainage: Generally imperfectly drained soils in which there is an impervious substratum and often a fairly high water table.

Native Vegetation: Parkland, consisting of grasses and scattered bluffs of black poplar, aspen poplar, willow, and occasional spruce.

Profile Description: Belloy soils are generally more variable than Peoria soils, and frequently have gravelly lenses and stones. The depth to the underlying heavier textured material is quite variable and may be somewhat shallower than that of Peoria soils. They are found in association with other soils developed on till or lacustro-till materials, particularly those found adjacent to stream courses or laking basins. Following is a description of an average Belloy soil profile:

Horizon	*Thickness in inches*	*Description*
A_0	1	Very dark brown to black organic debris. pH 7.8.
A_1	6	Black in the upper part grading to brown in the lower part, sandy loam to silt loam, weakly prismatic, friable. pH 7.0.
A_2	3	Light yellowish brown sandy loam, weakly platy to coarse platy, friable. pH 5.8.
B-C	6	Yellowish brown sandy or silt loam, very little structure, occasional gravelly lenses or some stones. This horizon varies considerably in texture and thickness. Gravelly or stony layer is very common at contact with underlying material. pH 6.3.
D at 12 to 24 below surface		Dark greyish brown to yellowish brown till in which lime is found at depths of 24 to 30 inches. pH 7.4.

Soil Rating: Generally good arable soils. The stony or gravelly phases are not particularly desirable.

Agricultural Use: Belloy soils have a fairly high native fertility but they can deteriorate fairly rapidly unless the fibre and organic matter content are maintained at a fairly high level. Wherever possible they should be cultivated across rather than up and down the slope. The inclusion of grasses and deep-rooted legumes should improve this soil considerably. Grasses will return fibre while the legumes will also aid in opening up the compact D horizon, and in replenishing the nutrient reserves in the upper horizons.

E. Soils Developed on Coarse Outwash and Shoreline Materials

These materials are coarse textured and often quite gravelly or stony. They are found as islands of varying size in association with the till areas, along some of the lower slopes of these areas or along the shore line of some of the laking or flood plain basins. Soils of the *Clouston* and *Grouard* series are formed on such coarse textured variable material. They are usually sandy and may be gravelly or stony. Their subsoil may contain thick gravel lenses or may be a deep deposit of gravel and cobble stones. The following are descriptions of the principal soils formed on this type of parent material:

(a) Clouston Series (Cl.): Grey Wooded (weakly structured) gravelly or stony loamy sand to sandy loam.

Extent and Occurrence: There are about 12,000 acres in which Clouston soils are predominant. They occur as relatively small islands in various parts of the mapped area and are generally found in association with Codesa and Braeburn soils. On the north slopes of the till area north of Sturgeon lake there is a fairly extensive Clouston soil area.

Topography: Variable, may consist of low ridges or long uniform slopes.

Drainage: Well drained to excessively drained soils.

Native Vegetation: Woodland, consisting of fairly heavy stands of aspen poplar and spruce.

Profile Description: Clouston soils are gravelly and stony soils that have a leached profile similar to that of other Grey Wooded soils. They usually have a lime accumulation horizon within 48 inches of the surface. Following is a description of an average Clouston profile:

Horizon	*Thickness in inches*	*Description*
A_0	2	Very dark greyish brown leaf litter. pH 7.4.
A_1	2	Greyish brown to brown coarse sandy loam, stony, weak blocky. pH 7.2.
A_2	3	Pale brown to light yellowish brown loamy coarse sand, weak platy. pH 5.3.
B	24	Brown and yellowish brown coarse sandy loam and loamy sand. Weak structure but some evidence of compaction. Gravelly and stony. pH 6.0.
B_{ca}	at 31	As above but with lime accumulation particularly on the undersides of the stones or pebbles. pH 7.0.

Soil Rating: Generally poor to fair arable soils.

Agricultural Use: Soils with gravelly subsoils are droughty since they have a low water-holding capacity. They also have a low fertility reserve. Unless the gravel and stone accumulation occurs at depths greater than 12 inches below the surface, such soils are not suited for crop production. If the gravel is deeper and the topography suitable, they may be fair arable soils. There are some gravel pits in the Clouston soil areas and some of these appear to be of commercial importance.

(b) Grouard Series (Gr.): Degraded Black to Black (weakly structured) gravelly or stony loamy sand to sandy loam.

Extent and Occurrence: There are only about 3,000 acres in which Grouard soils are predominant. They occur in relatively small islands adjacent to some of the stream courses and on some parts of the shore adjacent to Sturgeon lake.

Topography: Undulating to rolling, often consisting of long uniform slopes.

Drainage: Well drained to excessively drained soils.

Native Vegetation: Parkland consisting of grasses and bluffs of poplar, willow, and occasional spruce.

Profile Description: Except for a thicker and darker colored A_1 horizon, Grouard soils are otherwise the same as Clouston soils. Following is a description of a typical Grouard soil profile:

Horizon	*Thickness in inches*	*Description*
A_0	1	Very dark brown leaf litter. pH 7.2.
A_1	6	Brown to very dark brown coarse sandy loam, weak blocky, stony or gravelly. pH 7.0.
A_2	2	Pale brown to yellowish brown loamy sand, weak platy. Variable in thickness and may be absent. pH 6.2.
B	18	Brown and yellowish brown sandy loam and loamy sand strata that are often gravelly and stony. Weak structure but some compaction. pH 6.8.
B_{ca}	at 27	Pale brown to yellowish brown coarse sandy loam to loamy sand, very little structure, gravelly and stony. Lime accumulation, particularly on undersides of pebbles and stones. pH 7.8.

Soil Rating: Poor to fairly good arable soils.

Agricultural Use: These soils have a low water-holding capacity and are, as a consequence, droughty soils. They range from non-arable to fairly desirable agricultural soils, depending on the topography and on the nearness of the gravel to the surface. If gravel is deeper than 12 inches below the surface and the soils are cultivated, consideration should be given to maintaining the organic matter. The inclusion of both grasses and clovers in the crop rotation will help to maintain the organic matter content, and improve the water-holding capacity of these soils. Generally those soils in which the gravel is closer than about 12 inches from the surface should be seeded to permanent pasture.

Gravel pits of commercial importance are found in some of the Grouard soil areas. Such pits are found in the areas adjacent to the Smoky river and in the vicinity of Cornwall creek south of Crooked Creek.

F. Soils Developed on Residual and Modified Residual Materials

In the mapped area, there are two types of parent material that are developed from or on disturbed bedrock material. In the northern till areas, on some of the faces of steep slopes, there are outcrops of yellowish brown sandstone. The soils developed in these relatively small areas have a distinct yellowish brown color and have pieces of sandstone throughout their profile. In the vicinities of Valleyview, Debolt and Kleskun hills, Solonetz soils are of common occurrence. They appear to be closely underlain by saline, sandy shale, even though the upper portion of the solum may be developed from a till-like material. Exposures are found within a few feet in many of the steep slopes in these regions, and it would appear that the bedrock has exerted a major influence in the development of this parent material.

1. Yellowish brown to brownish yellow sandstone.

This material is found on some of the steep slopes of the till area in the northern portion of the mapped area, and on some of the higher elevations in the southwestern portion of the area.

(a) Teepee Series (Tp.): Grey Wooded and Podzolized Grey Wooded sandy loam to loam.

Extent and Occurrence: There are several small areas making up a total of about 6,000 acres, in which Teepee soils are predominant. Elsewhere in the mapped area they are of significant occurrence in association with some Codesa and Braeburn soils.

Topography: Gently rolling to hilly, frequently consisting of long uniform slopes.

Drainage: Moderately well drained soils that often have an excessive surface drainage.

Native Vegetation: Woodland, consisting of variable stands of aspen poplar, spruce, occasional pine and willows.

Profile Description: Teepee soils have a strong brown to yellowish brown B horizon in which occasional sandstone fragments are found. The texture of the profile is quite variable and may vary from sandy loam to clay loam depending on the character of the underlying sandstone or the degree of weathering. The following is a description of a Teepee soil profile found in the area northeast of Teepee Creek:

Horizon	*Thickness in inches*	*Description*
A_0	2	Dark brown organic debris. pH 6.6.
A_1	1	Brown sandy loam, often absent. pH 6.0.
A_2	3	Light brown to very pale brown very fine sandy loam. pH 5.5.
B_{11}	12	Strong brown to yellowish brown loam to clay loam, friable but firm when dry. pH 4.7.
B_{12}	8	Yellowish brown loam grading to sandy loam in lower part, friable. pH 5.0.
C		Yellowish brown, soft, semi-decomposed sandstone. pH 7.0.

Soil Rating: Poor to fairly good arable soils, depending on the depth to the underlying sandstone, and the topography.

Agricultural Use: Teepee soils are often quite shallow. These, and those occurring on the steep slopes, should not be cultivated. On undulating crowns, often found in association with Braeburn soils, Teepee soils with a deep solum should respond favorably to mixed crop farm management. At the present time there are no areas of Teepee soils that are being farmed.

2. Saline, Sandy Shale.

Solonetz-like soils of the *Debolt, Valleyview,* and *Kavanagh* series are formed on materials derived primarily from saline, sandy shales of the Wapiti formation. In many cases the unaltered bedrock may be found within a few feet. Usually the parent material consists of till having a high content of saline sandy shale residues, and as a result, is often hard or cemented. Following are descriptions of the principal soils formed on this type of parent material:

(a) Debolt Series (Db.): Grey Wooded (Solonetz to Solodized Solonetz) clay loam.

Extent and Occurrence: There are about 28,000 acres in which Debolt soils are predominant. They are found chiefly in the vicinity of Debolt, and near Smoky Heights.

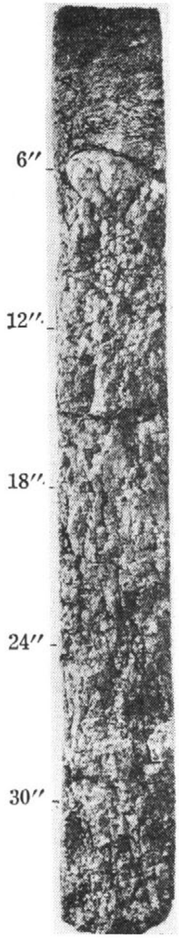
Topography: Undulating and gently rolling, usually consisting of long uniform slopes.

Drainage: Imperfectly drained soils that may have a somewhat excessive surface run-off.

Native Vegetation: Woodland, consisting of somewhat stunted aspen poplar and various shrubs.

Profile Description: Debolt soils have a greyish surface horizon underlain by a subsurface horizon that is relatively impervious to both root and water penetration. The material in the B horizon consists of a very hard till that is cemented by the weathered products of the underlying bedrock. The lower part of the solum may consist of residual material derived from the Wapiti formation. Following is a description of a typical Debolt soil profile:

Horizon	*Thickness in inches*	*Description*
A_0	1	Very dark brown organic debris. pH 5.9.
A_1	1	Very dark grey brown clay loam weakly granular to crumb. Often absent. pH 4.8.
A_2	4	Grey brown to grey silt loam, platy grading from fine in top portion to coarse in lower portion. pH 4.6.
$A_3(B_1)$	1	Light grey brown to light grey clay loam, nuciform—perhaps former parts of the B_2 horizon. pH 5.0.



Horizon	Thickness in inches	Description
B_{21}	6	Grey brown to dark grey brown clay, strongly columnar, top portion indurated, remainder very hard blocky. pH 4.5.
B_{22}	7	Dark grey to grey clay, massive, small, hard blocky. pH 7.1.
C_{ca}	6	Grey—with occasional dark grey strata—clay, small blocky, hard. pH 7.9.
$C_{(D)}$		Grey to light grey clay, small blocky to fragmental largely residual material. pH 8.0.

Soil Rating: Poor to fair arable soils.

Agricultural Use: Debolt soils are inferior agricultural soils. Their firm, hard subsoil is relatively impervious to both water and root penetration. To cultivate with any degree of satisfaction, this hard subsoil must be opened up either at the time of breaking or by growing deep-rooted crops such as sweet clover. Very few areas of these soils are presently cultivated. The gently sloping portions of these soil areas seem preferable in that they permit satisfactory surface drainage.

(b) Valleyview Series (Vv.): Degraded Black to Black (Solodized Solonetz to Solonetz) clay loam to clay.

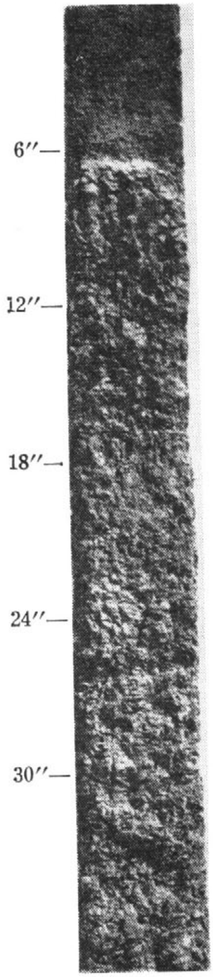
Extent and Occurrence: There are about 39,000 acres in which Valleyview soils are predominant. They occur near Valleyview and near Clairmont and Sexsmith, principally in association with some of the Landry and Esher soils.

Topography: Undulating to gently rolling, consisting usually of long fairly uniform slopes.

Drainage: Imperfectly drained soils that may have a somewhat excessive surface run-off.

Native Vegetation: Parkland, consisting of grasses and often sparse stands of aspen poplar, willow, and occasional spruce.

Profile Description: Valleyview soils are somewhat similar to Debolt soils but they have a darker and deeper A horizon. Their B horizon is not usually as compact nor does it usually have the dark stained cleavage faces common to Kavanagh soils. Following is a description of a typical Valleyview soil profile:



Horizon	Thickness in inches	Description
A_0	1	Very dark brown organic debris. pH 6.1.
A_{11}	3	Very dark grey loam, weak granular to crumb. pH 5.6.
A_{12}	3	Dark greyish brown to brown loam to very fine sandy loam, weak granular to platy. pH 5.6.
A_3	1	Grey very fine sandy loam, platy. pH 5.6.
B_{21}	2	Very dark greyish brown clay, very hard to indurated blocky upper portion of columns. pH 6.4.
B_{22}	10	Dark reddish brown to very dark greyish brown clay, hard, fine to medium blocky with occasional very dark grey stains on the cleavage faces and frequent root mats. pH 6.2.
B_{ca}	8	Greyish brown to brownish grey clay to clay loam, weak blocky, fairly firm, moderate lime. pH 7.8.
B_{SO_4}	8	As above, but tending to more pronounced horizontal cleavage. Contains chips of sandy shale and pockets of salts. pH 7.9.
C	at 30 to 40 from surface	Dark grey clay loam, nuciform to blocky, firm, horizontal cleavage tending to occasional laminations. Chips of sandy shale, coal and angular stone fragments common. pH 7.6.

Soil Rating: Generally fairly good arable soil.

Agricultural Use: Most of the Valleyview soil areas are being farmed. (See Cultivation Map, Fig. 4.)

While the subsoil is not usually as impervious as that of Kavanagh soils, it nevertheless seriously interferes with root and water penetration. This subsurface layer must be rendered more friable through the incorporation of additional organic matter. Deep-rooted crops such as sweet clover should materially assist in opening up and thereby improving the structure of these soils.

Most of the areas now under cultivation have long, fairly uniform slopes. Such areas of Valleyview soils are particularly vulnerable to water erosion. Maintaining the organic matter at fairly high levels, improvement of water penetration through the growing of deep-rooted crops, and cultivation across the slopes wherever possible, are essential considerations to the successful utilization of these soils.

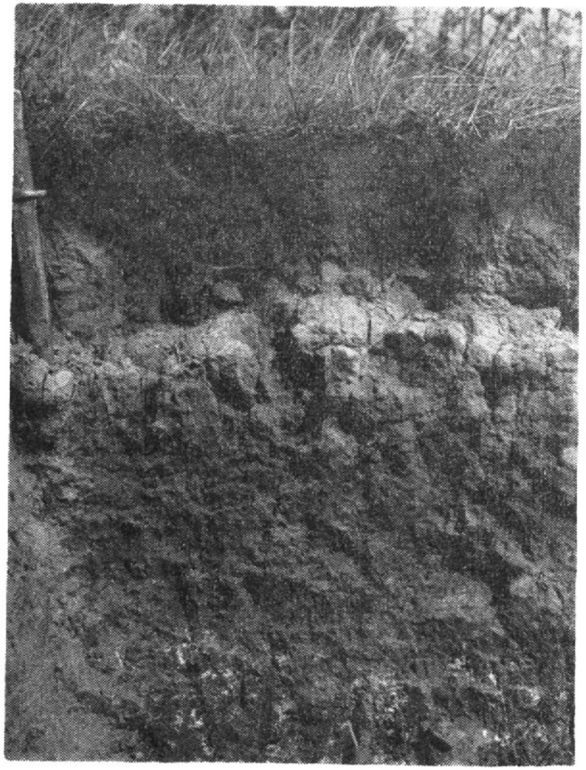


Figure 27—Black, Solodized Solonetz profile typical of the Valleyview series.

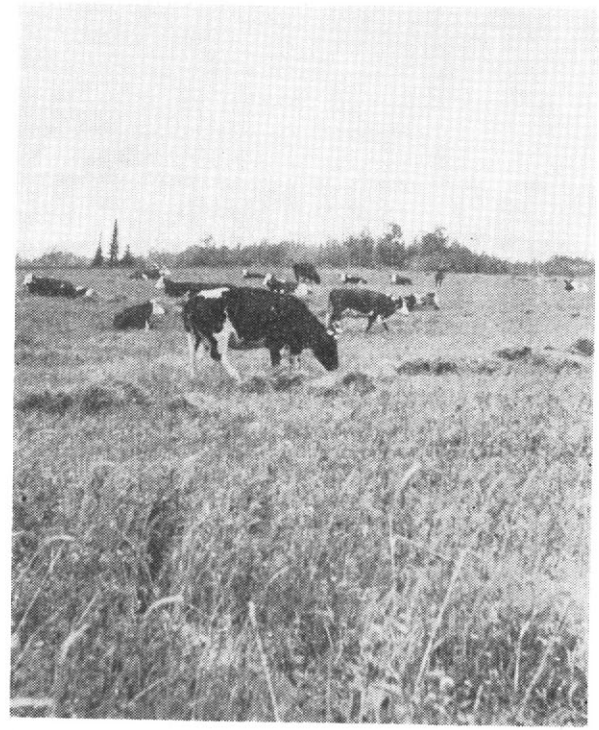


Figure 28—Good forage crops are raised on Kavanagh soils in the vicinity of Bad Heart and in the Kleskun hills.

(c) Kavanagh Series (Kv.): Degraded Black to Black (Solonetz) clay loam.

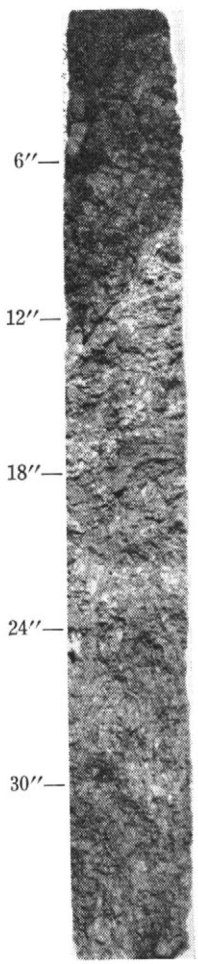
Extent and Occurrence: Occurring principally in the Kleskun hills east of Clairmont, there are approximately 7,000 acres in which Kavanagh soils are predominant.

Topography: Undulating to hilly, consisting of both simple and complex slopes.

Drainage: Imperfectly to poorly drained soils that in many cases have an excessive surface run-off.

Native Vegetation: Parkland, consisting of grasses that may include some of the salt grasses and scattered bluffs of willow and stunted or scrub poplar.

Profile Description: Kavanagh soils have a thin, dark colored surface horizon underlain by a subsurface horizon that is relatively impervious to both root and water penetration. While there is usually a fairly heavy concentration of salts in the lower part of the B horizon, there appears to be very little lateral movement of these salts. Soils with surface salt concentrations or salt crusts do not often occur in association with Kavanagh soils. Following is a description of an average Kavanagh soil profile:



Horizon	*Thickness in inches*	*Description*
A_1	4	Greyish brown to very dark brown loam to silt loam. Very little structure but considerable firmness due to organic fibre. The lower part of this horizon may be somewhat greyer in color or it may sometimes have a thin A_2 horizon. pH 6.7.
B_2	8	Dark greyish brown to dark grey clay loam, very firm to indurated round topped columns, strong fine to medium blocky. Very dark grey to black staining along cleavage faces. pH 8.1.
B_3	6	Greyish brown to dark greyish brown clay loam, massive, blocky to nuciform, fairly firm, variable till-like material. pH 9.2.
B_{ca} & SO_4 at 12 to 20		Greyish brown to dark greyish brown clay loam to loam, nuciform, friable. Occasional sandy streaks, ironstone nodules and coal flecks. pH 8.9.

Soil Rating: Poor to fair arable soils.

Agricultural Use: Kavanagh soils are inferior agricultural soils. Their very firm dark colored subsurface horizon is relatively impervious to both water and root penetration. To cultivate them with any degree of satisfaction, this hard layer must be opened up either at the time of breaking or by growing deep-rooted crops such as sweet clover. The former method does not appear too satisfactory since the power required for deep plowing in these soils tends to make the operation too costly. Deep-rooted crops, however, can often be grown to very good advantage. Their long tap roots tend to penetrate the hard layer and facilitate drainage and aeration. The addition of green manure and the gradual mixing in of the surface soil and organic matter will in time improve the structure of this undesirable subsoil. The undesirable characteristics of Kavanagh soils are particularly apparent following heavy rains and during prolonged dry spells, in those areas that have level or depressional topography.

G. Organic Soils

Organic soils of the *Eaglesham* and *Kenzie* series are found in many of the low-lying poorly drained areas. They occur in patches of varying size associated with practically all of the soil series mapped in this area.

Organic soils have an accumulation of organic matter that exceeds a thickness of about 12 inches. The organic matter may be derived mainly from the partial decomposition of sedges and grasses or of mosses. For the purposes of this report, Organic soils are classified as sedge peat or moss peat soils depending on the dominant characteristics of the organic accumulation. No attempt is made at classifying them according to the textural characteristics of the D horizon. Following is a description of the principal Organic soils mapped in the Grande Prairie and Sturgeon lake sheets.

(a) Eaglesham Series (Eg.): Peat fine and mainly of sedge origin.

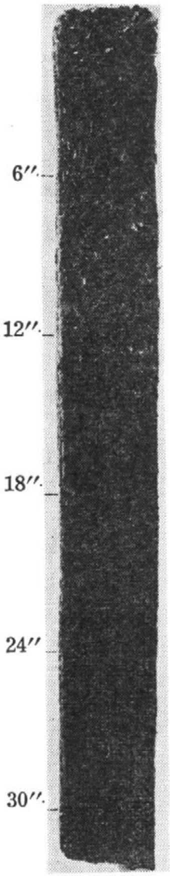
Extent and Occurrence: Occurring in scattered patches throughout the mapped area, there are about 48,000 acres in which Eaglesham soils are predominant. Numerous small areas are not indicated on the published map.

Topography: Level and depressional.

Drainage: Poor to very poor.

Native Vegetation: Sedges and coarse grasses, with occasional willow bluffs.

Profile Description: The solum of Eaglesham soils consists of an accumulation of peat, the greater part of which appears to be derived from sedge and grass remains. Separation into horizons is made on the basis of color and degree of decomposition. The thickness of the peat varies but seldom exceeds 36 inches in the mapped area. Following is a description of an Eaglesham profile commonly found in some of the poorly drained portions of medium to heavy textured soil areas:



Horizon	*Thickness in inches*	*Description*
1	**16**	Dark brown to brown partially decomposed sedge and rush remains. pH 5.8.
2	**8**	Dark brown to black fairly well decomposed sedge and rush remains. May be wet. pH 6.8.
3	**4**	Black, well decomposed peat in which there are few recognizable leaf and stem remains. Usually very wet. pH 7.3.
G	**10**	Light brownish grey to grey clay, usually wet and very sticky. Fine granular and fairly compact when dry. Numerous rusty stains or streaks. pH 7.8.
D_{ca}	**at 30 to 40**	Grey to dark grey clay, fine granular, moderate lime. Rusty stains or streaks are common particularly in the upper part of this horizon. pH 7.9.

Soil Rating: Non-arable unless reclaimed.

Agricultural Use: In many portions of the wooded areas, some of the shallower Eaglesham soils are among the first soils to be cultivated, particularly if they occur in areas of sufficient size to be farmed. Usually tree growth is not an impediment to cultivation and the only requirement is that of trenching to provide drainage. However, they are "cold" soils on which oats are often grown for greenfeed during the first few years of cultivation. When they become opened up and their drainage and aeration sufficiently improved, coarse grains can be grown successfully.

The deeper Eaglesham soils in which the organic accumulation exceeds a thickness of about 30 inches, and those in which the D horizon may be excessively stony or sandy, should not be cultivated. They can usually be of great value in storing and conserving water. The conservation of such areas will do much towards replenishing the ground water supplies of this area.

(b) Kenzie Series (Kz.): Peat coarse and mainly of moss origin (muskeg).

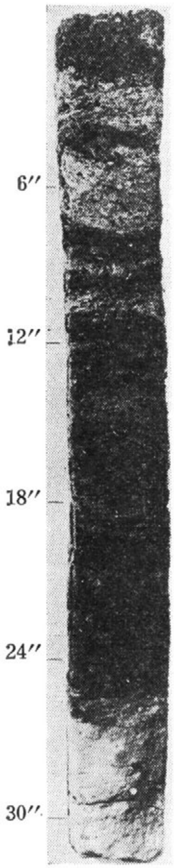
Extent and Occurrence: There is a total of about 195,000 acres in which Kenzie soils are predominant. They occur in patches of varying size scattered throughout the mapped area, and are particularly prominent in association with the sand areas adjacent to the Wapiti river. Only the larger areas of these soils were outlined in this survey.

Topography: Level and depressional.

Drainage: Very poor, may be wet to the surface.

Native Vegetation: Sphagnum moss, occasional sedges, labrador tea, cranberries, and variable stands of black spruce, tamarack, birch, and willow.

Profile Description: The organic material of Kenzie soils is usually much coarser and woodier than that of Eaglesham soils. It consists predominantly of moss peat which is usually much more acid in reaction than the sedge peat. The thickness of the peat accumulation is quite variable. It seldom exceeds 60 inches and may average about 36 inches. The following is a description of an average Kenzie soil profile found in association with many of the medium to heavy textured soils:



Horizon	*Thickness in inches*	*Description*
1	8	Dark brown to brown moss peat that is usually coarse and woody and often contains tree root and stem remains. pH 4.7.
2	10	Strong brown to dark yellowish brown peat containing recognizable remains of mosses and tree roots. Occasional thin, darker colored bands of sedge peat are common. Often wet. pH 4.3.
3	8	Dark brown to very dark brown fairly well decomposed peat that often contains recognizable stem and woody remains. Often very wet. pH 4.8.
G_{11}	9	Light yellowish brown to light brownish grey fine sandy loam, coarse blocky and very firm when dry. Occasional rusty streaks. pH 6.8.
G_{12}	6	Grey and light brownish grey clay, wet and very sticky. When dry it is massive, very firm tending to fine granular. Contains rusty stains and streaks. pH 7.0.
D_g	8	Greyish brown clay, fine granular, firm. pH 7.2.

Soil Rating: Non-arable unless reclaimed.

Agricultural Use: After drainage Kenzie soils are inferior agricultural soils. The woody nature of the peat makes it difficult to prepare a desirable seed bed. Their acid condition tends to interfere with the proper decomposition of the peat and may adversely affect the growth of some crops. Most of the Kenzie soil areas are not being cultivated at the present time.

Natural peat deposits play a very important part in the storage and conservation of water. They act like sponges in soaking up much of the spring run-off and rain water and holding it in storage. This water is then released gradually to streams and drainage basins. Peat bogs therefore tend to have a regulating effect in maintaining the water level of streams and local water tables, and in preventing

Figure 29—Cover typical of the Kenzie soil areas (moss peat bogs).

Figure 30—Cover typical of the Eaglesham soils area (sedge peat bogs).

the erosion that occurs when large volumes of water are suddenly spilled into a stream channel. From the standpoint of moisture conservation and flood control, it would appear extremely desirable that at least the larger and deeper of these natural reservoirs be protected and permanently withheld from cultivation.

AGRICULTURAL PROBLEMS

Land Development

Tree cover is the major impediment to agricultural development in this area. Through the use of adaptable power equipment, however, methods are being developed to bring about a rapid, efficient, and more economical improvement of bush lands. The cost of clearing, piling and breaking vary with the size and density of tree cover, the size of the equipment and the efficiency of the operator. In the mapped area, the custom charges in 1955 averaged from $10.00 per hour to $15.00 per hour (depending on the size of the machinery used) for clearing and piling, and about $9.00 per acre for breaking. Fairly open areas or areas with a light tree cover can be cleared at the rate of about 4 acres per hour, whereas in those areas that have a fairly heavy tree cover the rate of clearing may not exceed 1 acre per hour.

While power clearing has speeded up the development of new areas, it still is a relatively costly undertaking to the average new settler. As a result, desirable soil areas that have a fairly heavy tree cover are often passed up in favor of areas that are open or have a light tree cover. Frequently such areas are at considerable distance from transportation and market facilities. Some also consist of inferior agricultural land. In many cases, the absence of tree cover is the direct result of repeated forest fires. Since there are numerous suitable soil areas, adjacent to settlement, that have a fairly dense stand of both fire-killed and green poplar, some consideraton might be given to opening up such areas through a program of supervised and controlled burning. Such a program supplemented by a broadcast seeding of burned over areas with a grass-legume mixture should result in the development of well grassed over fairly open areas at a fraction of the cost required for power clearing. It could also serve to protect areas in which there are stands of commercial timber.

Water Supply

Throughout most of the Peace River area the difficulties experienced in obtaining a suitable well-water supply have long been a matter of grave concern. Dr. R. L. Rutherford's study, as reported in Research Council of Alberta Report No. 21, was made in order to obtain data on the possible underground water resources in the southwestern portion of the Peace River area. According to this report and supported by the observations of the Alberta Soil Survey during the mapping of this area, it would appear that in the mapped area there is some likelihood of obtaining suitable well-water supplies.

Oil exploration companies have found numerous areas in which good ground-water supplies are found. Some of these were in the sections N.E. 1-74-21, N.W. 9-71-24, S.W. 11-73-26. In addition, settlers have found good flowing or artesian wells near Whitemud Creek, near the old Kleskun lake east of Clairmont, and north of the town of Sexsmith. The depth to these flowing ground-water supplies is about 150 feet to about 200 feet. Elsewhere in the area, settlers found suitable ground-water supplies at depths varying from about 50 feet to 200 feet in some of the areas adjacent to New Fish Creek, Valleyview, Sturgeon lake, Crooked Creek, Debolt, Goodwin, Bezanson, Clairmont and Grande Prairie.

Soil Management and Conservation

An enduring agriculture can be established only if constant attention is given to the conservation of our soil resources. This involves careful consideration of the selection of a sequence of crops, the maintenance of soil fertility, and the use of soil and moisture conserving practices that will make the most effective use of rainfall and prevent serious permanent injury to the land.

Throughout the foregoing part of this report reference has been made to considerations that are believed pertinent to the development of an enduring agriculture in this area. Details regarding recommended cropping practices may be obtained from the District Agriculturist, the Experimental Farm at Beaverlodge or the University of Alberta. The following brief discussion of some of the considerations previously referred to may serve as a helpful guide in establishing a profitable and permanent agriculture in this area.

Usually, under native conditions in which the land has a good protecting vegetative cover, erosion is a gradual, normal process that aids in the formation and redistribution of soils. In this area, with its long uniform slopes, it would appear that normal erosion has been quite severe. The extent of the flood plain deposits adjacent to the Little Smoky river and in the valleys adjacent to many of the rivers, and the depth and width of the coulees associated with the numerous streams and rivers in the mapped area, seems to provide proof of the severity of normal erosion in this area. Under cultivation, there is a likelihood of much greater losses from soil erosion. Unless adequate measures are taken to guard against such accelerated erosion, it can become the most potent factor contributing to the deterioration of productive land.

Soils developed under a woodland vegetation are generally low in plant fibre, humus and nitrogen. In addition, a large proportion of the soils in the mapped area has a heavy textured subsoil through which water percolates very slowly. Fortunately, both characteristics can be improved through the judicious use of organic material.

The maintenance of an adequate supply of organic material in the soils of this area is therefore fundamental to good husbandry.

Available plant nutrients are released during the decomposition of organic material. This is one of the principal sources of nitrogen which is obtained from the air by soil bacteria and by bacteria associated with leguminous plants. Nutrient requirements beyond those made available in this way can be supplied through applications of chemical fertilizers.

Humus is another product of the decomposition of organic material. It consists of the very small, more stable portion that remains in the soil. Good tilth and a lasting crumb structure, that is resistant to the destructive action of water and wind, cannot be maintained unless there is a good supply of humus in the soil. Since plowing and cultivation speeds up the rate of decomposition, a continuous systematic return of all available residue is needed to ensure an adequate supply of humus in the soil. Fibrous residues and legume residues appear to be particularly desirable from the standpoint of improving the tilth and aeration of soils and increasing their resistance to soil erosion.

In an area that has a fairly heavy spring run-off and a growing season in which moisture can be a limiting factor in crop production, the conservation of that moisture will not only ensure better yields, but will also help to cut down soil losses due to water erosion. Organic material acts much like a sponge in soaking up water, and maintaining a good supply of organic material will do much towards making the best use of all available moisture. In addition, crop residues that are left on the surface appear to provide adequate protection for the soil against the action of raindrops during hazardous periods of high impact storms. Such cover absorbs the energy of the falling raindrops and prevents the destructive action of rain beating on bare ground. The repeated impact of the falling raindrops and the damaging reactions which the splashing raindrops set in motion may be the chief factors responsible for starting erosion. "Trash cover" farming, first practised in the southern portion of the province in order to prevent wind erosion, is likewise effective against water erosion.

In consideration of the foregoing, it should be apparent that grasses and legumes must have a place in the crop rotations. An awareness of these requirements might also stimulate a greater interest in livestock production. Diversification provides for a stability of income consistent with the best use and continued productivity of our soil resources.

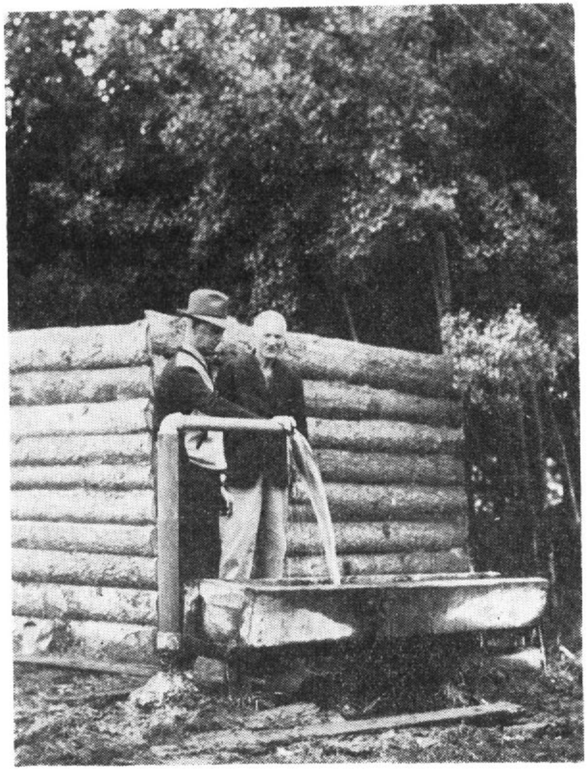


Figure 31—Artesian well about 2 miles north of Sexsmith.

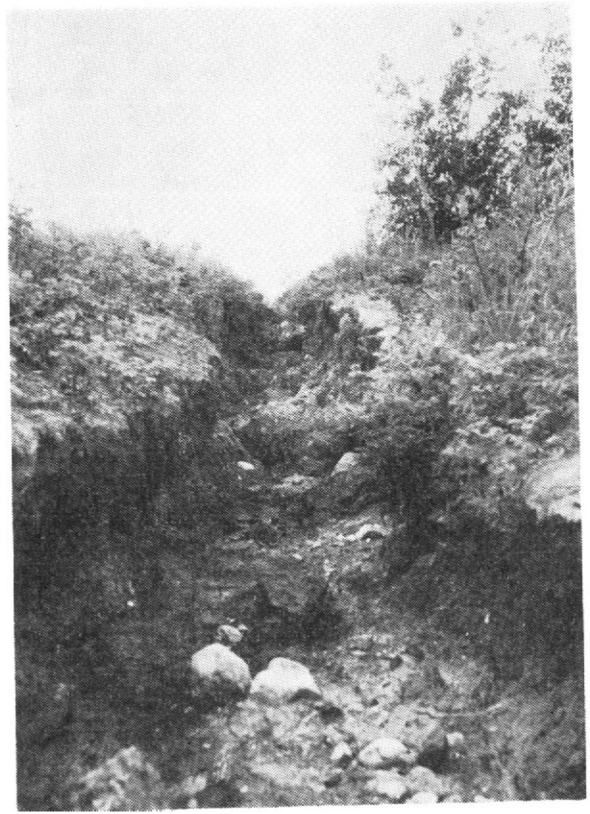


Figure 32—Gully erosion, resulting from the spring run-off in 1951, on a Valleyview soil area having a 3 percent slope.

CHEMICAL CHARACTERISTICS
OF
SOME REPRESENTATIVE SOIL PROFILES

Soil Reaction

Table 7 gives the average and range of reaction in horizons of various soils. The reaction is extremely variable especially in the Grey Wooded and Degraded Black soils. The A_3 and B_2 horizons are usually the most acidic, and frequently vary from about pH 4.5 to pH 6.5. The reaction in the Bca horizon in most of these soils will vary from pH 6.5 to pH 8.0.

Generally the solum of Grey Wooded and Degraded Black soils is somewhat acidic, but applications of lime have not been considered necessary for successful crop production in this area. This may be due to the fact that plants, through their root system, usually bring up sufficient calcium from the lower portions of the profile. However, the low calcium content and the high acid reaction in some soil horizons, would suggest that addition of lime might prove beneficial in some locations.

In the Sturgeon Lake and Grande Prairie sheets there are a few areas that contain an excess of salts sufficiently great to retard plant growth. They occur in the Kleskun and Bear lake basins and on some slopes from the Kleskun hills. There are from 1 to 5 per cent total salts in the uppermost horizons of the soils in this area. The principal salts present are calcium sulphate and sodium sulphate. Injurious effects are caused mainly by the sodium sulphate.

Nitrogen

Since the total amount of nitrogen in a soil usually depends on the organic matter content, the greatest variation may be expected to occur in the upper portion of the profile. The ranges and averages, given in Table 7, show this variation. There is an appreciable difference between soils of different zonal groups mainly because of the variation in thickness of the A_1 horizon. The A_1 horizon of Grey Wooded soils averages about 0.50 percent nitrogen and may range from 0.10 to 0.90 percent. In the Black soils the average nitrogen content is about the same but the range of variability is not as wide.

The lower horizons of the solum contain less nitrogen than the A_1 horizon and tend to vary with soil texture. The B_2 of the heavier textured soils varies in nitrogen from 0.10 to 0.20 percent, while the similar horizons in lighter textured soils contain less than 0.10 percent.

Further comparisons of the averages reported in Table 7 reveal that the average nitrogen content in the surface foot of the mineral horizons of the four Black soils was 0.37 percent, of the two Degraded Black soils, 0.21 percent, and of the six Grey Wooded soils, 0.09 percent. The greatest variation in the average nitrogen content in the surface foot, was in the Grey Wooded soils. It varied from 0.04 percent in the light textured soils to 0.11 percent in the medium to heavy textured soils.

TABLE 7—Averages and Ranges of pH, Nitrogen and Phosphorus of Soil Horizons of Various Soil Series.

Soil Horizon	Av. Thickness in inches	No. Samples Averaged	pH		Percent Nitrogen		Percent Phosphorus	
			Average	Range	Average	Range	Average	Range
Soils developed on glacial till:								
Braeburn Series—Grey Wooded loam to clay loam.								
A_1	1	8	6.6	4.5-7.6	0.42	0.20-0.86	0.10	0.05-0.12
A_2	4	12	5.5	4.4-6.5	0.06	0.03-0.10	0.03	0.02-0.05
A_3	3	10	5.2	4.4-6.0	0.06	0.03-0.09	0.03	0.01-0.05
B_2	10	12	5.0	4.0-6.7	0.06	0.05-0.09	0.03	0.02-0.04
B_3	16	11	5.5	4.2-7.1	0.06	0.05-0.09	0.04	0.03-0.06
C		9	6.8	4.6-7.9	0.06	0.04-0.08	0.06	0.04-0.07
Saddle Series—Degraded Black (Solodic) loam to clay loam.								
A_1	4	4	5.6	5.4-6.3	0.44	0.15-0.80	0.09	0.07-0.12
A_2	3	4	5.3	4.1-5.4	0.07	0.04-0.16	0.04	0.01-0.07
A_3	3	4	4.6	4.1-5.0	0.09	0.05-0.12	0.03	0.03-0.05
B_2	10	4	4.5	4.2-4.8	0.09	0.08-0.10	0.04	0.04-0.05
B_3	10	4	5.1	4.5-6.4	0.08	0.08-0.09	0.05	0.04-0.06
Bca&C		4	7.0	6.1-7.6	0.07	0.07-0.08	0.06	0.06-0.07
Sexsmith Series—Black (often Solodic) loam to clay loam.								
A_1	6	4	6.1	5.1-7.4	0.60	0.37-0.67	0.09	0.08-0.10
A_2	2	4	6.0	5.2-7.5	0.14	0.07-0.22	0.05	0.04-0.07
B_1	2	1	5.0		0.07		0.04	
B_2	12	4	5.6	5.0-6.7	0.10	0.09-0.12	0.04	0.04-0.05
B_3	8	4	5.7	5.4-6.9	0.08	0.06-0.09	0.04	0.04-0.05
Bca&C		4	7.0	5.9-7.8	0.06	0.06-0.07	0.05	0.04-0.06
Soils developed on lacustro-till:								
Donnelly Series—Grey Wooded (Solodic to Solodized Solonetz) clay loam to clay.								
A_1	1	14	6.0	5.1-6.9	0.50	0.10-0.90	0.09	0.04-0.18
A_2	3	16	5.4	4.5-6.9	0.09	0.04-0.20	0.04	0.01-0.06
A_3	2	10	4.9	4.4-6.5	0.10	0.01-0.33	0.04	0.03-0.06
B_2	12	16	5.1	4.0-7.3	0.09	0.06-0.12	0.04	0.02-0.05
B_3	8	14	6.2	4.2-7.7	0.08	0.04-0.12	0.06	0.04-0.08
Bca&C		12	7.2	5.1-7.9	0.07	0.04-0.10	0.06	0.05-0.07
Esher Series—Degraded Black (Solodic to Solodized Solonetz) clay loam to clay.								
A_1	4	8	5.7	4.9-6.9	0.50	0.20-0.80	0.10	0.08-0.12
A_2	3	3	5.5	4.6-6.1	0.05	0.04-0.06	0.03	0.03-0.04
A_3	3	7	4.9	4.3-5.7	0.12	0.06-0.21	0.04	0.03-0.05
B_2	11	8	4.7	4.1-5.7	0.11	0.06-0.14	0.04	0.03-0.05
B_3	11	8	5.9	4.3-7.7	0.09	0.06-0.13	0.06	0.04-0.07
Bca&C		6	7.4	5.0-8.1	0.09	0.06-0.12	0.06	0.04-0.08

TABLE 7—Continued

Soil Horizon	Av. Thickness in inches	No. Samples Averaged	pH Average	pH Range	Percent Nitrogen Average	Percent Nitrogen Range	Percent Phosphorus Average	Percent Phosphorus Range
Landry Series—Black (Solodic to Solodized Solonetz) clay loam to clay.								
A_1	6	6	5.8	5.7-6.0	0.60	0.40-0.70	0.10	0.07-0.12
A_2	2	5	5.7	5.2-6.6	0.19	0.14-0.23	0.06	0.04-0.07
B_1	2	4	5.3	4.8-5.6	0.16	0.14-0.19	0.06	0.05-0.07
B_2	10	6	6.2	5.2-7.9	0.15	0.14-0.17	0.06	0.04-0.07
B_3	7	3	6.3	5.8-6.8	0.14	0.12-0.17	0.06	0.05-0.07
B_{ca}		6	7.8	7.1-8.3	0.09	0.08-0.12	0.07	0.06-0.08
C		5	7.8	7.6-8.2	0.08	0.05-0.09	0.06	0.04-0.08
Goose Series—Meadow (somewhat poorly drained) clay loam to clay.								
A_1	6	6	5.9	5.2-6.7	0.50	0.30-0.70	0.12	0.08-0.15
B_g	10	6	5.7	4.6-7.6	0.15	0.08-0.23	0.06	0.04-0.09
BG-G	10	6	6.1	5.0-7.9	0.09	0.07-0.15	0.07	0.05-0.10
BG & B_{SO_4}		6	7.1	5.7-8.1	0.08	0.06-0.14	0.07	0.06-0.10
C		4	7.6	7.1-7.8	0.07	0.06-0.08	0.07	0.06-0.09
Soils developed on lacustrine deposits:								
Nampa Series—Grey Wooded (Solodic to Solodized Solonetz) silty clay loam to clay.								
A_1	1	11	6.3	5.5-7.1	0.50	0.30-1.00	0.11	0.06-0.15
A_2	3	11	5.4	4.6-6.1	0.10	0.03-0.18	0.06	0.03-0.15
A_3	3	8	5.2	4.6-6.0	0.10	0.07-0.18	0.04	0.03-0.07
B_2	12	11	5.3	4.4-6.6	0.10	0.07-0.13	0.05	0.03-0.09
B_3	8	9	5.6	4.5-7.5	0.09	0.07-0.12	0.07	0.03-0.14
B_{ca}&C		8	7.6	7.0-8.1	0.09	0.07-0.12	0.08	0.07-0.11
Rycroft Series—Black (Solodized Solonetz) silty clay loam to clay.								
A_1	6	6	6.2	5.3-7.0	0.70	0.50-0.80	0.11	0.06-0.18
A_2&A_3	3	5	5.6	4.9-6.3	0.24	0.15-0.39	0.07	0.04-0.13
B_2	10	6	6.4	5.5-7.2	0.20	0.15-0.25	0.09	0.04-0.23
B_3	6	6	6.8	5.9-8.0	0.17	0.12-0.20	0.06	0.04-0.08
B_{ca}&B_{SO_4}		4	7.7	7.4-8.1	0.11	0.09-0.14	0.07	0.07-0.08
Soils developed on alluvial and aeolian deposits:								
Davis Series—Grey Wooded loam to silt loam.								
A_0	2	6	7.2	6.9-7.6	0.60	0.20-1.00	0.07	0.05-0.12
A_2	3	6	6.8	6.2-7.3	0.09	0.07-0.15	0.03	0.02-0.05
B_1	11	6	6.2	5.6-7.9	0.08	0.05-0.09	0.04	0.02-0.09
B_2	6	2	6.5	6.0-7.0	0.06	0.06-0.07	0.05	0.03-0.06
B_{ca}&C		4	8.1	7.8-8.6	0.08	0.06-0.10	0.06	0.06-0.08
Culp Series—Grey Wooded loamy sand to sandy loam.								
A_0	2	2	7.0	6.5-7.5	0.84	0.71-0.98	0.11	0.06-0.15
A_2	6	3	6.8	5.9-7.2	0.04	0.03-0.05	0.04	0.01-0.07
A_3	4	3	6.1	5.7-6.4	0.04	0.02-0.05	0.04	0.02-0.06
B_2	12	3	6.7	6.4-7.2	0.04	0.02-0.05	0.05	0.04-0.05
B_3	6	2	7.2	6.4-8.0	0.04	0.03-0.05	0.04	0.03-0.05
B_{ca}&C		3	7.7	6.6-8.4	0.03	0.02-0.04	0.04	0.03-0.04

TABLE 7—Continued

Soil Horizon	Av. Thickness in inches	No. Samples Averaged	pH Average	pH Range	Percent Nitrogen Average	Percent Nitrogen Range	Percent Phosphorus Average	Percent Phosphorus Range
Soil developed on light textured deposits that overlie other heavier textured deposits:								
Codesa Series—Grey Wooded (weakly structured) sandy loam to silt loam.								
A_0	2	4	6.1	5.5-7.0	0.87	0.42-1.30	0.10	0.08-0.13
A_2	4	5	5.3	4.5-6.5	0.06	0.04-0.08	0.05	0.03-0.07
B&C	10	5	5.0	4.6-5.8	0.04	0.02-0.06	0.04	0.03-0.05
D_1	16	5	5.2	4.9-5.4	0.06	0.04-0.08	0.05	0.04-0.06
D_{ca}		5	7.4	7.2-7.6	0.06	0.05-0.09	0.06	0.05-0.08
Soil developed on residual and modified residual materials:								
Valleyview Series—Black and Degraded Black (Solonetz to Solodized Solonetz) clay loam to clay.								
A_1	5	6	5.6	4.9-6.2	0.60	0.10-0.80	0.11	0.06-0.16
A_2	2	5	5.6	5.0-6.5	0.17	0.07-0.26	0.08	0.05-0.10
A_3&B_1	1	5	5.7	5.0-6.4	0.17	0.11-0.23	0.06	0.04-0.08
B_2	12	6	6.4	4.8-7.6	0.16	0.09-0.24	0.06	0.03-0.07
B_{ca} & B_{SO_4}	10	6	7.8	7.3-8.2	0.08	0.06-0.09	0.06	0.05-0.07
B_{SO_4}&C		4	7.9	7.6-8.1	0.08	0.07-0.09	0.06	0.03-0.08

Phosphorus

Phosphorus is a mineral plant nutrient and the total amount in the soil is related to the soil's parent material. However, in the upper portion of the profile, phosphorus seems to be associated with the organic matter. Generally, soils high in organic matter contain more phosphorus.

Table 7 gives the analyses. The phosphorus content of the A_1 and A_2 horizons of the various soil series are very similar, though the thickness of the horizon differs considerably. Analyses of the parent materials in this area indicate that, while they cannot be considered deficient in phosphorus, the natural supply of many of them tends to be low. The total phosphorus in the lower horizons ranges from 0.14 percent in the heavy textured soils to 0.03 percent in the light textured and more porous soils. Usually soils of the Heart, Culp, and Davis series are lower in phosphorus than the soils of the Braeburn, Donnelly and Nampa series.

The average phosphorus content, calculated on the surface foot of the mineral horizons, of the four Black soils reported was 0.09 percent, of the two Degraded Black soils, 0.06 percent, and of the six Grey Wooded soils, 0.04 percent.

A consideration of both the total nitrogen and total phosphorus content of these soils indicates that these plant nutrients tend to be in relatively short supply. The values for total phosphorus vary in the same direction as do those for total nitrogen but the difference is not so great in degree. Frequently the soils in this area have been found to respond to applications of phosphorus and nitrogen fertilizers.

Sulphur

Investigations conducted by the University of Alberta reveal that in many parts of central Alberta Grey Wooded soils are deficient in sulphur. However, similar tests on soils of this area are incomplete and inconclusive. Various field trials indicate that sulphur may not be deficient on the heavy textured soils, whereas on the lighter textured soils, like those of the Davis and Culp, and perhaps those of the Braeburn series, further trials appear to be desirable. Generally the lighter textured soils tend to be lower in sulphate salts, and the profile is leached to a greater depth. Analyses show that the A_2 and B_2 horizons of some of the Grey Wooded soils will average less than 0.02 percent sulphur while the parent material and salt horizons of some soils frequently run over 0.40 percent sulphur. The response to sulphur of crops grown on such soils, seems to be related to the amount of sulphate in the parent material, and to the depth to which the salts are leached. Since these characteristics are exceedingly variable in this area, the response to application of sulphur may be expected to be quite variable.

Potassium

Potassium is rarely a deficient plant nutrient in Alberta soils. As a consequence a very limited number of analyses have been made to determine the potassium content of various soils. An analysis of a profile typical of the Nampa series showed a potassium content varying from 1.24 percent in the A_2 horizon to 1.73 percent in the C horizon. The other horizons have intermediate amounts and the variation in the amount of total potassium by horizons is much less than that of any other nutrient element.

Silica, Sesquioxide and Mechanical Analyses

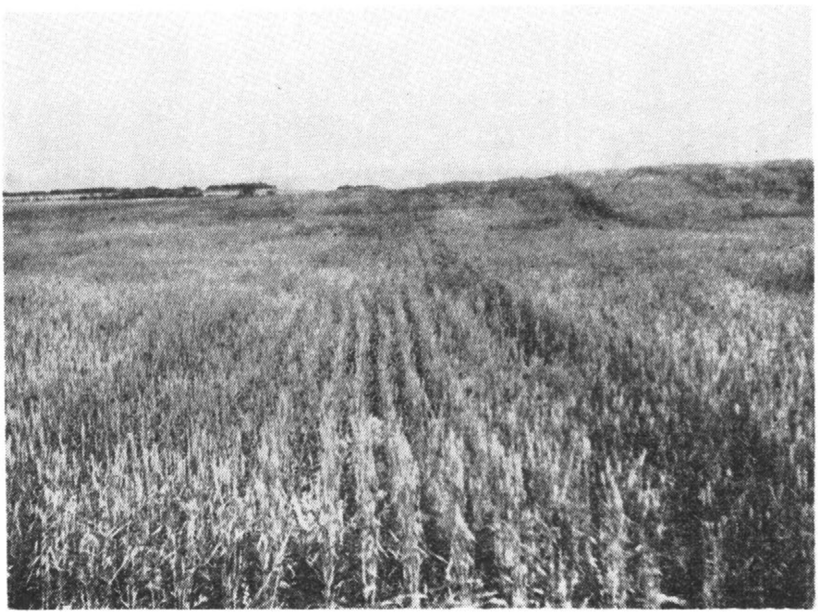
Table 8 gives the silica, sesquioxides and mechanical analyses of some of the representative soil profiles within the area. The silica—sesquioxide analyses were made on the complete soil sample, of which the mechanical analyses are given in the adjacent column.

This table shows a very close relationship between mechanical analyses and the silica—sesquioxide ratio of a soil sample. However, the soil profiles reported show, in varying degree, a tendency for iron and aluminum removal from the A horizon and accumulation in the B_2 horizon. This movement of iron and aluminum from the A horizon to the B_2 horizon is most apparent in the Grey Wooded soils.

The acidity of the various horizons of these soils does not appear to be related directly to leaching as expressed in terms of SiO_2 and R_2O_3 accumulation. In many of the soils analyzed in this area, the upper B horizons are the most acid horizons of the profile. Frequently this is more apparent in some of the Degraded Black soils than in Grey Wooded soils.

—Photo courtesy of C. H. Anderson, Canada Experimental Farm, Beaverlodge.

Figure 33—Plots at the Canada Illustration Station near Debolt show marked responses to application of commercial fertilizer.



—Photo courtesy of the Department of Soil Science, University of Alberta.

Figure 34—Fertilizer trial on wheat near Sexsmith shows that increased yields can be expected from applications of ammonium phosphate at recommended rates. The outer strips (fertilized) out-yielded the centre strip (unfertilized) by about 8 bushels.

TABLE 8—Silica, Sesquioxide and Mechanical Analyses of Some Representative Soil Profiles:

Horizon	Thickness in Inches	pH	Percent SiO$_2$	Percent Fe$_2$O$_3$	Percent Al$_2$O$_3$	$\frac{SiO_2}{R_2O_3}$	Sand, Silt and Clay Ratio
Soils developed on glacial till:							
Braeburn Series—Grey Wooded (Solodic) clay loam, 31-75-4 W 6.							
A_0 & A_1	2	6.4	56.08	2.21	6.50	11.92	......
A_2	6	6.1	84.04	2.63	7.50	15.56	30:55:15
B_1	4	5.7	74.88	4.18	12.90	8.17	18:56:26
B_{21}	10	4.5	69.37	5.28	14.69	6.55	19:54:47
B_{22}	14	4.3	73.97	5.07	11.94	8.26	27:32:41
B_{ca} @	40	7.1	73.57	4.33	12.26	8.30	30:34:36
Sexsmith Series—Black (Solodic) clay loam, 23-73-6 W 6.							
A_0	2	6.0	......	......	......	......	......
A_1	3	5.6	66.43	3.69	13.92	6.92	28:52:20
A_2	2	5.3	73.35	2.99	12.83	8.10	29:38:33
B_{21}	5	5.1	70.17	4.52	15.12	6.61	27:30:43
B_{22}	5	5.0	71.89	4.35	13.78	7.85	28:27:45
B_{23}	7	5.1	70.31	4.67	14.89	6.68	27:31:42
B_3	7	6.0	68.86	4.91	15.58	6.28	27:35:38
B_{ca}	7	7.8	68.26	4.69	15.06	6.42	27:33:40
C @	44	7.7	69.89	3.73	13.99	7.24	32:30:38
Soils developed on lacustro-till:							
Donnelly Series—Grey Wooded (Solodized Solonetz) clay loam, 6-72-26 W 5.							
A_1	2	6.6	52.98	1.60	7.41	10.63	21:63:16
A_2	3	6.9	83.05	1.58	10.27	12.66	24:64:12
B_1	2	6.5	76.11	4.80	12.06	8.56	23:52:25
B_{21}	7	6.3	71.35	4.70	14.50	6.95	25:36:39
B_{22}	8	6.3	67.42	5.39	15.91	5.91	21:35:44
B_3	14	7.0	68.47	4.91	15.97	6.06	21:36:43
B_{ca} & C @	36	7.7	66.58	5.00	16.15	5.87	26:38:36
Landry Series—Black (Solodized Solonetz to Solodic) clay loam, 22-73-6 W 6.							
A_1	7	5.7	63.18	4.04	10.86	7.88	15:49:36
A_2	2	5.6	73.48	3.70	11.37	9.08	22:50:28
B_1	2	5.6	70.21	5.87	12.05	7.54	17:54:29
B_{21}	8	6.7	62.53	5.61	17.54	5.02	11:26:63
B_{22}	6	6.2	64.22	5.35	17.10	5.31	12:27:61
B_{ca}	9	7.9	63.94	4.82	16.37	5.58	13:33:54
C @	48	7:8	64.07	5.69	16.58	5.40	13:27:60
Soils developed on lacustrine clay:							
Kleskun Series—Black (Solonetz) clay, 34-73-4 W 6.							
A_1	2	6.0	58.68	4.69	12.69	6.35	14:32:54
B_{21}	6	5.6	63.83	5.47	14.57	6.00	11:31:58
B_{22}	4	6.2	61.80	5.71	14.75	5.71	10:28:62
B_3	8	7.9	57.28	5.77	16.06	4.93	7:22:71
B_{ca}	16	7.8	59.17	5.81	16.96	4.99	8:24:68
C @	40	7.6	54.21	5.70	16.56	4.56	10:17:73

TABLE 8—Continued

Horizon	Thickness in inches	pH	Percent SiO$_2$	Percent Fe$_2$O$_3$	Percent Al$_2$O$_3$	SiO$_2$ / R$_2$O$_3$	Sand, Silt and Clay Ratio
Soils developed on residual and modified residual materials:							
Debolt Series—Grey Wooded (Solodized Solonetz) clay loam, 25-72-1 W 6.							
A_0 & A_1	2	5.6	70.9	2.14	8.78	11.92	....
A_2	3	4.8	81.3	2.53	9.76	12.09	27:53:20
B_1	1	4.7	76.3	3.45	11.23	9.62	24:46:30
B_{21}	7	4.5	69.8	4.84	14.49	6.76	23:29:48
B_{22}	8	5.0	68.0	5.08	15.70	6.09	24:29:47
B_{ca}	6	7.1	69.3	4.53	14.68	6.71	27:32:41
B_{SO_4}	8	7.5	66.2	4.15	13.58	6.94	34:38:28
Valleyview Series—Black (Solodized Solonetz) clay loam, 14-71-9 W 6.							
A_1	4	5.6	....	4.13	11.33	....	21:49:30
A_2	2	5.6	73.9	4.00	10.45	9.64	23:59:18
B_1	1	5.6	74.6	3.92	11.13	9.28	19:52:29
B_{21}	6	5.7	64.7	5.28	16.43	5.54	11:37:52
B_{22}	6	7.1	62.7	5.27	18.64	5.82	9:35:56
B_{ca} & SO_4	6	7.8	59.0	4.31	18.00	4.82	8:32:60
C_{SO_4}	8	7.9	56.4	3.93	18.61	4.53	9:44:47
D	9	7.8	68.3	4.32	12.76	7.46	28:49:23

APPENDIX

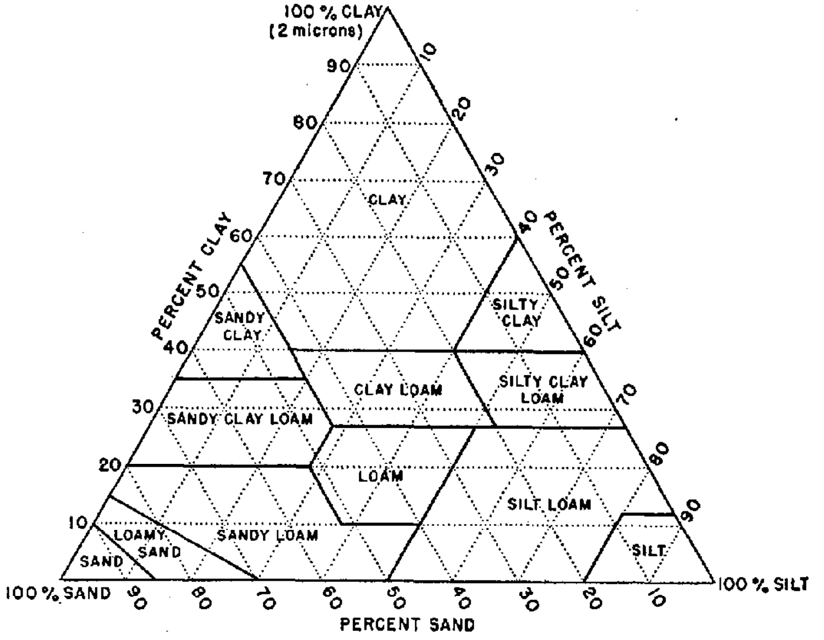
Throughout this report and in field classification frequent use is made of relative terms to describe features of significance in the mapped area. Definitions of some of these terms and the field designations used in this area are as follows:

TABLE 9—Soil Separates (Particle Sizes) on which Textural Classes are Based.

Separates	*Diameter in Millimetres*
Very Coarse Sand (V.C.S.)	2.0 -1.0
Coarse Sand (C.S.)	1.0 -0.5
Medium Sand (S.)	0.5 -0.25
Fine Sand (F.S.)	0.25-0.10
Very Fine Sand (V.F.S.)	0.10-0.05
Silt (Si.)	0.05-0.002
Clay (C.)	less than 0.002

Figure 35—Chart showing Proportions of Soil Separates in Various Soil Textural Classes

From U.S. Department of Agriculture, Bureau of Plant Industry, Soils and Agricultural Engineering Guide for Textural Classification—March, 1948.



A further separation of sands is made according to the prevalence of different sized sand fractions. Medium and coarse sands may contain over 25 percent coarse sand but not over 50 percent fine sands. Fine and very fine sands must contain over 50 percent of the respective fine sand fractions.

TABLE 10—Classes of Stony Land

S_0—*Stone free.*

S_1—*Occasional stones*—no serious handicap to cultivation.

S_2—*Moderately stony*—requiring removal, occasional stone piles in the field.

S_3—*Very stony*—serious handicap to cultivation, frequent stone piles in the field.

S_4—*Excessively stony*—too stony to permit cultivation.

TABLE 11—The Classification of Tree Cover

T_0—*Open land*—trees no handicap to cultivation.

T_1—*Light tree cover*—can be cleared by heavy, crawler type, clearing machinery at a rate of about 4 acres per hour.

T_2—*Medium tree cover*—can be cleared by heavy, crawler type, clearing machinery at a rate of about 2 acres per hour.

T_3—*Heavy tree cover*—can be cleared at a rate of about 1 acre per hour.

T_4—*Excessively heavy tree cover*—preferably left for timber.

Further designations, relating to the prevailing types of trees, are often included in this field classification.

TABLE 12—The Classification of Calcareous Soil Materials

Cc_1—*Slightly Calcareous*—materials usually contain less than the equivalent of 1 percent calcium. Weak effervescence to dilute hydrochloric acid.

Cc_2—*Moderately Calcareous*—materials that contain the equivalent of from 1 to about 5 percent calcium. Moderate effervescence to dilute hydrochloric acid.

Cc_3—*Very Calcareous*—materials that contain the equivalent of from 5 to about 10 percent calcium. Strong effervescence to dilute hydrochloric acid.

Cc_4—*Extremely Calcareous*—materials that contain the equivalent of over 10 percent calcium. Violent effervescence to dilute hydrochloric acid.

Classification of Soil Structure

Single masses of soil consisting of many individual soil particles are called aggregates. Soil aggregates vary in shape and size, and these variations are recognized in classifying the structure of soil profiles. Often one type of aggregate occurs within another. For example, the columnar structure of solonetz soils will break down into smaller aggregates. The *macrostructure* is used to designate the large columnar aggregates and *mesostructure* for the smaller blocky or nuciform aggregates. Still finer subdivisions of structure are referred to as *microstructure*. The following structures are recognized in describing the soil in the field and in this report.

Blocky—Block-like aggregates with sharp angular corners.

Nuciform—Nut-like aggregates with more or less clearly defined edges and faces that are sub-rectangular.

Granular—More or less rounded soil aggregates with an absence of smooth faces and edges, relatively non-porous.

Platy—Thin horizontal plates or aggregates in which the horizontal axis is longer than the vertical.

Columnar—Fairly large aggregates with a vertical axis longer than the horizontal and with fairly well-defined regular edges and surfaces. The tops of the columns are usually rounded. Commonly found in the B horizon of solonetzic soils.

Prismatic—Fairly large aggregates with a vertical axis longer than the horizontal and with fairly well defined regular edges and surfaces. The tops of the aggregates are usually flat.

Massive—Large cohesive masses of soil, almost amorphous or structureless, with irregular cleavage faces.

Vesicular—A soil structure that is characterized by small round or oval cavities or vesicles. *Crumb* structure is the term applied to porous granular aggregates.

Depending on the degree of distinctness, the various grades of structure may be indicated as weak, moderate or strong. Descriptive terms commonly used to denote size of structural aggregates are very fine, fine, medium, coarse or very coarse. Such terms as friable, hard, firm, very firm, etc., refer to the durability of the aggregates to displacement or gentle crushing.

TABLE 13—Classification of Drainage.

Excessively Drained—little retention of moisture by the soil—usually droughty.

Well Drained—Removal of water is not too rapid.

Imperfectly or Somewhat Poorly Drained—drainage slow—often due to an impervious layer and a fairly high water table.

Poorly Drained—Removal of water very slow—soil often remains wet for considerable periods.

Very Poorly Drained—Removal of water is so slow that the water table is at or near the surface.

The foregoing terms are relative and refer in a general way to the natural drainage characteristics of a soil. Specific reference to surface drainage may be designated in terms of run-off and described as high, medium, low or ponded. Similarly specific reference to the characteristics of horizons within the profile may be designated in terms of permeability or percolation characteristics and described as rapid, moderate, slow, very slow or none.

GLOSSARY*

Aeolian deposition—Wind laid material.

Aggregate (soil)—A single mass or cluster of soil consisting of many soil particles held together, such as a prism, granule or crumb, etc.

Alluvium—Water transported, recently deposited material on which the soil forming processes have not acted long enough to produce distinct soil horizons.

Available plant nutrients—Plant nutrients in soluble form, readily available to the plant roots.

Calcareous material—Material containing a relatively high percentage of calcium carbonate. Will effervesce visibly when treated with hydrochloric acid.

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

Cleavage—The capacity of a soil on shrinkage to separate along certain planes more readily than on others.

Concretions—Local concentrations of certain chemical compounds such as calcium carbonate or compounds of iron, that form hard grains or nodules of mixed compositions and of various sizes, shapes and coloring.

Consistence—The relative mutual attraction of the particles in the whole soil mass or their resistance to separation or deformation. Described by such terms as loose, compact, mellow, friable, plastic, sticky, soft, firm, hard and cemented.

Degradation—Change of one soil type to a more leached one.

Drift—Material of any sort deposited in one place after having been moved from another. *Glacial drift* includes all glacial deposits whether unstratified or stratified.

Erosion—The wearing away of the land surface by running water, wind or other geological agents. It includes both normal and accelerated soil erosion. The latter is brought about by changes in the natural cover or ground conditions and includes those due to human activity.

(a) *Sheet*—Removal of a more or less uniform layer of material from the land surface.

(b) *Rill*—A type of accelerated erosion that produces small channels which can be obliterated by tillage.

(c) *Gully*—Erosion-produced channels that are larger and deeper than rills and cannot be obliterated by tillage. Ordinarily they carry water only during and immediately following rains or following the melting of snows.

Flocculate—To aggregate individual particles into small groups or granules, used especially with reference to clay and colloidal behaviour. The reverse of flocculate is deflocculate, commonly referred to as puddling.

Flood Plain—The nearly flat surface subject to overflow along stream courses.

Friable—Easily crushed in the fingers, non-plastic.

Gley Soil—A soil whose solum is either wholly or partly modified by a fluctuating water table. Gleying is a reduction process that takes place in soils that are saturated with water for long periods of time. The horizon of most intense reduction, characterized by a grey often mottled appearance which on drying shows numerous rusty brown iron stains or streaks, is called the G horizon. It is generally very sticky when wet and hard when

*This is not a complete glossary, but is primarily to define some of the terms commonly used in this report.

dry. Those horizons in which the gleying is less intense are often designated as Bg or Cg horizons.

Green manure crop—Any crop that is plowed under for the purpose of improving the soil, especially by the addition of organic matter.

Horizon—A layer in the soil profile approximately parallel to the land surface with more or less well defined characteristics that has been produced through the operation of soil building processes.

Humus—The well decomposed, more or less stable part of the organic matter of the soil.

Impervious materials—Materials which resist the passage of drainage water and plant roots.

Lacustrine materials—Materials deposited by or settled out of lake waters.

Lithosol—A soil having no clearly expressed soil characteristics and consisting of an imperfectly weathered mass of rock fragments.

Mature soil—A soil with well developed characteristics produced by the natural processes of soil formation and in equilibrium with its environment.

Muck—Fairly well decomposed organic soil material relatively high in mineral content, dark in color and accumulated under conditions of imperfect drainage.

Nutrients (Plant)—The elements taken in by the plant, essential to its growth, and used by it in the elaboration of its food and tissue. These include nitrogen, phosphorus, calcium, magnesium, potassium, sulphur, iron, manganese, copper, boron and perhaps others obtained from the soil; and carbon, hydrogen and oxygen obtained largely from the air and water.

Organic Soil—A general term used in reference to any soil whose solum is made up of predominantly organic material.

Peat—Unconsolidated soil material consisting largely of undecomposed to partially decomposed organic matter accumulated under conditions of excessive moisture.

pH—A notation used to designate the relative acidity or alkalinity of soils and other materials. A pH of 7.0 indicates neutrality, higher values indicate alkalinity and lower values acidity.

Podzolization—A general term referring to that process by which soils are depleted of bases, become acid and develop leached A horizons. Specifically the term refers to the process by which Podzol soils are formed and in which the iron and alumina are removed from the upper part of the profile more rapidly than is the silica. This results in the development of a light colored surface horizon and an accumulation of iron, alumina and organic matter in the B horizon.

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

Relief—The elevations or inequalities of a land surface when considered collectively. Minor surface configurations, such as slight knolls, ridges or shallow depressions are referred to as micro-relief.

Solonetzic soils—Soils developed on somewhat saline parent material and characterized by a compact B horizon.

Solodization—A soil forming process that is somewhat similar to podzolization in that the soil becomes acid in the surface horizons and develops a leached A_2 horizon. Through improved drainage and an accompanying decrease in the salt content of Solonetz soils they develop a leached A_2 horizon accompanied by a general breakdown of the hard B horizon that ultimately results in the development of a Solod soil. The process of change of Solonetz to Solod is called "solodization". Whereas Solonetz and Solod soils are of uncommon occurrence, there are a great many soils, having intermediate profile characteristics that are referred to as Solodized-Solonetz soils.

Solum—The upper part of the soil profile, which is above the parent material and in which the processes of soil formation are taking place. It includes the A and B horizons.

Stratified—Composed of or arranged in strata or layers. The term is applied to parent materials. Those layers that are produced in soils by the processes of soil formation, are called soil horizons, while those inherited from the parent material are called *strata*. Thin horizontal layers are often referred to as *laminae,* strata up to about 12 inches in thickness as *bands,* and those over 12 inches are referred to in this report as *beds.*

Terrace—A flat or undulating plain bordering a river or a lake. Many streams are bordered by a series of terraces at different levels indicating flood plains at successive periods. Although many older terraces have become more or less hilly through dissection by streams or wind action, they are still regarded as terraces.

Till—A heterogenous mixture of stones, sand, silt and clay transported by glaciers and deposited during the melting and subsequent recession of the ice front.

Till plain—A level or undulating land surface covered by glacial till.

Varve—A periodic accumulation of sand, silt, and clay deposited in a lake basin. The light colored coarser silt in each varve is at the bottom and represents the initial materials settled in the flooding. The dark colored fine clay at the top is that which settled out slowly in quiet water during the latter stages of flooding. The thickness of a varve averages from 1/8 inch to 1/2 inch or even more and depends on the prevailing conditions of the flooding.

Water table—The upper limit of the part of the soil or underlying material wholly saturated with water.

Weathering—The physical and chemical disintegration and decomposition of rocks and minerals.

Zonal soils—Any one of the great soil groups having well developed soil characteristics that reflect the influence of climate and living organisms, chiefly vegetation. In the surveyed area these groups include the Grey Wooded, Degraded Black and Black soils.