Soil Survey
of
Red Deer Sheet

BY

W. E. BOWSER and T. W. PETERS
Dominion Experimental Farms Service

AND

J. D. NEWTON
University of Alberta

Report No. 16 of the Alberta Soil Survey

Experimental Farms Service, Dominion Department of Agriculture
in co-operation with the
Department of Soils, University of Alberta
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The authors of this report wish to acknowledge their appreciation for assistance and support from the following sources:

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A soil survey is in reality an inventory of the soil resources. Soils vary, one to another: for example, differences in color, texture and structure are often readily seen. They vary also in plant food and salt content. The inherent characteristics of any soil determine its productive capacity and also determine the most desirable methods to be used in farming it.

This report describes the properties of the surface and sub-soil of the various soil types. It describes the topography, drainage, and alkali problems of the area. It also contains a brief discussion of the climate, the agricultural development of the area, and the transportation facilities.

The soil map is part of this report. It is made on the scale of three miles to the inch, and shows not only the different soil types represented by different colors and symbols, but also important physical features such as topography, railroads, streams and towns. The soil map serves as a basis by which the better land can be distinguished from the poorer land, and therefore indicates the most desirable method of utilization. Three other maps accompany this report; one shows the distribution of the cultivated, abandoned, and virgin lands in the area at the time of the survey; one shows the relative productivity of the soil areas; and one shows the areas of similar parent material.

The main part of this report of the Red Deer Sheet describes the properties of the major soil types found in the area. In the write-up of each soil member or type, the first portion gives a description of the area in which the soil is found together with a fairly complete profile description; the second portion gives a brief discussion of some of the agricultural problems relating to that soil type together with some of the more easily recognized features of the soil profile. By using this brief description together with the soil map, it is hoped that the reader will be able to recognize the soil profiles found in his own farm and community. As the successful business man must know his stock of merchandise, so the successful farmer must know the characteristics and requirements of the soil he farms.

The classification of our soil resource into its respective types is necessary before intelligent use can be made of all the other scientific agricultural information now available to our farm people. It is our sincere hope that this report will help to stimulate a better understanding of the soil and its use; an understanding essential to full production without the all too frequent soil erosion.
Note to the Reader

This report, of necessity, must describe the soil types found in the area in specific scientific terminology, since soil workers in other places as well as workers in other sciences make use of these data. However, a great number of non-technical people read this report. An attempt has therefore been made to provide this group of readers with essential information in non-technical terms. The sub-sections on "Agricultural Use" under each soil type are so written, and there is a glossary at the back of this report defining some of the more frequently used scientific terms.

It is suggested that the reader find the name of the soil type on his farm or community from the soil map, and then read the section on its agricultural use in the report. The more technical profile descriptions can be studied at first hand in a nearby road cut.

NOTE: Reports for areas 1 to 6 inclusive are now out of print, but may be obtained on loan from the University Extension Library, University of Alberta, Edmonton.
Soil Survey of Red Deer Sheet

by

W. E. BOWSER*, T. W. PETERS* and
J. D. NEWTON**

DESCRIPTION OF THE AREA

The Red Deer sheet, number 215, is located in Central Alberta and comprises an area approximately 84 miles east and west by 48 miles north and south. More exactly it consists of townships 33 to 40 inclusive within ranges 15 to 28 inclusive west of the 4th meridian (see plate 1).

The mapped area extends in the east from a point 6 miles south of Sullivan Lake to 5 miles south-west of Galahad and in the west from a point 4 miles east of Olds to Gull Lake. The city of Red Deer is near the west side of the area.

The soil map for the area described above represents 114 townships or portions thereof or approximately 2,580,000 acres.

DRAINAGE

The mapped area is drained by the Saskatchewan River system; mainly by Red Deer River, tributary of the South Saskatchewan. The north-east corner is drained by Battle River which flows into the North Saskatchewan. The south-east corner has many inland basins, the largest of which is Sullivan Lake.

Red Deer River enters the area from the south-west in tp. 36 rge. 38 at an elevation of approximately 2900 feet. It flows north-east to Burbank, then east to Nevis and then south to leave the area in tp. 33 rge. 21 at an elevation just under 2400 feet. Up to the big bend at Nevis the valley is, in general, quite wide. The banks, covered with vegetation, slope up gradually and are primarily of glacial or post-glacial materials. There are some arable river flats along this portion of the river mainly in the vicinity of Red Deer. South of Nevis the river has deep steeply eroded banks generally devoid of vegetative cover and of pre-glacial deposited materials. The valley in this latter section averages over 350 feet deep.

Blindman River enters the area from the west and runs into Red Deer River at Burbank just south of Blackfalds. Pariby Creek, north of Alix, drains into Buffalo Lake and Buffalo Lake has a high water drainage into Red Deer River via Tail Creek.

Kneehill, Three Hills and Ghostpine Creeks rise in the moraine between Elnora and Innisfail. They flow in fairly wide, deep valleys.

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in a south-easterly direction out of the area to enter Red Deer River just north-west of Drumheller. It is possible that these creeks represent ice front drainage ways. Ghostpine Lake is near the headwaters of Ghostpine Creek. Big Valley Creek has a fairly deep wide channel mainly grass covered, that drains from Ewing Lake to Red Deer River via Big Valley.

Battle River cuts through the extreme north-east corner of the area. It has a deep eroded valley composed mainly of pre-glacial materials. Redwillow, Bigknife and Paintearth Creeks drain the area north of the Stettler-Halkirk railway line into Battle River. Paintearth Creek has a deep wide valley. It gets its name from the numerous red and yellow burnt shale outcrops that are found in this valley. Redwillow Creek has a fairly shallow wide valley: evergreen trees were found in this valley.

The only flowing well seen was just west of Scollard. Numerous seepages were seen but very few sizable springs. Buffalo Lake (partly in the Red Deer sheet and partly in the Peace Hills sheet to the north) is the largest lake in the area. As stated above, this lake has a high water connection with Red Deer River channel. This valley continues north up Wolf Creek to connect with Battle River at Ponoka. This valley may have been an interglacial connection between Battle and Red Deer Rivers. Delburne Lake at Delburne is a local resort.

Mikwan, Goosequill and Hummock Lakes, that lie between Lousana and Elnora, are inland basins in the moraine. There is considerable fluctuation in their depth. Foxall and Ewing Lakes, west of Ferml, have an outlet through Big Valley Creek. Their depth, however, also fluctuates considerably with the years.

Lowden, Lonepine, Gough, Farrell and Chain Lakes south-east of Stettler are primarily shallow inland basins. In general they are somewhat saline; at times they may be practically dry. Marion and Shooting Lakes have a high water outlet through Bigknife Creek. They, however, are also quite shallow and appear slightly saline. Sullivan Lake, along the east side is also an inland basin and is somewhat saline. At this time (1947) the shore line of Sullivan Lake had receded at least one-half mile.

There are numerous small lakes and sloughs in the area, particularly in the more pronounced moraine; that is from Buffalo Lake south. Many of these dry up during the summer and provide a crop of meadow hay.

**TRANSPORTATION**

The first railway built in this area was the Calgary and Edmonton line now operated by the Canadian Pacific. This line enters the area from the south-west in Township 35 Range 28 going northward through Lindsfall, population * (1269), Penhold (132), Red Deer (3955), Blackfalds (118) and Lacombe (1808).

*With one exception the population figures given in this report are for 1946. The figure for Erskine is for 1941.
The Coronation branch of the Canadian Pacific Railway goes east from Lacombe traversing the northern half of the area passing through the towns of Clive (224), Alix (124), Erskine (172), Stettler (1489), Botha (111), Gadsby (119) and Halkirk (120).

The Brazeau branch of the Canadian National Railway enters the area from the west in Tp. 38, going east through Joffre, Haynes and Alix and then going south-east to leave the area in the southeast corner. On the portion east of Alix there are several sidings and the hamlets of Byemoor and Endiang.

The Calgary-Vegreville branch of the Canadian National Railway traverses the area east of Red Deer River from north to south through Stettler, Big Valley (207), Scollard and Rumsey (88).

The Calgary-Tofield branch of the Canadian National Railway traverses the area west of Red Deer River through Mirror (558), Alix, Delburne (377), Elnora (199), Huxley and Trochu (507).

The Acme branch of the Canadian Pacific Railway enters the area from the south in range 26 to terminate six miles north at Wimborne.

The Canadian Pacific Railway has a line that goes west from Lacombe through Gull Lake and a line that goes west from Red Deer through Sylvan Lake.

The area is, then, fairly well supplied with railroad facilities; most places being within fifteen miles of a railroad.

A hard surfaced highway parallels the Edmonton-Calgary railway line along the west side of the area. A gravelled road links Gull Lake, Lacombe, Alix, Stettler and Halkirk (a portion between Lacombe and Alix is hard surfaced). A gravelled road extends south from Stettler through Big Valley and Rumsey, and one links Mirror, Alix, Delburne and on south through Trochu. A hard surfaced road leads west from Red Deer to Sylvan Lake (west of the surveyed area) and a gravelled road goes east to Delburne. There is gravel on portions of some of the market roads. The area is fairly well supplied with municipal roads although few of these have any gravel surfacing. Red Deer River is crossed by bridges, west of Innisfail, west of Penhold, at Red Deer, east of Red Deer in sec. 13, tp. 38, rge. 26 and just south of Nevis in tp. 38, rge. 22. The next crossing south of the Nevis bridge is about thirty-five miles south via the Rumsey ferry.

AGRICULTURAL DEVELOPMENT

Agriculture in the Red Deer area dates back to about 1880. There is record of a farm in operation in 1882 at Red Deer crossing (three miles west of the present city of Red Deer). In 1883, the year the railway reached Calgary, a stage coach service was inaugurated between Calgary and Edmonton. The following year George Gaetz settled on a farm that is now the site of the city of Red Deer. Two years later he made a trip to Ottawa, taking
samples of grain with him, to discuss the agricultural possibilities of the area with Dr. Saunders of the Dominion Department of Agriculture.

The first white man to travel the Red Deer country was Anthony Hendry. He spent the fall and winter of 1754-55 in the area between Three Hills and Lacombe. Part of the winter was spent along Ghostpine lake. (He referred to it as Archithinue Lake in his diary since it was in the country of the Blackfoot-Indians.) It is interesting to note that his descriptions of the vegetative cover in the area correspond very closely to present cover: that is relatively open prairie between Ghostpine and Three Hills Creeks; wooded country between Innisfail and Ghostpine Lake and mixed deciduous and coniferous trees along the lake. His diary indicates that the country abounded in beaver, deer, elk and buffalo. The names Buffalo lake, Waskasu (Red Deer) and Ponoka (Elk) indicate the more recent occurrence of these animals.

Father Lacombe (Père Albert Lacombe), who came west in 1852, was a frequent visitor to this area, while ministering to the Blackfoot and the Cree Indians. (The town of Lacombe was named in his honor.)

The Calgary-Edmonton railway was built in 1890-92 and real settlement of this area immediately followed, first along the railway and later to the east and west. There was a sizable ranch established near Buffalo Lake by 1897 and about 1902 the settlement of Blumenau was started. Three years later the railway came from Lacombe and the name was changed to Stettler in honor of one of the original settlers. The Calgary-Camrose railway line through Alix, Elnora and Trochu was built shortly afterwards.

The census of 1901 showed less than 5,000 acres of wheat in the area covered by the Red Deer sheet. By 1910 this acreage had increased to nearly 75,000 acres, most of it adjacent to the Calgary-Edmonton railway line. Table I gives the acreage in crop in the census years between 1920 and 1945. This is broken down according to zones. It is noted that the high in cropped acres occurred in 1940 with an overall total of 590,000 acres. The decrease in 1945 was due, in part, to the wheat acreage reduction programme. If it is assumed that approximately one-third of the land is in fallow each year, there are approximately 675,000 acres of cultivated land in the area. The second part of Table I shows the distribution by crops. The significant fact brought out by this table is the marked change from wheat to coarse grains in the black and thin black zones. Wheat is still the principal crop in the dark brown zone.

The cultivation map (see Plate V) shows the distribution of the cultivated acreage on this sheet. With the exception of some of the rougher moraine areas and the Torlea soils north-west of Sullivan Lake, cultivation is spread fairly uniformly over the mapped area; most of the quarter sections, however, have less than 140 acres cultivated. Some of the uncultivated area is water, some rough
land and some tree covered. There is, however, some fairly good land that could still be brought under cultivation. The leaving of woodlots and windbreaks is a valuable asset and should be encouraged. From the cultivation map it is also seen that there are approximately 360 quarter sections of abandoned land—land that once has been cultivated. This is an overall area of 60,000 acres. Much of this is in the dark brown soil zone with the greatest concentration on the Torlea soils. The two other concentrations are in the rougher Hughenden loams east of Big Valley and the Elnora loams in the moraine east of Elnora.

### TABLE I
Acreage in crop in the Red Deer Sheet

<table>
<thead>
<tr>
<th>Year</th>
<th>Total acres of grain crops by zones</th>
<th>Dark Brown</th>
<th>Thin Black</th>
<th>Black</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1920</td>
<td></td>
<td>71,500</td>
<td>129,000</td>
<td>127,000</td>
<td>327,500</td>
</tr>
<tr>
<td>1925</td>
<td></td>
<td>105,000</td>
<td>170,000</td>
<td>169,000</td>
<td>444,000</td>
</tr>
<tr>
<td>1930</td>
<td></td>
<td>128,000</td>
<td>213,000</td>
<td>219,000</td>
<td>550,000</td>
</tr>
<tr>
<td>1935</td>
<td></td>
<td>101,000</td>
<td>210,000</td>
<td>229,000</td>
<td>540,000</td>
</tr>
<tr>
<td>1940</td>
<td></td>
<td>120,000</td>
<td>215,000</td>
<td>255,500</td>
<td>590,500</td>
</tr>
<tr>
<td>1945</td>
<td></td>
<td>99,000</td>
<td>175,500</td>
<td>216,000</td>
<td>490,500</td>
</tr>
</tbody>
</table>

Acreage by Principal Crops

<table>
<thead>
<tr>
<th>Year</th>
<th>Dark Brown</th>
<th>Thin Black</th>
<th>Black</th>
</tr>
</thead>
<tbody>
<tr>
<td>1925</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1935</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1945</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

From the available records it is estimated that the average wheat yield in the dark brown zone has been about 12 bushels per acre, in the thin black zone 16 bushels and in the black zone between 19 and 20 bushels per acre. The average yield of oats as computed from the census year yields has been 22 bushels, 26 bushels and 31 bushels per acre for the respective zones, barley has yielded 19 bushels, 21 bushels and 22 bushels per acre respectively. The oat and barley yields show less zonal significance than do the wheat yields. These yields cover all soil types and many different farm practices. Some of the better soil types have given higher yields than this and many individual farmers have exceeded these averages.

### TOPOGRAPHY

The Red Deer Sheet lies half-way up the third prairie steppe and its topography is mainly undulating to gently rolling. In general the Red Deer Sheet can be divided into three main topographic units. The area in the north-east corner bounded roughly by Red Willow, Erskine, Gough Lake and Sullivan Lake, is mapped as depressional to gently undulating. Over much of this area there is a thin mantle of ground moraine: the underlying bedrock, how-
ever, comes practically to the surface north-west of Sullivan Lake and adjacent to Paintearth Creek. The west side of this plain is approximately 200 feet higher than the east side.

The second topographic unit is mainly the Beaverhills Moraine. This runs approximately north and south and covers an area from Red Willow, Erskine, Endiang and Scapa on the east to Knee Hills Creek and just east of Red Deer and Lacombe in the west. The Beaverhills Moraine reaches its greatest width in this mapped area, being approximately 70 miles across at its widest point. This moraine is, in general, mapped as gently rolling to rolling. There are, however, numerous hilly areas scattered throughout the area.

The third topographic unit is a relatively level area bounded on the east by a line running north along Knee Hills Creek just east of Red Deer and Lacombe, and extending west to the 5th meridian. This part of the area is mapped gently undulating to gently rolling topography. It is low moraine that has been subjected to much water sorting. In this area there are a few fairly high crowns that have local bedrock cores: Antler hill is an example of these. The west side of the mapped area has an elevation of from 3250 feet in the south-west corner to 3000 feet in the north-west corner; the east side has an elevation of from 2700 in the south-east corner to 2350 feet in the north-east corner. There is therefore a rise of about 500 feet in elevation from east to west. The high points are in tps 37 and 36, rges 25 and 26, east of Penhold (about 3400 feet), and the low point is in the Battle River channel, tsp 40, rge 15, just under 200 feet.

Four topographic classes are shown on the soil map by means of a hatched legend, namely level to undulating, gently rolling, rolling and hilly. The data in Table II give the acreage and percentage distribution of the main topographic classes mapped on the Red Deer Sheet. Approximately 45 percent of the area is mapped as level to undulating (the unhatched portion) and well over half of this is nearer level than undulating. As stated earlier the largest area of this topography class lies in the north-east corner.

Approximately 24 percent is mapped as gently rolling. Land of this class offers very little obstruction to cultivation. Most of the slopes are between 5 to 9 percent and therefore the soils on this topography type do not offer a water erosion problem. However, since the slopes are gentle, up to now very few precautions have been taken to prevent water erosion. Most of this gently rolling topography is associated with the terminal moraine which covers a large portion of the area.

Rolling land makes up approximately 16 percent of the mapped area. If other conditions are favorable rolling land is considered arable. This topographic class includes low choppy hills and fairly high ridges with long uniform slopes, most of the slopes being between 10-15 percent. In the rolling areas of higher rainfall constant consideration should be given to danger of water erosion. Numerous
small lakes and sloughs are characteristic of the rolling and hilly areas.

All the hilly land mapped lies within the Beaver Hills Moraine. The largest areas lie east of Scollard and Rumsey (see Plate 3, fig. 2) and west of Delburne along Red Deer River. Most of these areas are non-arable; the slopes generally being steep and broken. They are pasture lands. Overgrazing of these lands will result in water erosion and loss of carrying capacity. Most of the northern slopes are tree covered: the southern slopes generally have more of a parkland cover, particularly in the west half of the area.

The areas colored red on the soil map are eroded lands totalling approximately 4 percent of the area and are confined chiefly to the river and stream courses. In general, they are steep slopes and non-arable. Some are tree covered, some are grass covered and many are bare bedrock exposures: the last being of greatest percentage. That is, eroded land refers to geologic erosion and not to the erosion of presently cultivated fields.

### TABLE II.

<table>
<thead>
<tr>
<th>Division</th>
<th>Acres</th>
<th>% of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hilly</td>
<td>395,600</td>
<td>7.6</td>
</tr>
<tr>
<td>Rolling</td>
<td>415,000</td>
<td>16.1</td>
</tr>
<tr>
<td>Gently Rolling</td>
<td>620,000</td>
<td>24.0</td>
</tr>
<tr>
<td>Level and Undulating</td>
<td>1,118,000</td>
<td>43.3</td>
</tr>
<tr>
<td>Eroded Lands</td>
<td>102,000</td>
<td>4.0</td>
</tr>
<tr>
<td>Water and marshes</td>
<td>150,000</td>
<td>5.9</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>2,580,000</strong></td>
<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>

### SOIL FORMING FACTORS

This section of the report gives a brief discussion of the principal factors responsible for forming the soils mapped on the Red Deer sheet. The long time climatic conditions that have prevailed, have induced a particular vegetative growth. These two interrelated external forces acting on the original surface mantle of the earth have produced the present soil profile. Since the soil profile is the basis of soil classification, a study of the soil-forming factors operative in this area is essential.

### CLIMATE

The climate of the Red Deer sheet varies somewhat from west to east. The variation, however, is mainly in the amount of total precipitation, in general there being a decrease in rainfall from west to east. Also there is, in general, a lower mean winter temperature towards the eastern side of the province. Although the weather records are for a relatively short period of time, the variation in soil profile and vegetation would indicate that this decrease in total precipitation has existed for a considerable length of time. The
soil's solum varies from thick in the west to relatively thin in the eastern section. The vegetative cover changes from practically open prairie on the east side to parkland in the west; along the west side there are sizable areas of practically continuous forest.

All the meteorological data given in this report are compiled from the Dominion meteorological records. Reports from the following stations are included: Rocky Mountain House about forty miles west of the western boundary of the surveyed area and in the Grey Wooded Soil Zone; Olds and Alix in the Black Soil Zone and Stettler in the Thin Black Soil Zone.

Table III gives the average monthly seasonal and annual precipitation at Alix, Olds, Stettler and Rocky Mountain House. In this table the year is divided into three sections namely, the previous fall, winter and growing season. This is done because it is thought that the previous fall's plus the growing season's moisture is fairly closely related to the crop growth obtained. The figures in table III indicate a decrease in precipitation from west to east, that is from the Grey Wooded Zone to the Thin Black Zone. No stations are reported for the Dark Brown Zone. Sedgewick, which lies northeast of the area and between the Thin Black and Dark Brown Zones, has an eighteen year average of 14.35 inches. This would appear to be about average for the Dark Brown Zone in the north central part of the province. There is, therefore, approximately five inches decrease in total precipitation from west to east.

**TABLE III.**

Precipitation in inches

<table>
<thead>
<tr>
<th>Period</th>
<th>1906-46</th>
<th>1916-46</th>
<th>1918-46</th>
<th>1917-46</th>
</tr>
</thead>
<tbody>
<tr>
<td>September</td>
<td>1.43</td>
<td>1.77</td>
<td>1.90</td>
<td>2.24</td>
</tr>
<tr>
<td>October</td>
<td>0.81</td>
<td>0.98</td>
<td>0.64</td>
<td>1.05</td>
</tr>
<tr>
<td>Previous Fall</td>
<td>2.24</td>
<td>2.73</td>
<td>2.54</td>
<td>3.59</td>
</tr>
<tr>
<td>November</td>
<td>0.91</td>
<td>0.70</td>
<td>0.71</td>
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</tr>
<tr>
<td>December</td>
<td>0.75</td>
<td>0.52</td>
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</tr>
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<td>March</td>
<td>0.94</td>
<td>0.75</td>
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</tr>
<tr>
<td>Winter</td>
<td>4.09</td>
<td>3.25</td>
<td>2.72</td>
<td>3.43</td>
</tr>
<tr>
<td>April</td>
<td>0.90</td>
<td>1.15</td>
<td>1.12</td>
<td>1.01</td>
</tr>
<tr>
<td>May</td>
<td>1.82</td>
<td>2.65</td>
<td>1.84</td>
<td>2.01</td>
</tr>
<tr>
<td>June</td>
<td>3.01</td>
<td>3.25</td>
<td>2.97</td>
<td>3.75</td>
</tr>
<tr>
<td>July</td>
<td>2.66</td>
<td>2.49</td>
<td>2.53</td>
<td>2.73</td>
</tr>
<tr>
<td>August</td>
<td>2.03</td>
<td>2.58</td>
<td>1.72</td>
<td>2.97</td>
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<tr>
<td>Growing Season</td>
<td>10.21</td>
<td>11.45</td>
<td>10.23</td>
<td>12.37</td>
</tr>
<tr>
<td>Total</td>
<td>16.54</td>
<td>17.43</td>
<td>15.49</td>
<td>19.09</td>
</tr>
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</table>
A large percentage of the precipitation that falls during winter months in Alberta is lost by evaporation in the winter and during the spring run-off. As a result the moisture that falls throughout the previous fall and growing season in the main determines the crop produced. Fortunately in Alberta a large percentage of the annual precipitation comes during this effective period. From the figures in table III it can be calculated that 75 percent or over of the annual moisture falls during this effective period for all the stations reported.

Table IV gives the distribution of snowfall at Alix and Rocky Mountain House. It is interesting to note that for the recorded period August has been the only snow free month at Rocky Mountain House and July and August the only ones at Alix.

At all the stations reported in table III June is the month of highest rainfall with July and August about equal and only slightly lower than June. These are the important growing months. However, there must be sufficient reserve moisture to carry the crop into June, hence the necessity for conserving the previous fall’s precipitation. Between five and six inches fall during June and July in most of the Red Deer area, and this with some reserve moisture in the spring is usually sufficient to produce a fair crop.

During the period 1920 to 1941 at Olds the previous fall’s plus growing seasons rainfall has varied from 6.87 inches to 19.57 inches (see table V). During that period three years were below 10.00 inches (and it is likely 1924 was also below); these might be considered as drought years. During the same period at Alix five years were below 10.00 inches and at Stettler four years were...
below and four only slightly above the 10.00 inch mark. That is, the frequency of drought years increases from west to east.

Although annual precipitation figures are of value, their interpretation must consider certain factors. It may be said that below a certain minimum precipitation it is practically impossible to grow a crop and that what rain does fall has a low efficiency factor. However, it should be remembered that such factors as rainfall distribution, the amount of evaporation, the soil type, and the type of farm management influence the efficiency of the rainfall. In general an equal amount of rainfall is more effective in the northern part of the province than in the southern. This is due to a lower rate of evaporation. The factors of soil type and farm management are discussed elsewhere in this report.

**TABLE V.**

*Previous Fall plus Growing Season Precipitation*

<table>
<thead>
<tr>
<th>Year</th>
<th>Rocky Mt.</th>
<th>House</th>
<th>Olds</th>
<th>Alix</th>
<th>Stettler</th>
</tr>
</thead>
<tbody>
<tr>
<td>1907</td>
<td>15.37</td>
<td>9.74</td>
<td>11.60</td>
<td>10.50</td>
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</tr>
<tr>
<td>1908</td>
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<td>8.99</td>
<td>11.99</td>
<td>12.70</td>
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<td>1909</td>
<td>12.35</td>
<td>9.71</td>
<td>8.59</td>
<td>12.50</td>
<td></td>
</tr>
<tr>
<td>1910</td>
<td>12.97</td>
<td>8.10</td>
<td>5.33</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1911</td>
<td>13.55</td>
<td>12.62</td>
<td>12.62</td>
<td>15.80</td>
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<tr>
<td>1912</td>
<td>11.56</td>
<td>11.28</td>
<td>15.24</td>
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<td>15.33</td>
<td>15.30</td>
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<td>10.55</td>
<td>15.35</td>
<td>12.62</td>
<td>16.70</td>
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<td>1918</td>
<td>14.40</td>
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<td>16.62</td>
<td>16.70</td>
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<td>1919</td>
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<td>15.64</td>
<td>16.62</td>
<td>16.70</td>
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<tr>
<td>1920</td>
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<td>15.69</td>
<td>16.62</td>
<td>16.70</td>
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<td>1925</td>
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<td>15.73</td>
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<td>1929</td>
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<td>15.74</td>
<td>16.62</td>
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</tr>
<tr>
<td>1930</td>
<td>15.60</td>
<td>15.75</td>
<td>16.62</td>
<td>16.70</td>
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</tr>
<tr>
<td>1931</td>
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<td>15.76</td>
<td>16.62</td>
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<tr>
<td>1932</td>
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<td>15.77</td>
<td>16.62</td>
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<tr>
<td>1933</td>
<td>15.90</td>
<td>15.78</td>
<td>16.62</td>
<td>16.70</td>
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</tr>
<tr>
<td>1934</td>
<td>16.00</td>
<td>15.79</td>
<td>16.62</td>
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<tr>
<td>1935</td>
<td>16.10</td>
<td>15.80</td>
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<tr>
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<td>15.81</td>
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<tr>
<td>1937</td>
<td>16.30</td>
<td>15.82</td>
<td>16.62</td>
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<td>15.84</td>
<td>16.62</td>
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<tr>
<td>1940</td>
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<td>15.85</td>
<td>16.62</td>
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<td>1941</td>
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<td>15.86</td>
<td>16.62</td>
<td>16.70</td>
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<tr>
<td>1942</td>
<td>16.80</td>
<td>15.87</td>
<td>16.62</td>
<td>16.70</td>
<td></td>
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</tbody>
</table>
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. It must be noted that the frost-free period is ended as soon as the temperature reaches 32°F. Yet this temperature will not damage most crops. Thus the frost-free period is not, in general, as long as the growing season. Frost will vary with changes in relief or topography. In a statistical atlas published by the Dominion Bureau of Statistics in 1931 the killing frost is placed at 29°F. The authors prepared a map on this basis from which it is shown that Lacombe has about 105 days and Stettler between 110 and 115 days killing frost-free. Using 32°F as the limit of the frost-free period Lacombe has about 79 days (32 years average); Alix has 90 days (15 years average). Although early frosts do occur occasionally in the surveyed area, in general it can be stated that frost is not a serious handicap to cereal production.

Wind data have been taken at Lacombe and should be fairly representative of this area. Table VI gives a summary of wind velocity and direction for Lacombe and other centres in the province.

**TABLE VI.**

<table>
<thead>
<tr>
<th></th>
<th>Total Av.</th>
<th>Pre-</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
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<td></td>
<td>annual</td>
<td>Av.</td>
<td>direction</td>
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<td></td>
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<tr>
<td></td>
<td>mileage</td>
<td>miles/hr.</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Medicine Hat</td>
<td>78,000</td>
<td>8.9</td>
<td>W. &amp; E.W.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lethbridge</td>
<td>100,000</td>
<td>11.5</td>
<td>W.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calgary</td>
<td>79,000</td>
<td>9.0</td>
<td>N.W.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lacombe</td>
<td>30,000</td>
<td>4.5</td>
<td>Variable</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fairview</td>
<td>61,000</td>
<td>7.0</td>
<td>W.</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
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</tbody>
</table>

From the table it can be seen that at Lacombe there is no definite prevailing wind direction and also that the total average annual mileage is the lowest of the stations reported. Winds of gale proportions are relatively infrequent in this area.

Edmonton receives about 2200 hours of bright sunshine per year out of a possible total of approximately 4450 hours. Records from 1916 to 1947 at Lacombe show an average of 2150 hours of sunshine, varying from a low of approximately 1900 hours in 1932 to a high of over 2400 hours in 1928. Records at Olds from 1925 to 1947 show an average of 2070 hours of sunshine from a low of near 1800 to a high of approximately 2275 hours.

The climate of this sheet is characterized by moderately warm summer and relatively cold winter temperatures. Table VII gives the monthly, seasonal and annual mean temperatures for stations on or near the surveyed area. The mean temperatures reported in this table are the average temperatures for the month. The yearly mean for the sheet is between 35°F and 36°F, with a winter mean of about 17°F and a growing season mean of about 51°F. Over the area July is, on the average, the warmest month and January and
February the coldest months. In general the summers are warm and permit rapid growth. This area is on the northern edge of the main Chinook belt and is therefore somewhat influenced by these winds.

**TABLE VII.**
Monthly, seasonal and annual mean temperatures (degrees F.) at Stettler Olds and Rocky Mountain House

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>September</td>
<td>45.3</td>
<td>47.3</td>
<td>47.0</td>
</tr>
<tr>
<td>October</td>
<td>39.0</td>
<td>40.4</td>
<td>40.0</td>
</tr>
<tr>
<td>Previous Fall</td>
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<td>42.4</td>
<td>39.0</td>
</tr>
<tr>
<td>November</td>
<td>21.2</td>
<td>25.2</td>
<td>21.0</td>
</tr>
<tr>
<td>December</td>
<td>13.3</td>
<td>16.5</td>
<td>11.7</td>
</tr>
<tr>
<td>January</td>
<td>12.7</td>
<td>11.4</td>
<td>9.8</td>
</tr>
<tr>
<td>February</td>
<td>12.2</td>
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<tr>
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<td>20.4</td>
<td>22.0</td>
</tr>
<tr>
<td>Winter</td>
<td>16.4</td>
<td>17.0</td>
<td>15.6</td>
</tr>
<tr>
<td>April</td>
<td>38.1</td>
<td>38.0</td>
<td>37.2</td>
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</tr>
<tr>
<td>June</td>
<td>56.2</td>
<td>52.4</td>
<td>54.0</td>
</tr>
<tr>
<td>July</td>
<td>61.3</td>
<td>60.3</td>
<td>59.4</td>
</tr>
<tr>
<td>August</td>
<td>59.0</td>
<td>54.0</td>
<td>55.7</td>
</tr>
<tr>
<td>Growing season</td>
<td></td>
<td>59.3</td>
<td>59.3</td>
</tr>
<tr>
<td>Year</td>
<td>36.0</td>
<td>35.4</td>
<td>34.8</td>
</tr>
</tbody>
</table>

**VEGETATION**

This description of the native vegetation of the Red Deer area is confined to the dominant vegetation in each of the three major soil zones, i.e., the Black, the Thin Black and the Dark Brown. The prime purpose is to list the dominant native vegetation in each of these three zones as it is found today. This recognizes the fact that the present vegetative cover may or may not be the same type of vegetation existing during the formation of the present soil profiles found in these zones. There is quite naturally a gradation or tension belt between the vegetative zones, just as there is between the soil zones, so that any line drawn is necessarily arbitrary. There are, however, recognizable vegetative differences between the zones proper. In general, there is a change from the long grass prairie on the east side to practically continuous forest on the west side.

The eastern edge of the main Grey Wooded Soil Zone lies just west of the mapped area. This Zone is characterized by a dominance of fairly heavy tree cover, with the native grasses occurring mainly in the lower areas. Some of the trees are large enough to be of commercial value. Small islands of grey soil occur on the west side of the area. These have a fairly heavy cover of poplar
(mainly aspen) but, in general, the trees are not as large as in the
main zone farther west.

The Black Soil Zone occupies the west and west central portion
of the mapped area. The tree cover in this zone is not as continuous
as in the Grey Wooded Zone, and the amount and kind of trees vary
somewhat between the different soil types. Poplar is the principal
tree growth with willow in the lower areas. Some spruce and jack
pine is found along the drainage ways, on the sandy soils and on
some of the northern slopes. The Black Soil Zone, in general, is
parkland country with varying amounts of open country. These
open areas may be mainly grass covered or they may be dominated
by a low shrub cover. Wild fruit trees, buck brush and rose bushes
generally dominate in these open areas (see plate V, fig. 2). Where
possible, differences in vegetative cover between soils have been
indicated in the description of the soil types.

The Thin Black Soil Zone occupies the east central side of the
mapped area. This is open parkland country and, in general,
is a vegetative transition from the parkland area to the west (that is
over fifty percent tree covered) to the prairie grassland to the
east. Tree growth occurs primarily in the lower areas and on the
northern slopes; most of the southern slopes and the level plains
are grass covered. The tree cover is primarily aspen poplar with
willow growth around the low spots. Silver willow is common
along the edges of the poplar groves.

The Dark Brown Soil Zone occupies the east side of the mapped
area. This zone is often referred to as the long grass prairie. The
grass cover is dominated by Agropyrons, Blue grama grass, spear
grasses and fescues. There is some sage and cactus in the drier
spots. Scrub poplar and willow clumps occur in some of the
valleys and near the base of some northern slopes.

The soil profile that develops in any one place is the result of
the influence of a number of factors; one of these factors is the
native vegetative cover. In fact the close relationship between
plants and the soil on which they grow is of prime importance
from the standpoint of soil classification. For example, in this area
under heavy woods a grey soil develops, under a grass vegetation,
a dark soil with a dark surface horizon develops. That is, there is
a much greater accumulation of humus under grass than under
woods. Other differences also develop: the grey soil tends to be
more acidic and the lime carbonate accumulation horizon tends to
be at a greater depth from the surface than in the black soil. The
greatest percentage of grey-black earths are found at the edge of
the heavily wooded area. This might indicate that these soils have
been under the influence of tree cover for a much shorter period of
time than have the grey soils to the west; that is, they have not had
time to entirely lose the black surface horizon that developed
under an earlier grass cover.
Along the same general approach as briefly suggested above, native vegetative cover can be used as an indicator of the type of soil profile found in an area. Salt grass is alkali tolerant. Kentucky blue grows best on neutral soil and sphagnum moss, found in some of the small peat areas along the west side, grows in quite acid conditions. Winter red top, northern reed grass and the flowering shooting star are indicative of locally moist soils. Sand grass and Canada wild rye grass are found in the sandy soils, whereas wild sunflower is usually confined to the heavier textured soils. A large number of the grasses, however, seem to have adapted themselves to a fairly wide range of soil and often climatic conditions.

THE SOILS' PARENT MATERIAL

The Red Deer area was practically all, if not all, covered by the Keewatin Glaciation. This ice sheet, it is thought, moved in a general south-westerly direction, and in passing over the area, mixed materials it had carried for a considerable distance with the material from the immediately underlying bedrock. This glacial drift was deposited as a mantle over the area, the depth varying greatly from place to place; and this mixed drift is the parent material of most of the soil in this area. Since the material deposited in any one place was mainly of local origin, there is a marked similarity between the surface glacial drift and the underlying bedrock. In a few places the agents of erosion have removed all the drift, with the exception of the larger erratics; so that in these spots the original bedrock is the parent material of the present soil profile. Examples of this are found in the Torlea soils along the east side. Wind and water have further sorted and moved the drift material, and in some places there is a deposition of colluvial or lacustrine material over the glacial till. A considerable portion of the Red Deer area has been so modified and the Peace Hills, Irma, Penhold and Three Hills soils are examples of this.

The uppermost bedrock horizons vary from upper Cretaceous on the eastern side to lower Tertiary on the western side.* Bearpaw shale is uppermost in the extreme north-east corner; that is, in township 40, range 15.

(1) "The Bearpaw formation consists chiefly of dark grey clay shales and sandy shales of marine depositions. There are several thin beds of light grey bentonite interstratified with the shales . . ." In places there is a high content of gypsum salt in this Bearpaw shale and it is suggested that this has contributed much of the gypsum occurring in the drift covering the north-east corner of the area.

*Plate VII gives the geologic formations in Red Deer sheet. This plate was prepared by the Department of Geology, University of Alberta.

(1) The statements in quotation marks are extracted from Research Council of Alberta Report No. 34, titled, "Geology," by J. A. Allan, Professor of Geology, University of Alberta. For a more complete discussion of Alberta Geology, the reader is referred to this and other geological publications.
The uppermost bedrock horizon between the Bearpaw and a line beginning in township 40 range 22 and carrying south-east through Nevis and Big Valley is Edmonton formation. That is, Edmonton formation is the immediately underlying bedrock formation over most of the east half of the area. It is of upper cretaceous age.

(1) "The Edmonton formation . . . consists largely of sediments deposited under fresh and brackish water conditions. . . . The composition of the strata varies greatly both laterally and vertically. The Edmonton formation . . . consists of fine grained sandstones, highly calcareous sandstones, sandy shale, bentonitic sandstones and shales, bentonite, ironstone bands, carbonaceous shales and coal. Bentonite is the prevailing constituent throughout the whole series of beds." This formation made the main contribution to the drift sheet, and hence to the soils' parent material, in the eastern two-thirds of the area. (The two-thirds referred to here in place of the one-half referred to in the paragraph above is the result of carry over of material by the glacier.)

The uppermost bedrock in the western half of the area is Paskapoo formation; that is, it lies immediately to the west of the Edmonton formation. (1) "Paskapoo is lower Tertiary in age . . . and consists chiefly of soft, grey, clayey and calcareous sandstones, and soft shales and clays. The formation is of freshwater deposition." Some of the drift overlying this formation has a medium to high lime carbonate content. For approximately twenty-five miles west of the Edmonton Paskapoo contact line the drift appears to be mixed origin; west of this the drift is mainly of Paskapoo origin.

As stated earlier in this section, most of the area is covered by a mantle of glacial drift originating, in the main, from the immediately underlying bedrock. A terminal moraine, the Beaverhills Moraine, cuts through the centre of the sheet from Buffalo Lake to Rumsey and Trochu. The material in this moraine is mainly of Edmonton formation origin. It is a brown sandy clay till, containing many small bits of coal and ironstone. Beaverhills, Angus Ridge and Elnora soils are found on this moraine.

A relatively level plain east and north of the above described terminal moraine covers the east portion of the area: in general north-east of a line through Buffalo Lake, Fenn and Byemoor. The glacial till cover varies greatly in depth but is, in general, relatively shallow. This material is also mainly of Edmonton origin with, however, a small percentage of Bearpaw shale. The material, then, contains some salt as well as some bentonite. Most of the soils in this till area belong to the solonetz group, as for example the Killam, Daysland and Halkirk soils.

In the north-east portion, that is, north and east of Stettler, there is an area of glacial-lacustrine deposition. In general, it is a shallow deposition over the till. Gadsby silt loams and silty clay loams occur on this material.
Other smaller lacustrine basins occur south-east of Stettler, the largest of these adjacent to, and including Gough Lake. In this area the lacustrine material is directly on Edmonton bedrock and was primarily sorted out of the bedrock. Consequently it has a fairly high salt content.

In the extreme south-east portion of the sheet, adjacent to Farrell Lake, alluvial sands occur. These sandy soils lie on the north-east side of the large clay basin and quite possibly originated at the time of the Drumheller Lake. Some of these sands have been subsequently shifted by the wind.

As indicated earlier, a considerable acreage of Torlea soils occur along the east side. These soils are formed on the weathered and at times sorted bedrooks, primarily Edmonton. In these places the till, possibly never very thick, has been removed by the agents of erosion so that only erratics remain.

With the exception of the water sorted areas adjacent to some of the creek and river valleys, most of the area west of the Beaverhills Moraine has a fairly deep covering of ground moraine, and the surface varies considerably in degree of roughness. A high ridge-like area runs from Wimborne north to Chigwell (just east of Lacombe). Bedrock is exposed along this ridge and it is presumed that the core of this ridge is mainly of residual material, mainly Paskapoo bedrock. Antler Hill north-east of Innisfail is of similar formation.

The glacial till between the Beaverhills Moraine and the ridge described above contain materials from both the Edmonton and the Paskapoo formations. West of this ridge it is composed primarily of materials from the Paskapoo formation. Antler, Cygnet, Falun and Breton soils occur on this till. This area merges on the west into the Duffield Moraine that enters the mapped area in the north-west corner and continues southward along the west side. This moraine is less pronounced here than in the Peace Hills area to the north. The till in this area is a brown sandy clay loam, low in salt content, and medium to high in lime carbonate content. It contains varying numbers of sandstone erratics.

The amount of water sorted material west of the Beaverhills Moraine is relatively small. Following up the Ghostpine, Three Hills and Kneehill Valleys are extensions of the lacustrine Drumheller clay basin. Between Innisfail and Burbank (on Red Deer River), between Burbank and Lacombe (up an old drainage channel), and west up Blindman Valley, there are soils on water sorted materials: alluvial flood plains and many small alluvial-lacustrine basins. This material has been carried in by streams from the west—some of these streams originating in the mountains. It is thought, however, that most of this material is of Paskapoo origin. Penhold loams and sandy loams predominate although there is some Ponoka loam in the north-west corner.
Soil Survey of Red Deer Sheet

Two areas of aeolian sand occur, one is south of Red Deer near where Cygnet and Waskasu Creeks join Red Deer River and one at Burbank, where Blindman and Red Deer Rivers join.

Plate IV gives the distribution of the soils' parent material on the Red Deer sheet. Eight different materials are shown on the map: the two glacial tills are subdivided into ground and terminal moraines. If the zone line divisions were superimposed on this map it could be considered as a broad catena map of the area (see par. 3 of Soil Classification, p. 30). Each area on this map represents a different parent material. On each of these parent materials one or more soil profile types have developed. All the profile types, however, within one parent material (catena) area will have certain common inherited characteristics; for example, similar mineralogical composition. Although other factors must be considered it is suggested that the soils in these areas of similar parent material might have somewhat similar plant food contents, and conversely have similar plant food deficiencies.

SOIL FORMATION

Soil is defined as that part of the earth's surface that is utilized by the growing plant, and may vary from a few inches to several feet in thickness. A vertical cross section of this layer is called the soil profile. This profile differs markedly from the underlying rock material. The most important of these is the occurrence of layers or horizons in the profile. The development of horizons in the soil profile is the result of climate, vegetation, and soil micro-organisms acting on the original parent material over a long period of time: the effectiveness of these is influenced by relief and external and internal drainage. Since one or all of these factors may change from place to place a great number of soil profiles are found.

The soils' parent material is of rock origin and imparts definite characteristics to the soil profile; it influences the present texture of the soil and it also largely determines the amount and kind of mineral plant foods and alkali salts present. That is, certain soil differences are inherited from the parent material. On this parent material deposited by moving ice sheets, wind or water, the agents of soil formation, namely, climate, vegetation and soil micro-organisms, work. The rock particles weather and decompose into a more finely divided condition. The soluble portions formed are then carried downward by the percolating rain water. Concurrent with this, there is a return of plant foods by way of grass and tree roots from the lower portions of the profile to the plant superstructure. When the plant dies its remains decay and the humus formed tends to collect on or in the surface horizon giving it a dark color. This humus is also constantly decaying and liberating plant foods that may be carried downward by the rain or may be re-used by plants. The materials carried down by the percolating water tend to be deposited at lower depths and may give rise to the more
compact heavier textured subsurface horizons. Plate II gives a schematic picture of a soil profile together with the names of the various horizons. The A horizon is the portion of the profile from which materials are leached by the rainwater and in which, in most soil profiles, the organic matter accumulates, the B horizon is the portion in which the materials carried from A are deposited, and the C horizon is the relatively unaltered parent material. Where material different from that in which the solum has formed underlies the solum it is referred to as the D horizon.

The above brief discussion indicates that soil formation is a complex process that is slowly but continuously going on. It should be added, however, that with the advent of cultivation, a completely new environment may be established and the soil forming processes thereby altered.

PLATE II

A<sub>n</sub>—Raw Humus.

A<sub>1</sub>—Dark colored mineral horizon.

A<sub>2</sub>—Horizon of maximum eluviation (leaching).

A<sub>i</sub> & B<sub>i</sub>—Transitional horizons.

B<sub>u</sub>—Horizon of illuviation (accumulation).

B<sub>r</sub>—Horizon of lesser illuviation.

B<sub>n</sub>—Horizon of lime carbonate accumulation.

C—Parent material.

Note: the above is a schematic drawing of a soil profile. (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<sub>r</sub> horizon may be subdivided into B<sub>r1</sub>, B<sub>r2</sub>, etc.
The interaction of these soil forming factors as applied to the Red Deer area has resulted in many different soil types. For example, the lower rainfall in the thin black zone has formed a thinner profile and a lower accumulation of surface humus than in the black zone. The relatively humid condition in the grey wooded zone has resulted in excessive leaching of the mineral plant foods and the rapid decomposition of the organic litter. The result is usually a very light colored surface horizon underneath the leaf mat. In addition to these zonal climatic differences there are also local climatic differences due to local changes in topography. For example, the soil moisture condition in a valley is quite different from that on the adjoining slope; these differences have resulted in different soil profiles being formed. Differences in soil drainage affect the movement of salts through the profile, and this in turn is reflected in the type of profile formed. All of these factors help determine the type of profile formed at any one spot, and each profile offers its own specific agricultural problems and potentialities.

The following is a brief description of the major profile types found in the mapped area.

A. Soils Developed Under Grass.

I. Profiles found on relatively non-saline parent material in the moderately to well drained topographic positions.

(1) **Black Earth.**
These soils have a pronounced black surface (A<sub>1</sub>) horizon that is usually granular to loose in structure. The B horizon is massive in the light textured soils, usually mildly prismatic in the intermediate textured soils and blocky in the heavy textured soils. The division between the A and B horizons is usually gradual and indistinct. The lower portion of the B horizon has a lime carbonate accumulation.

(2) **Thin Black Earth.**
These soils are similar to the black earth excepting that the Black A horizon is shallow, less than six or seven inches and the B horizon usually has a more pronounced prismatic structure.

(3) **Dark Brown Earth.**
These soils have a dark brown surface (A<sub>1</sub>) horizon. The B horizon has a well defined prismatic to columnar structure that may carry up into the A horizon—in the heavy textured soils the B horizon is more of a large nuciform to blocky structure. There is a lime carbonate accumulation in the lower part of the B horizon.

(4) **Black Solodic (Black Nuciform Pan).**
These soils have a fairly deep black prismatic A<sub>1</sub> horizon, a more or less defined A<sub>2</sub> horizon and a thin, fairly
hard blocky to nuciform B₂ horizon. There is a lime accumulation horizon.

(5) **Thin Black Solodic (Thin Black Nuciform Pan).**
These soils are similar to the one described immediately above excepting for the thinner black A₁ horizon and shallower to lime.

II. Profiles found on slightly saline parent material in moderately to fairly well-drained positions.

(1) **Black Solonetzic (Black Mildly Columnar Pan).**
These soils have a fairly deep black A₁ horizon, a thin more or less defined A₂ horizon and a deep prismatic to columnar B₂ horizon. There is a lime accumulation horizon.

(2) **Thin Black Solonetzic (Thin Black Mildly Columnar Pan).**
These soils are similar to the ones described immediately above excepting for a thinner black A₁ and shallower to the lime horizon.

(3) **Dark Brown Solonetzic (Dark Brown Mildly Columnar Pan).**
These soils have a dark brown A₁ horizon, a thin A₂ horizon and a fairly deep prismatic to columnar B₂ horizon. There is a lime accumulation horizon and usually a noticeable salt accumulation.

III. Profiles found on somewhat saline parent material in areas of moderately drained topographic positions.

(1) **Black Soildized Solonetz (Black Hard Columnar Pan).**
These soils have a black somewhat loose A₁ horizon, a pronounced grey A₂ horizon and a hard compact columnar B₂ horizon (the columns may be round topped). There is a lime concentration and usually a salt concentration in the lower part of the B horizon.

(2) **Thin Black Solidized Solonetz (Thin Black Hard Columnar Pan).**
These soils are similar to above excepting for the thinner Black A₁ horizon: it is usually not over three or four inches in thickness.

(3) **Dark Brown Solidized Solonetz (Dark Brown Hard Columnar Pan).**
These soils have a brown to dark brown A₁ horizon and a pronounced A₂. The B horizon has characteristics similar to the black columnar pan described above.
IV. Profiles formed on ill to moderately drained topographic positions.

(1) **Black Meadow** (Weisenboden).

These soils have a deep dark A horizon and a fairly light colored, rather sticky, B horizon. There may be some mottling in the upper part of the B horizon. Lime carbonate may be present in part of the A horizon as well as in the B horizon. In general it has weak structural development.

(2) **Saline Meadow** (Solonchak).

These soils usually have a light colored surface horizon and there is very little horizon differentiation throughout the profile. Salts occur throughout the profile often collecting on the surface.

(3) **Depression Podsol** (Slough Podsol).

These soils usually occur in the kettle holes of the parkland areas. They have a fairly deep grey A, horizon and a heavy sticky subsoil. Rusty streaks are found usually in the upper part of the B (subsoil) and occasionally in the lower part of the A (surface) horizon.

B. Soils Developed under Recent Forest.

1. Profiles found on relatively non-saline parent material in the moderately to well drained topographic positions.

(1) **Grey-black Earth**.

These soils have a dark grey to brown granular to mildly platy A horizon. The B horizon is mildly to strongly nuciform. There is a lime carbonate horizon.

(2) **Grey-black Solodic (Nuciform Pan)**.

These soils have a dark grey to brown A, horizon and a pale brown to light grey brown A, horizon. The B horizon is generally strongly nuciform, somewhat waxy. There is a lime carbonate horizon.

C. Soils Developed under Forest.

(1) **Grey Wooded**.

These soils have a deep ashy grey to light grey brown A, horizon and a compact blocky to nuciform B horizon. The dark colored A, horizon is usually thin and may be almost imperceptible. Lime carbonate is usually present in the C horizon and may occur in the lower portion of the B horizon.
SOILS

This section of the report describes the soil types found and mapped on the Red Deer Sheet. These types are grouped first under their respective soil zones and, secondly, under similar types of parent material. Immediately following is a brief discussion of the procedure used in soil mapping.

SOIL CLASSIFICATION AND MAPPING

The soil survey of the Red Deer sheet was made by traversing the area at one mile intervals: that is, every north south road allowance. Cross traverses were made where necessary. Field notes were taken along these traverses and this information was supplemented by laboratory analysis of representative profile samples. In this type of survey boundary lines between soil types was determined along the lines of traverse and then projected between the lines of traverse. In general these boundary lines can be fairly accurately observed. However, if more detailed information is required, further inspection should be made inside the section lines. Also, numerous small areas have to be omitted on a map of the scale of one inch to three miles.

Briefly put, soil classification means the identification and description of profile types and the showing of the genetic relationship of one profile type to another. Soil mapping means determining the area and extent of each type. As far as available information will permit, this report attempts also to relate these types to an agricultural use classification.

One of the most important separations made on the soil map is the division into zones. A soil zone is a geographic area within which most of the soils have one common characteristic, namely, a similar color and depth of the surface or A horizon, characteristics that are the result of the average climate and vegetation operative in the zone. In general, in Alberta there is an increase in effective rainfall from south and east to the north and west. As a result of this, there is a corresponding change from short grass prairie through a parkland vegetation to the wooded areas. In the mapped area there are five soil climatic zones mapped, namely, the Dark Brown, Thin Black, Black, Grey-black and Grey Wooded.

Following the zonal separation the soils were mapped on a profile type basis. Concurrent with the profile type separation the catena boundaries were established. A catena is a group of soils formed on the same parent material and being within one zone or having similar zonal characteristics (see the section on Parent Material and plate IV). Each member of this group is called a catenary member or a profile type. There may be one or many profile types within any one catena depending on the different topographic or drainage positions represented within the boundaries of the catena. The major profile types within each catena are
identified and named. The name given to each type is usually a place name where this type is of dominant occurrence. A single profile type may make up the catena to the practical exclusion of all other types, but more often it occurs in intimate association with other types. For example, the higher well-drained positions have one profile type, the lower ill-drained positions have another profile type. Where more than one profile type occurs in one mapped area, the approximate percentage of each type is shown on the soil map.

All the profile types in any one zone formed from similar parent material have certain common inherited characteristics. These areas of similar parent material (catenas) usually form a specific landscape type and the related profiles in the area occur in a specific pattern. As a result most of the mixed areas appearing on the map are composed of profile types on similar parent material. There are, however, areas where two parent materials were so intimately mixed that separation was not practical on the scale of mapping used. An example of this is the area east of Innisfail where glacial till from both Edmonton and Paskapoo formation occurs.

There are areas mapped where profile types of two different soil climatic zones occur. For example, in the moraine east of Lacombe there are areas where black and grey soils occur in close association.

It is seen from table VIII below that most of the profile types mapped are of a loam texture. Actually loam textured soils make up over 70 percent of the entire sheet. A loam soil is of intermediate texture; that is, neither the sand, silt nor clay, predominate. Loam soils generally do not erode as readily as do soils of either a lighter or a heavier texture.

About 10 percent of the area is mapped as sandy loams. Sandy loam soils have a predominance of sand in their composition, generally between 50 and 75 percent sand. They are lighter in texture, more vulnerable to wind erosion and usually are lower in natural fertility than the loam soils. The sandy loams are divided into fine sandy loams, sandy loams and coarse sandy loams depending upon the size of the sand grains. Loamy sand is lighter (more sandy) than sandy loam. Only 1 percent of the area is mapped as loamy sand.

Silty clay loam is a heavier textured soil than is a loam soil: that is, it contains a higher percentage of the finer silt and clay particles. Clay loam contains the same amount of clay as does silty clay loam but has more sand and less silt—it is coarser textured than is silty clay loam. In general both of these textures make desirable agricultural soil. They have a fairly high water-holding capacity, and are usually fairly well supplied with the mineral plant nutrients. Approximately 2 percent is mapped as clay loam and silty clay loam.
Only 1 percent is mapped as clay. Clay is referred to as a heavy soil. It has a high water holding capacity but takes water slowly. It therefore is vulnerable to water erosion. Clay soils, particularly in the drier areas, are usually the most productive but must be cultivated with great care.

Some soil areas are described as loam to silt loam. These soils are generally slightly heavier than the loam areas. They contain a higher percentage of silt particles and less sand particles than the loam soils.

Table VIII gives the named profile types mapped on the Red Deer Sheet. They are grouped to show the relationship between the types.

In the descriptions to follow each of these profile types is described, an average profile description is given as well as information regarding their agricultural use. The reaction (pH) is given for each profile described. These pH's are for the profiles analysed and are not necessarily averages. The depths given for the profile horizons are average thicknesses and do not, except where specifically stated refer to depths from the surface.

**TABLE VIII**

SOIL TYPES MAPPED ON THE RED DEER SHEET

**Grey Wooded Soils**

- A. Soils developed on glacial till:
  1. Till mainly of Paskapoo* origin.
     (a) Breton loam (grey wooded).

**Grey Black (Degraded Black) Soils**

- A. Soils developed on glacial till:
  1. Till of mixed Edmonton* and Paskapoo* origin.
     (a) Falun loam (grey-black earth).

- B. Soils developed on alluvial-aeolian deposition:
  1. Sandy loam to loamy sand parent material.
     (a) Carvel sandy loam (grey-black earth).

**Black Soils**

- A. Soils developed on glacial till:
  1. Till mainly of Edmonton* origin.
     (a) Beaverhills loam (black earth).
     (b) Angus Ridge loam (black solodic).
     (c) Camrose loam (black solodized solonetz).
  2. Till mainly of Paskapoo* origin.
     (a) Antler loam (black earth).
     (b) Cygnet loam (black solodic).

- B. Soils developed on glacial lacustrine deposited materials:
  1. Somewhat saline sandy clay parent material.
     (a) Navarre loam and silt loam (black earth).
     (b) Navarre meadow (meadow type).
     (c) Mialmo silt loam (black solodic).
     (d) Wetaskiwin loam and heavy loam (black solodized solonetz).

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*For a description of Edmonton and Paskapoo formations see the section on "The Soils' Parent Material."
C. Soils developed on alluvial-lacustrine deposited materials:
   1. Variable sandy loam to clay loam parent material that may contain gravel lenses.
      (a) Ponoka loam (black mildly solonetzic).
   2. Calcareous parent material.
      (a) Penhold fine sandy loam (black earth).
      (b) Penhold loam (black earth).
      (c) Penhold meadow silt loam (meadow type).
      (d) Niobe silt loam (black solonetzic).
   D. Soils developed on alluvial-aeolian deposited materials:
   1. Sandy loam to loamy sand parent materials.
      (a) Peace Hills loamy sand (black earth).
      (b) Peace Hills sandy loam and fine sandy loam (black earth to mildly solonetzic).
   E. Soils developed on coarse outwash materials:
      (a) Ferintosh sandy loam (black earth).
   F. Soils developed on relatively undisturbed residual material:
      1. Somewhat saline sandstones and sandy shales.
         (a) Kavanagh loam (solonetz to solodized solonetz).

Thick Black Soils
A. Soils developed on glacial till:
   1. Till mainly of Edmonton* origin.
      (a) Elnora loam (thin black earth).
      (b) Daysland loam (thin black solodic).
      (c) Killam loam (thin black solodized solonetz).
   2. Till mainly of Paskapoo* origin.
      (a) Airdrie loam (thin black earth).
B. Soils developed on glacial-lacustrine deposited materials:
   1. Slightly saline silty clay parent material.
      (a) Gadsby silt loam and silty clay loam (thin black solodized solonetz).
   2. Relatively non-saline clay parent material.
      (a) Three Hills clay and silty clay loam (thin black earth).
      (b) Twinling clay loam and silty clay loam (thin black solonetzic).
C. Soils developed on alluvial-aeolian deposited materials:
   1. Sandy loam to loamy sand parent material.
      (a) Irma sandy loam, fine sandy loam and loam (sandy) (thin black earth).

Dark Brown Soils
A. Soils developed on glacial till:
   1. Till mainly of Edmonton* origin.
      (a) Hughendon loam and clay loam (dark brown earth).
      (b) Halkirk loam (dark brown solodized solonetz).
B. Soils developed on glacial-lacustrine deposited materials:
   1. Relatively non-saline clay parent material.
      (a) Drumheller clay (dark brown earth).
      (b) Michichi clay loam (dark brown solonetzic).
C. Soils developed on alluvial-aeolian deposited materials:
   1. Sandy loam to loamy sand parent material.
      (a) Wainwright loamy sand (dark brown earth).
      (b) Metisk loamy sandy loams (dark brown earth).
      (c) Sullivan Lake sandy loams (dark brown solodized solonetz).
D. Soils developed on coarse outwash materials.
   (a) Scollard sandy loam (dark brown earth).
E. Soils developed on relatively undisturbed residual material.
   1. Somewhat saline sandstones and sandy shales.
      (a) Torlea loam and sandy loam (dark brown solonetz).

Miscellaneous Soils
A. Alluvial—Recent River Deposits.
B. Saline Meadow.

Land Types
A. Slough.
B. Eroded Lands.

**GREY WOODED SOILS**

The grey wooded soils in Alberta lie mainly in the Western and Northern part of the province; that is, in the forested portion of the province. This area is referred to as the Grey Wooded Soil Zone. The eastern side of the zone lies just west of the Red Deer mapped area. Areas of grey soils, however, are found on the higher lands west of Lacombe, west of Red Deer and west of Alix. These soils are strongly leached soils formed under sub-humid conditions, conditions that are the result of a moderate rainfall, a low rate of evaporation and a forest cover. The average annual precipitation over most of the Grey Wooded Zone adjacent to the mapped area is about 19 inches and the average annual temperature is about 35°F. This humid condition causes a rapid decomposition of the organic material (leaves and roots) that collect on or near the surface of the soil. Some of the products of this decomposition pass out into the air as a gas and some are carried down to the lower horizons of the profile by the percolating rain water. This results in a leached, light-colored surface of A1 horizon that is relatively low in fertility. The average nitrogen content of the surface foot of these grey wooded soils is about 0.1 percent. In general, it can be said that these soils are characterized by a very thin to absent black A1 or surface horizon, an ashy light grey-brown surface or A2 horizon and a fairly compact brown B1 or sub-surface horizon. There are varying amounts of the A0 and A20 horizons (surface leaf mat) present. Most of these grey wooded soils have a calcium (lime) concentration horizon at a depth averaging about 50 to 60 inches from the surface.

A. Grey Wooded Soils Developed on Glacial Till

1. Parent Material Mainly of Paskapoo Formation Origin.

The Paskapoo formation is a fresh water deposition of Early Tertiary age. It consists chiefly of soft grey clayey, somewhat calcareous sandstones and soft clays and shales. The till formed from the Paskapoo is generally of a brown color, is gritty, and has a medium to medium high lime content. Breton loam is the only soil type mapped in this grouping. Minor percentages of the following profiles will also be found: peaty spots in the depressions, grey-
black soils on some of the lower slopes and small islands of black soil on the better drained low lands. Following is a description of Breton loams.

(a) BRETON LOAM (map symbol Bn.L.)

Breton loam is a fairly well to well drained soil usually found on undulating to rolling morainal topography. The native cover is mainly aspen poplar with some balsam poplar and spruce. Stones are few to some in number (mixed granites and sandstones) and, although a factor in cultivation, do not generally offer undue obstruction.

Breton loam is found as islands in the west portion of the mapped area. There are 14,000 acres mapped. The following is a description of an average Breton loam profile. It is a grey wooded profile.

Inches
1-3  A<sub>L</sub>-Leaf mat. pH 6.2 to 6.8.
1-2  A<sub>L</sub>-Dark brown loam—loose. pH 6.0 to 6.3.
4-7  A<sub>L</sub>-Light grey brown, platy—loam to sandy loam—easily crushing into small irregular fragments. pH 5.8 to 6.2.
1-2  A<sub>2</sub>-Brown, porous, firm. Breaks to nuciform fragments. pH 5.8 to 6.2.
10-20 B—Brown to dark brown clay loam to clay—medium nuciform to blocky. pH 5.5 to 6.0.
10-20 B—Brown, medium nuciform but less well defined than B<sub>L</sub>. pH 5.5 to 7.0.
Ca—at average of 48” from the surface—often spotted with lime. pH 7.5.
C—Fairly uniform brown sandy clay loam to clay till. Highly silicious. pH 7.6.

The plowed field is generally of a light grey brown color and tends to bake and crust on exposure.

Agricultural Use.

The Breton loam is relatively low in natural fertility. The leaching process by which these soils have formed has tended to remove most of the soluble plant foods from the upper horizons and deposited them in the lower horizons, beginning with the heavy textured B horizon. Consequently the lower horizons are generally better supplied with mineral plant food elements than is the surface horizon.

The main management problems associated with the cultivation of this soil, then, are: first the incorporation of organic matter into the surface horizon to provide a better structure and to provide readily available plant food for the young plants. This can be done mainly by growing clover and alfalfa which also adds the much needed nitrogen. And, secondly, to supply the mineral plant foods that may be deficient either due to leaching or because of a lack in the original parent material. Information to date indicates that Breton loam is primarily deficient in the element, sulphur. As
cropping continues it is believed that other mineral deficiencies will become apparent. Due to the high lime content of the parent material and the fact that this mineral is within the range of the plant roots, the Breton soils have not become extremely acid and little response has yet been obtained from the application of lime.

**Grey-Black Soils**

The grey black soils in Alberta, in general, occur in a narrow transition belt between the Grey Wooded Soil Zone and the Black Soil Zone. However, there are numerous islands of these transition soils within both the main black and grey zones. These soils are usually tree covered, although the forest cover is not generally as heavy as in the grey wooded soil areas. Grey-black soils are transitional in nature, that is, in some profile characteristics they are intermediate between the black and the grey profiles. Leaching has taken place to a degree, and has produced an A horizon that is either of a brown to dark brown color, or that has a significant amount of black A, horizon over a relatively thin light brown A, horizon (the plowed field is generally darker in color than in the grey wooded soil areas). The average nitrogen content of the surface foot of these soils is about 0.3 percent. There is a fairly compact B, horizon and the Calcium (lime) horizon averages 45 to 50 inches from the surface. An A, horizon is usually present but is relatively thin.

**A. Grey-Black Soils Developed on Glacial Till**

(a) FALUN LOAM (map symbol Fn.L.)

Falun loam is a medium textured grey-black soil developed on glacial till that is mainly of "Paskapoo" origin. (See Soil Parent Material, page 22.) In the Red Deer area most of the Falun loam lies close to the contact between the Edmonton and Paskapoo formations, and, therefore, the parent till in these areas is quite mixed. Stones are few to some in number.

It is a fairly well to well drained soil usually found on gently undulating to gently rolling topography. The native vegetative cover is mainly aspen poplar with varying amounts of balsam poplar.

Falun loam is mapped west of Lacombe and in the Beaverhills Moraine as far east as Range 22. There are 93,000 acres mapped.

There is a considerable range in the degree of leaching in the Falun loam areas, that is, all the way from nearly black to profiles that approach grey wooded. Numerous small areas of black soil, grey soil and peat are often associated with the Falun loam. (See plate IX, fig. 1.)

The following description of an average Falun loam profile is intermediate between the two extremes referred to above. It is a grey-black earth profile.
Inches

1. A - Grass and leaf mould. pH 6.0 to 6.5.
3. A - Brown to light brown loam, platy to fragmental. pH 5.7 to 5.9.
1/2 - 2. A - Brown to light brown, heavy loam, somewhat porous medium nuciform; this horizon may be absent. pH 5.8 to 6.0.
20-30 B - Dark brown clay loam, large blocky to nuciform. Slight staining on the cleavage faces. pH 6.0 to 6.3.
Ca - at 40" to 50" from the surface—usually only a slight lime concentration. pH 7.5.
C - Brown clay to clay loam till; often lime spotted. pH 7.7.

Agricultural Use.

The Falum loam is, as would be expected, about intermediate in native fertility between the black soils and the grey wooded soils. They are therefore fairly fertile soils and since they are in a relatively high rainfall zone, produce fairly satisfactorily during the first few years of cultivation. They do, however, soon respond to the inclusion of green manure crops, principally legumes. There are insufficient fertilizer data available on these soils, but indications are that some response is usually obtained from the addition of ammonium phosphate together with sulphate.

The Falum loams are mixed farming soils and wheat should form a minor part of the rotation, emphasis being placed on hay and pasture crops and coarse grains.

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 any cultivation up and down the slopes should both receive consideration.

B. Grey-Black Soils Developed on Alluvial-Aeolian Material

(a) CARVEL SANDY LOAM (map symbol Cv.S.L.)

The Carvel sandy loams are light textured grey-black soils developed on silicious transported material of mixed Upper Cretaceous and Tertiary origin. Only a limited acreage (about 4,000 acres) of this soil occurs in the mapped area. One area is mapped south of Gull Lake and one on the east side of Ghostpine Lake.

The area south of Gull Lake is of gently undulating topography. The sandy deposition varies from two to four feet over till and Ponoka loam is found adjacent to this soil area. It is fairly good to good arable land. The area near Ghostpine Lake is a light sandy loam on rolling topography. This area is only fair arable land.

Carvel sandy loams have from 2 to 5 inches of a dark brown to black A1 horizon and from 2 to 5 inches of a brown to light brown A2 horizon. The B3 horizon is a loam to heavy loam texture.

BLACK SOILS

The black soils of Alberta lie mainly in a triangular area between the points of Olds, Westlock and Lloydminster. This is the Parkland section of the province and is referred to as the Black
Soil Zone. This zone includes about one-half of the mapped area. The eastern edge of the zone is marked by the line dividing it from the Thin Black Zone, and the western edge by the Grey-black soils. The average precipitation in the Black Zone portion of this sheet is between 17 and 18 inches, and the average annual temperature about 36°F. The black soils generally have 6 inches or more of black surface soil and the average nitrogen content of the surface foot is between 0.4 and 0.5 percent. From the point of view of nitrogen and organic matter these soils are very rich soils. Generally they are also well supplied with the mineral plant foods, although after some years of cropping some have become deficient in available phosphorus.

A. Black Soils Developed on Glacial Till

1. Parent Material mainly of Edmonton formation origin.

In general east of range 25 the glacial till is mainly of Edmonton formation origin (see page 23), is generally of a brown to grey, brown color and of a sandy clay loam texture. It has a low to medium lime carbonate content and contains Precambrian rocks, ironstones and coal. In the Black Soil Zone this till is practically all in Beaverhills Moraine and appears to be fairly deep. Between ranges 23 and 26 there is a till area of mixed Edmonton and Paskapoo origin. (See Parent Material map plate IV.) West of this line the till is of Paskapoo origin and will be described later.

The following principal profile types have been mapped in this grouping: Beaverhills loam, Camrose loam and Angus Ridge loam.

As indicated earlier, in this terminal moraine there are small areas of Falun loam and Breton loam particularly on the northern slopes. In the moraine Angus Ridge loam and Beaverhills loam are of about equal distribution, and the two make up from 75 to 90 percent of the area. Beaverhills loam occurs on the crowns and Angus Ridge loam on the hill slopes. Camrose loam or meadow soils, or both, may occur on the lower slopes adjacent to the marshy kettle holes.

Following is a description of the three main profile types formed on this till.

(a) BEAVERHILLS LOAM (map symbol Bf.L.)

Beaverhills loam is a well drained soil found on undulating to hilly topography. The native cover is a parkland vegetation of grass, shrubs and poplar. This profile type occurs over the northeastern two-thirds of the Black Zone and, in general, makes up from 50 to 80 percent of this area: approximately 265,000 acres.

The following is a description of an average Beaverhills loam profile: it is a prismatic black earth profile.
Soil Survey of Red Deer Sheet

Inches

6 A_n Black loam, weakly prismatic, crushes easily to small crumbs. pH 6.0.
4 A_n-Dark brown loam to heavy loam, weakly prismatic. pH 6.9.
15-30 B_Brown clay loam. Widely separated vertical cleavage lines. pH 6.5.
Ca-al about 36′ from the surface. pH 7.8.
C_Brown till with a low salt content. pH 7.8.

In rolling topography this profile occurs on the knolls and part of the way down the slope. The dry knolls have a thinner profile than the one described; some of the table lands may have a deeper profile. There is indication of columnar structure in the B horizon of some of the Beaverhills profiles.

Agricultural Use.

Beaverhills loam is the "normal" black loam and can be distinguished from the Angus Ridge loam by the absence of the light-colored subsurface horizon (see Plate IX, fig. 2). That is, there usually is a gradual change from the black surface to the brown subsoil. In the main, Beaverhills loam occupies the well drained topographic position. This soil type from a texture, structure, and plant food point of view is very good arable soil. Its final rating will, however, depend on the topography class; the hilly areas, for example, are mainly pasture lands.

In the more rolling lands of the terminal moraine, Beaverhills loam occurs in intimate association with Angus Ridge loam. A discussion on agricultural use in these lands must, then, be primarily of the complete association rather than of the individual soil types. The main problem, in these rolling lands, is the prevention of water erosion. At present, slopes up to and above 15 per cent are being cultivated. This is dangerous practice unless erosion control measures are adopted. Since these two soils have fairly receptive sub-soils, the amount of erosion to date has not been excessive. However, with continued cultivation it will become more apparent. The slopes should not be cultivated up and down the slope and should not be, at any one time, completely in fallow. In other words, some form of contour farming should, at all times, be practiced. In general, the steeper the slope the thinner the surface soil and therefore erosion, both wind and water, will tend to expose the less fertile subsoil. Contour farming in these areas would have another advantage, namely, that generally the fields would be of one soil type. This makes for a uniformity of crop growth and uniformity in ripening, a condition not possible if all types from the shallow Beaverhills loam on the knolls to deep meadow soils in the valleys are in one field.

(b) ANGUS RIDGE LOAM (map symbol Ar.L.)

Angus Ridge loam is a fairly well to well drained soil found on gently undulating to rolling topography. The native cover is grass and shrubs with bluffs mainly of aspen poplar. This profile type
occurs in the north-east two-thirds of the Black Zone and is associated with Beaverhills loam. In all there are 95,000 acres mapped.

The following is a description of an average Angus Ridge loam profile: it is a solodic (nuciform pan) profile.

Inches

7 A₁—Black loam. Weakly irregular prismatic. pH 7.0.
7 A₂—Black loam. Firm, irregular prismatic with horizontal cleavage lines. pH 6.0.
1-2 A₃—Grey black to grey brown loam. Firm, somewhat porous, pronounced silica grains showing. Structure similar to A₁.
7 B₁—Brown clay loam. May be somewhat columnar, breaking readily into medium blocky or nuciform. pH 5.9.
18 B₂—Brown clay loam to clay. Some vertical cleavage lines. Weakly nuciform to massive. pH 6.5.
C—at about 40” from the surface—low to medium lime content.
   pH 7.8.

The Angus Ridge loam generally occupies the well drained higher land. In the gently undulating topography it usually occurs over the knoll and part of the way down the slopes. No visible salt concentration was noted in the Angus Ridge profiles to at least 50 inches. Although mechanical analysis showed no differences between the parent till of Angus Ridge loam as compared to Camrose loam, the filtration rate was about three times as fast in the Angus Ridge parent material. Some thinner profiles of this type were found, profiles that are tending towards the solodized solonetz.

Agricultural Use.

Angus Ridge loam is found on the more nearly level topographic phases. It has a fairly high natural fertility and a desirable profile structure throughout and is, therefore, adaptable to a wide range of crops. The Angus Ridge profile can be distinguished by a deep black surface, a thin grey subsurface horizon and a brown clay loam subsoil that contains stones, coal flecks and small ironstones (see Plate IX, fig. 2). It is good to excellent arable land.

Since it is a very productive soil and consequently a valuable asset, every precaution should be taken to see that this productivity is maintained. This warning, we think, is timely because too often, soils of high native fertility are the last to receive conservation attention. The owners as well as the community can ill afford to allow deterioration to take place. This soil type is adapted to a mixed farming agriculture; a continuous cereal-fallow rotation should not be continued. (See Agricultural Use of Beaverhills loam, p. 39.)

(c) CAMROSE LOAM (map symbol Cam.L.)

Camrose loam is a soil of poor to fairly good drainage usually found on level to gently undulating topography. The native cover is mainly grass and small shrubs. A few small areas of Camrose loam are mapped: mainly adjacent to Erskine. As stated earlier
Soil Survey of Red Deer Sheet

In this section, patches of Camrose loam may occur near the kettle holes. Many of these, however, are too small to map. There are about 24,000 acres mapped.

The following is a description of an average Camrose loam profile: it is a solodized solonet (columnar pan) profile.

Inches

5  A1 -- Black loam, irregular prismatic, crushes readily to small crumbs. pH 6.2.
5  A2 -- Black loam, prismatic. pH 6.2.
2  A3 -- Grey black loam, prismatic to columnar. pH 6.7.
1  A4 -- Grey gritty loam. Weakly platy and porous. pH 6.7.
8  B1 -- Very dark brown clay loam to clay. Columnar with flat or rounded tops; medium blocky mesostructure. pH 7.4.
Ca (Lime) at about 36" from surface. Low concentration. pH 8.1.
SO3 (Salt) at from 30" to 40" from surface, variable concentration.
C -- Brown to grey brown till. This till, because of the salt content, is often in a semi-deflocculated condition causing very slow water penetration. pH 8.1.

This profile has ten to twelve inches of A horizon and occupies the moderately to fairly well drained positions: it is generally found on the very gentle slopes. A thinner phase of this profile, namely, one with four to six inches of A, and practically no A2 may be found farther down the slope and bordering the depressions. This latter profile is included with the Camrose loam because it is still slightly solodized, although it more closely approaches the solonet. This thinner profile has only poor to moderate drainage, and may have varying amounts of red mottling in the B horizon. There is usually a higher salt concentration than in the better drained profile.

Agricultural Use.

The profile characteristics of the Camrose loam indicate its management problems. Those characteristics are a relatively loose, black surface horizon, a very hard columnar subsurface horizon, and a salt concentration layer in the subsoil. Each of these three characteristics may have some detrimental effect on the productivity of Camrose loam; the loose A horizon is vulnerable to wind erosion; the tight hard B horizon retards water and root penetration and salt may be in heavy enough concentrations to be toxic. A fuller description of the management of these columnar pan soils is given under Killam loam, page 57.

Although Camrose loam has certain undesirable morphological characteristics it is generally fairly good to good arable land and the deeper phase is adaptable to a fairly wide range of crops. The shallow phase is only fair to fairly good arable land.

(d) OTHER SOILS

Minor percentages of black meadow soil and depression podsol occur in the lower areas. The meadow soils occur where drainage is somewhat impeded. They are generally quite fertile soils having
upward of 16 inches of black surface. The lower portion of the A horizon may contain carbonates. Depression podsols occur in a few of the undrained basins—under native conditions these depressions are usually surrounded by a ring of low willow growth, and appear as grey spots in the cultivated field. Heavy applications of barnyard manure improves the fertility and tilth of these soils. If they are fairly large areas it may be advantageous to seed them down to a grass legume mixture containing, for example, Reed canary grass or red top. Actually a very small percentage of the kettle holes in this area are depression podsols; most are sloughs that have water in the spring but dry early enough to produce a crop of meadow hay. These sloughs have a muck-like surface.


The till of Paskapoo origin lies principally in the south-west corner, and in the black zone covers the undulating to gently rolling area south and east of Innisfail. This till is of a brown color, is gritty, and has a medium or slightly higher lime carbonate content. Sandstone erratics commonly occur.

Two profile types have been mapped, namely, Antler loam and Cygnet loam. These two profile types occur in approximately the same relative positions as do the Beaverhills loam and Angus Ridge loam, that is, in general, the Cygnet loam occurring on the lower part of the slopes and on the leveller topography. The depressional spots in this area are mainly Penhold Meadow soil and sloughs.

Following is a description of the two main profile types formed on this till.

(a) ANTLER LOAM (map symbol Ant.L.)

Antler loam is a soil with good drainage found on undulating to hilly topography. The native cover is a parkland vegetation of grass, shrubs and poplar. Throughout the general area south-east of Innisfail it makes up about 60 percent of the total. There are 70,000 acres mapped.

The following is a description of an average Antler loam profile: it is a prismatic black earth profile.

Inches

8 A1—Black loam (somewhat sandy) loose. This horizon forms a ledge in the roadcut. pH 7.1.
5 A2—Black loam, firm, irregular prismatic. (Fairly sharp break to the B horizon.)
10 Bw—Brown to yellow brown. Structure similar to A2 above; friable, granular to small nucliform mesostructure. pH 8.0.
4 B2—Light yellow brown prismatic. Ca— at about 30” from the surface. Medium to high concentration—friable, light brown. pH 8.4.
C —Brown sandy clay loam till containing sandstone erratics.

Agricultural Use.

Antler loam is the “normal” black loam and can usually be distinguished by the deep black surface, the yellow brown subsurface
and the sandstone slabs (see Plate IX, fig. 3). In the main it occupies the well drained uplands. Although only limited information is available on its fertility requirements, some farmers have obtained yield increases by the use of phosphatic fertilizers. In general, Antler loam, from a texture, structure and total plant food content should be very good arable soil. Its final rating will depend on the topography class. At present, the Antler loam of this area is devoted primarily to wheat production, although there is also considerable mixed farming in the district. The discussion under the Agricultural use of Beaverhills loam, page 39, is applicable to this soil and the reader is directed to it.

(b) CYGNET LOAM (map symbol Cy.L.)

Cygnet loam is a soil with fairly good to good drainage found mainly on gently undulating to gently rolling topography. The native cover is grass, shrubs and bluffs of aspen poplar. Along the west side of the mapped area it occurs under fairly continuous tree cover. This soil is found associated with Antler loam and is formed on the same parent till. However, the surface material in the Cygnet areas shows evidence of sorting and/or wind or water deposition. This is particularly evident in the area adjacent to Penhold. In this area the top 18 inches is quite uniform and relatively stone-free. In all there are approximately 38,000 acres mapped.

The following is a description of an average Cygnet loam profile: it is a solodic (nuciform pan) profile.

Inches
6 A_a—Black loam, somewhat loose.
6 A_s—Black loam. Mildly prismatic.
1 A_s—Light grey brown to grey brown, platy; breaks to small porous nuciform mesostructure.
2 B_a—Brown to greyish brown. Firm, small nuciform.
10 B_s—Brown to dark brown clay loam mildly columnar; medium nuciform mesostructure.
5 B_s—Less firm and less structure than in B_a.
C—at about 30" from the surface. Medium to high lime concentration.
C—a—Light brown sandy clay loam; contains some coal and ironstone as well as sandstone erratics.

In some of the areas there is distinct evidence of a wooded type of leaching of the Cygnet loam. As a result the A horizon in spots is dark brown rather than black. In some areas all graduations between Cygnet loam and Falun loam can be found. Some of the Cygnet loam therefore approaches a grey-black (nuciform pan) profile.

In the main Antler loam area south-east of Innisfail, Cygnet loam forms about 20 percent of the total. On the plain west of Red Deer river Cygnet loam forms from 40 to 60 percent of the total area.
Agricultural Use.

Cygnet loam is usually found on the relatively level topographic phases and can be distinguished from the surrounding Antler loam by the light colored $A_2$ horizon immediately below the black surface and by the nut-like structure of the subsoil. In general, Cygnet loam is very good arable land and every effort should be made to prevent deterioration, particularly by both wind and water erosion. Those areas that have a dark brown rather than black surface would probably respond to the application of fertilizers as well as the periodic inclusion of a legume crop in the rotation.

B. Soils Developed on Glacial Lacustrine Deposited Materials

1. *Somewhat saline sandy clay parent material.*

   The soils in this group are on parent material that is sorted out of Edmonton and Paskapoo tills, mainly the former. It is a yellow brown to grey brown clay with varying quantities of silt and fine sand. Towards the lower depths, close to the till contact, there may be distinct varying. Some of the lenses are of a dark colored shaley clay. The parent clay has a medium to medium low lime content and a medium to medium high salt content. Three soil types appear on the map, namely, the Wetaskiwin, the Navarre, and the Malmo. However, minor percentages of slough podsols and of solonetz profiles occur. Some Ponoka loam also occurs associated with the above soils.

   (a) **NAVARRE LOAM AND SILT LOAM**
   
   (map symbol Nv.L. and Nv.S.L.)

   The Navarre loams are fair to fairly well drained soils, usually found on level to flat topography. The native cover is a mixed vegetation of grass, shrubs and willow. Most of the Navarre loam occurs in the Lacombe Flat. In all there are only 10,000 acres mapped.

   The following is a description of an average Navarre loam profile. It is, genetically, between the prismatic black earth and the black meadow types.

   **Inches**

   12 A — Black silty loam, mildly prismatic, somewhat loose near the top. (Up to 20" of black A occurs). pH 8.1.

   12-15 B — Brown to dark brown sandy clay loam to clay.Breaks into a small nuciform to granular mesostructure. pH 7.9.

   Ca — May occur anywhere from 10" below the surface to 30" below.

   SO — May occur in medium to low concentrations to the top of the B horizon.

   C — Brown uniform silty clay. pH 7.6.

   There are, then, varying amounts of calcification and salinization in these profiles. Fairly heavy salt concentrations were apparent in the road cuts caused presumably by seepage from the surrounding higher land. No excessive salt concentrations however were found in the top three feet of most profiles.
Fig. 1.—Crop in Halkirk Loam Area—note the uneven growth.

Fig. 2.—Rolling to hilly moraine east of Big Valley mapped primarily as Hughenden loam. It is pasture land.

Fig. 3.—Ghost Pine Creek Valley west of Huxley. One of the wide creek valleys leading into the Drumheller clay basin.
PLATE IV.

Parent Material of Soils of Red Deer Sheet

NOTE: Areas of mixed parent materials shown by barring of colors.
Fig. 1.—An area of alluvium in Red Deer river flat. It is good arable land.

Fig. 2.—Native fruit abounds in the rougher morainic areas. These are choke cherries.

Fig. 3.—Rochon sands on Buffalo Lake, a local summer resort.
Present Cultivated, Abandoned and

Completely Cultivated (140-160 acres) ............................
Partially Cultivated (10-140 acres) ...........................
Virgin Lands of the Red Deer Sheet

Abandoned Cultivation (10-160 acres)  
Virgin Lands (Idle and Pasture)
Fig. 1.—A profile of Airdrie loam. It is a sorted, glacial, thin black soil profile. Note the heavy concentration of lime close to the surface.

Fig. 2.—A profile of Killam loam. This is the solodized-solonetz profile. Note the sharp break between the $A_s$ and $B_s$ horizons. It is fair to fairly good arable land depending mainly on the depth of $A_s$ (surface) horizon and amount of salt present.

Fig. 3.—In sand dune area south of Red Deer. Note the buried profile indicating an earlier period when the dunes were stabilized.
Fig. 1.—An area of mixed Falun and Breton soil types. The greyer Breton soil is usually confined to the higher land in these mixed areas.

Fig. 2.—A profile of Angus Ridge loam. This is a solodic profile formed on glacial till. It is found in the Beaverhills moraines associated with Beaverhills loam and Camrose loam. It is very good arable land.

Fig. 3.—A profile of Antler loam. This is a black earth on glacial till of Paskapoo formation origin. It has a fairly high lime carbonate subsoil.
Agricultural Use.

Navarre loam is distinguished by a deep black surface, a sharp break from the black surface horizon to the brown sub-surface horizon, and by the presence of white salt seepage spots along the exposed road cuts.

Navarre silty loam is fairly good to very good arable land depending mainly on drainage and salt concentration. In general the less well drained profiles have the greatest amount of salt. In general no alkali was noted. Coarse grains and hay would seem to be the most desirable crop.

(b) NAVARRE MEADOW

Occurring in the Lacombe flat associated with the Navarre silt loam and Wetaskiwin loam are many low poorly drained areas that have been mapped as Navarre Meadow. Small areas of this also occur associated with Wetaskiwin loam south-east of Red Deer. The profiles in these areas differ from Navarre silt loam in having a more glei-like B horizon, and having some salt and lime fairly close to the surface. The surface (A) horizon is a fairly deep black silt loam to silty clay loam.

These areas are covered with a fine meadow grass and scattered willow clumps. These are usually wet in the spring of the year. If cultivated they should be seeded to a grass legume mixture and used for hay or pasture.

(c) MALMO LOAM (map symbol Mo.L.)

Malmo loam and silt loam are fairly well to well drained soils usually found on level to gently undulating topography. The native cover is a parkland vegetation. Small areas of Malmo loam occur on the rim of the Lacombe Flat. In all only 2,000 acres are mapped.

The following is a description of an average Malmo loam profile: it is a solodic (nuciform pan) profile.

Inches

5 Aa—Black silty loam. Slightly prismatic. pH 6.5.
9 Aa—Black silty loam. Prismatic to weakly columnar. pH 6.3.
14 Bb—Brown to yellow brown clay. Larger more irregular nuciform than Bb. pH 6.9.
Ca & C—at about 36” to 40” from the surface. Sandy clay. Low lime, generally low to medium low salt content. pH 7.8.

The above profile is generally in the well drained position; Navarre loam usually occurs in the lower positions.

Agricultural Use.

Malmo loam can be recognized by the deep black surface horizon, the thin greyish subsurface horizon and the fairly heavy textured uniform, stone-free subsoil.
Malmo silty loam is very good arable land. It has a high native fertility. Since much of it is on relatively low relief, frost is a hazard particularly in some of the higher rainfall years. A considerable percentage of this soil could well be used for hay and coarse grain crops.

(a) WETASKIWIN LOAM, HEAVY LOAM AND SILTY CLAY LOAM
(map symbol Wkn.L., Wkn.HL. and Wkn.Si.C.L.)

The Wetaskiwin Loams are imperfectly to fairly well drained soils usually found on level topography. The native cover is a parkland vegetation of grass, shrubs, willow and aspen poplar. The thinner phase of this type is generally found under a grassland vegetation. In all there are only 22,000 acres mapped, occurring mainly in some of the lower areas adjacent to Lacombe south-east of Red Deer and in Three Hills Valley.

The area in Three Hills valley mapped as a silty clay loam is somewhat heavier textured and slightly less saline than the average Wetaskiwin profile. The parent material has some of the characteristics of the Three Hills clay. Small patches of a soil having a fairly high lime parent material occur in this area.

The following is a description of an average Wetaskiwin heavy loam profile. This is a solodized solonetz (columnar pan) profile. Inches

9 A,—Loam to heavy loam that is black on the surface, but slightly grey black towards the bottom. Weakly columnar and somewhat porous. pH 6.0.
2 A1—Grey loam (sandy), similar macrostructure to the A1 horizon but more porous. pH 6.4.
6 B1—Very dark brown sandy clay, heavily stained, columnar with flat to rounded tops, hard medium blocky mesostructure. pH 7.8.
4 B2—Greasy dark brown, less staining and less pronounced structure than in B1. pH 7.9.
B & SO,—at 24" to 30" from the surface. Brown, gritty clay, containing salt inclusions. pH 7.8.
Ca—at 30" to 45" from the surface. Brown to dark brown, stone free, massive sandy clay; containing some lime and salt. pH 8.5.

The A1 may vary from 6 to 12 inches in depth and the A2 from 1 to 4 inches in depth. Still thinner members, that is with less than 6 inches of A1 and less than 1 inch A2 occur. These are approaching the solonetz profile.

Agricultural Use.

The Wetaskiwin loam can be recognized by the hard columnar subsurface horizon with its rounded tops looking much like a cauliflower head. It can be distinguished from the Camrose loam by the fact that it is usually on more level topography and both the surface and subsoil are practically stone free.

Wetaskiwin loam is fairly good to good arable land. In this area, particularly, it is adapted to mixed farming. Deep rooted
legumes that will penetrate the hard subsurface horizon should improve this soil. For a more complete discussion of the agricultural use of this profile type the reader is referred to the discussion of Killam loam on page 57.

C. Soils on Alluvial Lacustrine Deposition

These soils are developed on materials deposited in relatively slowly moving water and the areas have, therefore, a fairly uniform texture throughout. Two soil types are mapped, namely, the Ponoka loams and the Penhold loams.

1. Sandy loam to clay loam parent material that may contain gravel lenses.

(a) PONOKA LOAM (map symbol Pk.L.)

Ponoka loams are medium textured black soils developed on a sandy loam to clay loam parent material of alluvial-lacustrine deposition over glacial till: the deposition is often lighter in texture in the lower layers than in the upper portion; that is, immediately above the till contact, there usually is a sandy loam to gravelly loam deposition. The subsequent deposition is generally of a loam to silty loam texture. In spots the till, D horizon, is within two or three feet of the surface. The parent material is low in lime and also low in salt content. It is often found associated with Angus Ridge loam or with Peace Hills sandy loam.

Ponoka loam is a well drained soil usually found on level to gently undulating topography. The native cover is a parkland to light forest vegetation of poplar bluffs with open areas covered by tall grasses and shrubs. This soil is mapped in the north-west corner of the sheet, and a small area in the moraine north of Red Deer River. In all, there are 66,000 acres mapped.

The following is a description of an average Ponoka loam profile. It is between a prismatic black earth and black solonetzic (mildly columnar pan) profile.

Inches

9  A<sub>n</sub>—Black, mildly prismatic loam (sandy). pH 6.6.
4  A<sub>n</sub>—Very dark brown prismatic loam. pH 6.5.
1-3  A<sub>n</sub>—Grey brown to brown loam. Horizontal cleavage: may be weakly platy and porous. pH 6.4.
8  B<sub>n</sub>—Brown to reddish brown sandy clay loam. Weakly columnar, may be of somewhat nuciform mesostructure. pH 6.4.
10-15  B<sub>n</sub>—Similar to B<sub>n</sub> but less defined structure. pH 6.5.
C—Sandy loam to heavy loam, low lime content. pH 7.8.
D—Glacial till.

In the profiles where the D horizon is relatively close, they approach the Angus Ridge type. In the areas with a more pronounced alluvial deposition the profiles tend to approach, genetically, the black earth with less columnar structure in the B<sub>n</sub> horizon and a brown A<sub>n</sub> horizon.
Agricultural Use.

Ponoka loam generally can be recognized by a deep black surface horizon, a thin light-colored subsurface horizon and a uniform somewhat sandy subsoil. The areas are usually stone free although in places there is a concentration of boulders at the contact of the till and the overlying material. The upper portion of the profile looks much like the Angus Ridge profile (see Plate IX, fig. 2), but can be distinguished from the Angus Ridge by the stone-free subsoil.

Ponoka loam is good to very good arable land. What was said regarding the use of Angus Ridge loam (page 40) applies equally well to Ponoka loam with this addition; much of the Ponoka loam has a relatively light textured subsoil as well as being slightly lighter textured throughout. It, therefore, is slightly less drought-resistant than is Angus Ridge loam.

2. Calcareous Parent Material.

(a) PENHOLD FINE SANDY LOAM, LOAM AND SILT LOAM
(map symbol Pe.F.S.L., Pe.L. and Pe.Si.L.)

Penhold fine sandy loam and loam are well drained soils usually found on level to gently undulating topography. The native vegetative cover is parkland with many small clumps of shrubs and low poplar. It occurs mainly in association with Red Deer River alluvial plain—principally between Innisfail and Lacombe. Some Penhold (mainly fine sandy loam) occurs adjacent to Alix. In this area it is found on undulating to rolling topography, mainly along the river valley south of Alix. There are 12,000 acres mapped.

The parent material of this soil is primarily of Paskapoo formation origin and is relatively high in lime carbonate and relatively low in water soluble salt. The underlying till (mainly of Paskapoo origin) is usually five feet or more below the surface.

The following is a description of an average Penhold loam profile. It is a prismatic black earth.

Inches

6 A—Black loam. Loose to very weakly prismatic.
7 A—Black loam—weakly prismatic—some tonguing.
1 A—Dark brown loam.
8 B—Yellow brown heavy loam to clay loam. Prismatic, breaking into a friable granular mesostructure.
C & Ca—at about 24” from the surface. Light brown very fine sand to silt loam. High in calcium carbonate.
D—Tilt at varying depths, from 50 inches down.

Agricultural Use.

Penhold loams can be distinguished in the field by a fairly deep black surface, a bright yellow brown subsurface, breaking sharply to a light brown chalky subsoil. It is distinguished from the Antler loams by being stone-free.
Most of the Penhold soils in this sheet lie in the old Red Deer Valley, and are on relatively level topography. Due to their somewhat sandy character they would be subject to wind erosion although no serious deterioration was noted at the time of survey. The high lime nature of the parent material might slightly reduce yield in dryer seasons. In general, however, they are good to excellent arable lands. Periodic seeding to grass and legume and the use of suitable fertilizers should maintain a high level of productivity.

(b) PENHOLD MEADOW (map symbol Pe.M.)

Associated with the Penhold loams is a sizable acreage of Penhold meadow. This soil occurs in the lower spots having poor to imperfect drainage. In general these lower areas are only slightly lower than the surrounding Penhold loams and rarely hold water for any length of time in the spring. They are usually cultivated with the other portions of the field.

The following is a description of an average Penhold meadow profile.

Inches
12-18 A—Black to grey black loam to silt loam. Friable, very little structure. pH 7.7.
3 A s Dark brown (may or may not be present).
2-4 B—Brown clay loam (may or may not be present). pH 8.5.
Ca & G—at about 18" to 20" from the surface. Grey brown loam to silty clay loam. High in calcium carbonate. May have some blue-grey streaking.

NOTE: In the lower positions the lime may come practically to the surface, that is, well up in the black A horizon.

Agricultural Use.

Penhold meadow soils can be distinguished in the field by the deep black to grey-black surface and the fairly sharp break to the grey-brown chalky subsoil. It is found in the lower positions and is generally associated with the Penhold loams.

There is a fairly wide range of drainage conditions in this soil grouping; namely from fairly good drainage in those profiles that approach the Penhold loam in character to poor drainage in those profiles that approach slough conditions. Therefore a fairly wide range of management practices must necessarily exist. In general, these areas are best suited to coarse grains, with those of the poorest drainage being suitable for only some hay crops.

Since Penhold loam and Penhold meadow soils exist in close association, and in a patchwork pattern, some difficulty is experienced in getting uniformity in the fields. For most desirable results it is suggested that the pattern of the cultivated fields be made to conform as closely as practical, with the soil type.

(c) NIobe silt loam (map symbol Ni.Si.L.)

Niobe silt loam is a fairly well drained soil found on level to undulating topography. The native cover is grass and shrubs. In
The Red Deer area it is mapped exclusively in the Penhold flat, and is intimately mixed with Penhold silt loam and Penhold meadow.

The following is a description of an average Niobe silt loam profile: It is a black solodic (nuciform pan) profile. There are 19,000 acres mapped.

Inches
8-10 A — Black silt loam. Weakly prismatic. pH 7.1.
1 1/4 — A — Greyish brown to light grey. Tongued, coarse silt loam.
4-6 B — Dark brown to strong brown. Medium nuciform. pH 7.2.
2-4 B — Dark brown to brown. Medium to large nuciform.
6-12 C — Brown silty clay loam to clay loam. pH 8.6.
C — Varved; mixed dark grey clay and brown limy sandy clay loam.
D — Till at 24" to 48" from the surface.

The parent material of this soil is, in general, a mixture of the parent material of Malmo silt loam and Penhold loam.

Agricultural Use.

The Niobe silt loam can be distinguished from Malmo silt loam by the tonguing of the A horizon, by the frequency of varves often fairly close to the surface and by the somewhat more limy parent material. It can be distinguished from Penhold loam by the more drab colored B horizon and the heavier varved subsoil.

Nioble silt loam is very good arable land. It is, in general, the most desirable soil in the Penbold flat. The presence of a fairly sharp break between the surface and subsoil, as well as a heavy textured subsoil, makes this soil susceptible to water erosion and precautionary measures should be taken, particularly in the sloping areas.

D. Soils Developed on Alluvial-Avian Deposited Material

These soils are developed on water and wind sorted, highly siliceous, sandy material. They are mainly found associated with present or past water courses. The deposition varies from fine to coarse sand and the depth of deposition over the underlying till varies from three or four feet to considerable depths.

(a) PEACE HILLS LOAMY SAND AND SAND
(map symbol Ph.L.S. and Ph.S.)

Peace Hills loamy sand is a well to excessively drained soil usually found on undulating to gently rolling dome-like topography; that is, most of this soil type is wind sorted and deposited. The native vegetative cover is mainly scrub poplar on the northern slopes and in the valleys; the southern slopes are grassed. Some willow and occasional spruce are found in the lower positions. Loamy sand areas are mapped in the sandy area adjacent to Alix, near Ghostpine Lake and south of Red Deer. In all there are 18,000 acres mapped.

One Peace Hills sand area is mapped south of Red Deer (about 2,500 acres). This area is a mixture of dune sand with sand and
loamy sand in the level spots between the dunes. Poplar is the principal tree growth on the dunes; poplar and spruce in the more humid level spots. There are dark layers (old A horizons) inside the dunes indicating previous periods of stabilization. (See Plate VIII, fig. 3.) It is non-arable land.

The following is a description of an average Peace Hills loamy sand profile: it is a black earth profile.

Inches
12 A—Black to grey black loamy sand. Some firmness due to organic fibre. pH 6.6.
18 B—Brown to yellow brown loamy sand. Practically structureless with slight evidence of compaction. pH 6.7.
C—at 60' from the surface. Yellow brown to brown sand. Loose. pH 6.8.

These soils are stone-free. There may or may not be some carbonate in the lower horizons. Profiles grading towards the sandy loam and towards the sand occur. Those tending towards the sandy loam usually have a slight indication of an A₂ horizon, and those tending towards the sand have a thinner dark A₁ horizon. The loamy sand occurring in the lower topographic positions have a sandy clay as a D horizon usually within about four feet of the surface.

Agricultural Use.

Peace Hills loamy sand can generally be recognized by the dune-like topography on which it occurs and by the loose sandy texture. A loamy sand soil contains between 75 and 85 percent sand and it, therefore, generally lacks firmness in the profile cut.

These soils usually have a much lower reserve of mineral plant foods than do the medium and heavy textured soils. They are, then, soils that may respond to fertilizer amendments. Sand has a low water-holding capacity, and tends to be droughty. Fibre, however, has a high water-holding capacity, so it is essential that the organic matter content of these soils be maintained at a fairly high level. This will also reduce loss by wind erosion.

The loamy sand on undulating to gently rolling topography is best as pasture land: if cultivated, it should be seeded permanently to grass. That occurring on nearly level topography is fair to fairly good arable land.

(b) PEACE HILLS SANDY LOAMS

(map symbols—Ph.S.L., sandy loams; Ph.F.S.L., fine sandy loam)

The Peace Hills sandy loams are well to somewhat excessively drained soils mainly on level to undulating topography. The native cover is a parkland vegetation of aspen poplar, shrubs and the coarser grasses.

These sandy loam soils are mainly developed on material of alluvial deposition and are found scattered throughout the zone, the
larger areas occur south of Lacombe, around Ghostpine Lake, and adjacent to Delburne and Alix. Approximately 122,000 acres are mapped.

Fine sandy loam is made up predominantly of fine sand. In general they tend to be slightly heavier in texture than the other sandy loams, and the profiles consequently have more structure. The fine sandy loam soils on this sheet are usually found on level topography and the heavy textured D horizon is often within the average plant feeding range.

The sandy loam soils may be made up predominantly of medium sand or the areas may be mixtures containing coarse, medium and fine sandy loam profiles.

The following is a description of an average Peace Hills sandy loam profile. This is a black earth to mildly solonetzic profile.

<table>
<thead>
<tr>
<th>Inches</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>14</td>
<td>A - Black sandy loam, weakly prismatic, usually firm enough to slightly overhang in the roadcut. pH 6.3.</td>
</tr>
<tr>
<td>1'/2</td>
<td>A&lt;sub&gt;2&lt;/sub&gt; - From a light brown to dark brown sandy loam, slightly porous. pH 6.1.</td>
</tr>
<tr>
<td>20</td>
<td>B - Loam (sandy), brown to yellow brown. Some organic staining along the vertical cleavage lines in the upper portion of the profile. pH 5.8.</td>
</tr>
<tr>
<td>C</td>
<td>Yellow brown to brown. Loam to sandy loam. pH 5.9.</td>
</tr>
</tbody>
</table>

In those places where the underlying till is relatively close to the surface the B horizon may be heavier in texture and there is a more pronounced A<sub>2</sub> development.

**Agricultural Use.**

Peace Hills sandy loams can be distinguished in the field by a deep black sandy surface horizon, a thin lighter colored horizon directly below the black and a fairly loose sandy subsoil. The profiles are stone free.

These soils can be described as being between Ponoka loam and Peace Hills loamy sand in character. They are sufficiently sandy to be vulnerable to wind erosion and to have a relatively low water-holding capacity, yet they have sufficient of the fine soil particles to make them fairly fertile soils. They should remain a fairly fertile soil if the organic matter (fiber) content is maintained at a satisfactory level. This means the inclusion of both grass and clover in the crop rotation. This cannot be over-emphasized because these sandy loam soils can deteriorate very rapidly; or conversely they respond profitably to good management. Deterioration is already noticeable along some of the unprotected ridges.

The sandy loam areas vary from fair to good arable land depending on depth of black surface, topography and variability.
E. Soils Formed on Coarse Outwash Material

These are coarse textured soils in the Black Zone developed on gravelly outwash material. The surface is usually of a sandy loam texture. The subsoil may contain thick gravel lenses or may be a deep deposit of gravel and cobble stones.

(a) FERINTOSH SANDY LOAM (map symbol Fth.S.L.)

Ferintosh sandy loam is an excessively drained soil usually found on level lower bench lands. Profiles occur that are transitional in nature between the Ferintosh and the Peace Hills sandy loam. If the gravel deposit is quite deep and practically to the surface the area is simply designated as “gravel.” There are 3,400 acres of Ferintosh sandy loam and gravel mapped.

Agricultural Use.

In this group are put those soils with pronounced gravelly subsoils; that is, soils in which the subsoil is continuous gravel or where the gravel lenses are thick and extensive enough to seriously affect growth conditions. These soils are droughty soils, since they have a low water-holding capacity. They may also have a low fertility reserve. They range from non-arable to fairly good arable lands depending on topography and the nearness of the gravel to the surface.

F. Soils Developed on Sorted Residual Material

There are a number of small areas of thin surfaced solonetz-like soils that have developed primarily on Edmonton formation either “in situ” or slightly sorted. The unaltered bed rock can usually be found within a few feet from the surface. The surface texture generally is a loam but the plowed fields may be heavier due to the mixing in of the heavy textured B horizon.

(a) KAVANAGH LOAM (map symbol Kv.L.)

Kavanagh loam is a poorly drained soil usually found on depressional to gently undulating topography. The native cover is mainly of the coarser grasses including some salt resistant varieties. There is some willow growth and some scrub poplar on the higher positions. There are only 14,000 acres mapped.

The following is a description of an average Kavanagh loam profile. It appears to be between solonetz and thin phase solodized solonetz in character, that is, it is generally a shallow phase columnar pan profile.

Inches

5 A₁—Very dark brown loam (sandy). Practically structureless. pH 6.3.
3 A₂—Light grey brown sandy loam. Porous. pH 6.3.
6 B₁—Dark brown to black sandy clay. Flat to round topped columns, large nuciform mesostructure. pH 5.8.
9 B₂—Brown to dark brown. Hard, irregular, blocky. pH 7.5.
Ca—At 25” from the surface. Very dark brown. Lime and salts, also contains ironstones and pebbles. pH 7.2.
C—At 40” from the surface. Brown clay loam to silty clay loam with coal and ironstones. pH 8.9.
The B and C horizons vary somewhat in color and texture depending upon the character of the particular bed rock lens occurring at the surface.

The depressional spots in this area do not appear to have excessive surface salt concentrations. This may be because of the relatively impervious nature of the subsoil in the surrounding higher land.

Agricultural Use.

Kavanagh loam can generally be distinguished by the thin surface layer, the very hard dark colored subsurface layer and the presence of exposed bed rock along the road cuts.

This is an inferior soil: there is a relatively shallow dark surface soil; the subsoil is relatively impervious to both water and root penetration; and there are varying quantities of salt present in the subsoil. To cultivate it with any degree of satisfaction, the hard subsurface layer must be rendered more friable. This can be assisted by plowing into this hard layer, and mixing with it the surface soil as well as added organic material, and by sowing such deep rooted crops as sweet clover that will tend to penetrate the hard layer.

THIN BLACK SOILS

The thin black soils in Alberta lie in a narrow transition belt between the Black Soil Zone and the Dark Brown Soil Zone; the Thin Black Zone cuts diagonally across the mapped area. The average annual precipitation in the area is between 15 and 16 inches and the average annual temperature about 35°F. Thin black soils, in general, have from three to six inches of black top soil, and the lime concentration horizon is found at about 26 to 36 inches from the surface. The nitrogen content of the surface foot is about 0.25 to 0.30 percent.

Thin black soils are, on the average, relatively well supplied with the plant food elements; some have, after a few years of cropping, become deficient in available phosphorus. Rainfall or lack of rainfall is a much greater limiting factor to crop production on these soils than on the soils of the Black Zone and as a result, therefore, a smaller range of crops can be satisfactorily grown on these soils than on the black soils. The thin black soils have been used primarily to produce wheat.

A. Thin Black Soils Developed on Glacial Till

1. Parent Material mainly of Edmonton Formation Origin.

The soils in the group are medium textured thin black soils developed on glacial till that is mainly of Edmonton formation origin; some Bearpaw shale is mixed with this till, mainly towards the eastern side. These soils are, in general, the thin black counterpart of the Camrose, Angus Ridge and Beaverhills soils described earlier in the report. The main area of these soils occurs
partly on the relatively level ground moraine east of Stettler and partly on the rougher Beaverhills Moraine centering on Elnora. The parent till is of a dark grey brown color and of a sandy clay loam texture. It contains erratics of Precambrian rock, iron and coal flecks, salt inclusions and some small bits of shale.

As indicated above, the soils of this group occur over two landscape patterns. There is, therefore, a difference in the percentage distribution of the soil types between the two landscapes. On the level ground moraine area east of Stettler, Killam loam is the dominant profile type, the remainder being made up primarily of Daysland loam; minor percentages of Elnora loam and sloughs occur.

In the rougher morainal area, south and west from Fenn, Elnora loam and Daysland loam occur much more frequently than does Killam loam. There appears to be a little less of the Bearpaw shale mixed in the till in this area than in the ground moraine area to the north east.

(a) **ELNORA LOAM** (map symbol E.L.)

Elnora loam is a well drained soil generally found on undulating to hilly topography. The native cover is an open parkland vegetation. The tree growth, composed mainly of poplar and small flowering shrubs, occupies the northern slopes; the southern slopes are principally grass covered. About 180,000 acres of Elnora loam are mapped, the greatest percentage occurring in the moraine south and west of Fenn.

The following is a description of an average Elnora loam profile. It is the prismatic thin black earth profile.

Inches
4. B —Variable depth; structure similar to Bz, but no apparent staining.

On the steeper slopes a thin phase of this member occurs due to loss of water by run-off and to a relatively high natural erosion. There are from few to some stones in these soil areas.

**Agricultural Use.**

An Elnora loam profile can be distinguished in the field by its thin black surface, the gradual change to the brown subsoil and the relatively friable nature of the subsoil. This last characteristic distinguishes it from the harder more nodular to blocky subsoil of the Daysland and Killam loams. It is found in the higher topographic positions and generally occurs on undulating or rougher topography.
Elnora loam is good arable land if on gently undulating to undulating topography. The rougher phases are less desirable. The prevention of water run-off is an important factor in the utilization of these soils both from the point of view of water conservation and soil conservation. Under natural conditions, hill slopes in the Thin Black Zone are generally drier than the surrounding level land and can be classed as semi-arid. This loss of run-off water can be reduced by keeping the soil in an open receptive condition, by keeping up the fibre content, and by cultivating on the contour. Steep slopes should remain in grass.

(b) DAYSLAND LOAM (map symbol D.I.L.)

Daysland loam is a well drained soil usually found on gently undulating topography. The native cover is quite similar to that on Killam loam excepting that there is a slightly higher percentage of tree growth in the Daysland areas. These areas are of slightly rougher topography than the surrounding Killam areas, and there may be a deeper till mantle covering the bed-rock. In general, the Daysland loam profile usually occurs in a higher topographic position than the Killam loam. There are 70,000 acres of Daysland loam mapped.

The following is a description of an average Daysland loam profile. It is a solodic (nuciform pan) profile.

<table>
<thead>
<tr>
<th>Inches</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
</tr>
<tr>
<td>A_r—Black loam, becoming dark brown towards the base. Prismatic. pH 6.5.</td>
</tr>
<tr>
<td>1- 3</td>
</tr>
<tr>
<td>A_r—Brown to light brown loam. Prismatic to columnar, breaking into a somewhat porous nuciform mesostructure. The columns continue down into the B_r horizon. pH 5.9.</td>
</tr>
<tr>
<td>12 B_r—Brown to dark brown clay loam. Columnar, fairly easily broken down to a medium nuciform mesostructure. pH 6.2.</td>
</tr>
<tr>
<td>C—at 36°. Brown to dark brown till. Similar in appearance to Killam parent material but no apparent soil. pH 7.8.</td>
</tr>
</tbody>
</table>

Agricultural Use.

The presence of a thin, friable light-colored horizon just below the black surface distinguishes Daysland loam from Elnora loam. It can be distinguished from the Killam loam in that it does not have the sharp break between the surface and subsurface and does not have the hard round topped columns at this break.

Daysland loam is good arable land and is used mainly for wheat production. Since this soil occurs mostly on slightly sloping land, and since the subsoil is fairly heavy, it is vulnerable to water erosion. There seems no reason why this soil type should not continue to be a wheat growing area providing the organic matter content is maintained and other precautions also taken to prevent both wind and water erosion.

(c) KILLAM LOAM (map symbol K.I.L.)

Killam loam is a poor to fairly well drained soil usually found on depressional to gently undulating topography. The native cover
Soil Survey of Red Deer Sheet

is an open parkland vegetation. The aspen poplar and willow bluffs cover a much smaller percentage of the area than do the medium to short grasses. In many of the mapped areas it forms about 75 percent of the total. In all there are 106,000 acres mapped.

The following is a description of an average Killam loam profile. It is a solodized solonetz (columnar pan) profile.

Inches

6 A.—Black loam grading to dark brown at the base. Weakly prismatic. pH 5.9.
1-2 A.—Light brown to light grey brown sandy loam. Weakly platy; crushes to a fine powder. pH 5.7.
Ca & SO4—At about 24” to 30” from the surface. Low to medium concentration.
C—Dark brown clay loam to clay. Contains lime, salt, iron and coal flecks and shale fragments. pH 7.7.

A thinner phase, that is one with three or four inches of dark A, may occur in some of the lower positions. It is less well drained and may have a higher salt content in the subsoil than the deeper phase. In these areas there is about 10 percent of eroded pits; that is, pits in which the surface or A horizon has been eroded off. A small percentage of eroded pits, mostly grassed over, occurs in the general Killam loam area. About 1,000 acres of stony phase Killam Loam are mapped along Battle River in Range 16.

Agricultural Use.

Killam loam can be distinguished in the field by the thin black surface soil and the hard dark brown columnar subsurface horizon, and also by the light-colored rounded caps of the subsurface horizon. (See Plate VIII, fig. 2.)

Two characteristics of this soil have a pronounced influence on its agricultural use, namely, the hard, tight subsurface horizon and the salt content of the subsoil. These soils absorb water very slowly so that during heavy rains the thin surface layer may become so wet that it actually flows. This can eventually expose the less fertile and hard to cultivate subsoil. Under less heavy rains the water rarely soaks into the subsoil and so is quickly lost by evaporation. This reduces the amount of rain available for plant growth. This is more apparent and more significant in the shallower soils on the east side of the sheet than in the Wetaskiwin and Camrose soils on the west side. The dry hard subsurface horizon offers considerable physical obstruction to root penetration. Every effort should be made to keep this hard layer permeable by cultivation or by growing deep rooted legumes.

Since the salt concentration is usually not overly high and contains considerable gypsum, alkali is not a serious problem. In
some of the lower spots, however, it is in sufficient quantities and
close enough to the surface to affect growth. Alkali-resistant crops
should be grown in these areas. In general this soil is fairly good
arable land.

For a description of the agricultural use of the depressional
spots in this area, the reader is referred to the description of
sloughs on page 42.


The soils in this group are medium textured thin black soils de-
veloped on glacial till that is mainly of Paskapoo formation origin.
These soils are the thin black counterpart of the Antler soils de-
scribed earlier in this report. They are mapped on the western
edge of the Beaverhills Moraine. The parent till is a brown color,
is gritty and has a medium to high lime carbonate content. Airdrie
loam is the principal member of this group.

(a) AIRDRIE LOAM (map symbol Ad.L.)

Airdrie loam is a medium textured well drained soil developed
on glacial till. The topography varies from gently undulating to
rolling. The native vegetative cover is an open parkland character-
ized by small poplar clumps particularly in the more sheltered
spots and by willow in the low spots. Stones are few to some in
number, mainly sandstone slabs and quartzites.

The parent material of the Airdrie loam as mapped in this area
appears to contain some Edmonton formation till; and the profiles
show some of the characteristics of the Elnora loam. There are
52,000 acres mapped.

Below is a description of a typical Airdrie loam profile. It is a
thin black earth.

<table>
<thead>
<tr>
<th>Inches</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>Black loam (sandy). Loose with weakly developed vertical cleavage lines.</td>
</tr>
<tr>
<td>1</td>
<td>Dark brown.</td>
</tr>
<tr>
<td>6-10</td>
<td>Brown to yellow brown heavy loam. Wide irregular prismatic. Very little staining on the cleavage faces.</td>
</tr>
</tbody>
</table>
| 4-10   | Brown to light brown heavy loam. Structure similar to B,.
| Ca     | Varies from 18” to 24” from the surface. Medium to medium high concentration. |
| C      | Brown loam to clay loam (sandy) till with a medium high calcium carbonate (lime) content. |

NOTE: (1) In some places the lime content of the Ca horizon is quite high and may occur at 8 to 10 inches from the surface.
(2) The Airdrie loam profiles in the moraine between Knee Hill and Three Hills Creeks have a less pronounced yellow tinge and a more pronounced prismatic structure in the B horizon. There is also more evidence of staining along the cleavage lines of the B horizon.
Agricultural Use.

An Airdrie loam profile can be distinguished by the shallow black surface, the yellow brown subsurface and the presence of sandstone erratics (see Plate VIII, fig. 1).

Airdrie loam is good arable land, if on gently undulating to undulating topography. The mapped areas lie on the northern edge of the main Chinook Belt and are therefore subject to a fairly high evaporation factor. This together with the fairly limy nature of the subsoil would indicate that all possible effort should be made, first, to increase the water-holding capacity of these soils, and secondly, to prevent loss of water by run-off. Limited experimental data would indicate that they will respond to the application of phosphatic fertilizers.

Associated with the Airdrie loam in the more poorly drained areas is from 10 to 15 percent of Penhold meadow (see page 49). Many of these are arable; some however, in average years contain runoff water till late in the spring or early summer. Farming practices that would tend to hold more of the runoff water in the surrounding higher land would be doubly desirable.

B. Thin Black Soils Formed on Material of Glacial Lacustrine Deposition


The soils of this group are formed primarily on material that is sorted out of the surrounding glacial till of Edmonton formation origin. In a general way they are the thin black counterpart of the Wetaskiwin loams. Gadsby silt loam is the only profile type mapped.

(a) GADSBY SILT LOAM AND LOAM
(map symbol Gd.Si.L. and Gd.L.)

Gadsby loam and silt loam are of medium to medium heavy textured soils developed on glacial lacustrine material. This deposition is often fairly shallow and the underlying glacial till may be within three or four feet of the surface. The parent material is a brown uniform silty clay containing a low to medium lime carbonate content and a medium to medium heavy salt content. The mapped areas occur north of Gadsby and Stettler and are associated with Killam loam.

The Gadsby loams are fairly well drained soils usually found on relatively level topography in an area that is generally slightly lower than the surrounding land. The native cover is made up of small poplar and willow bluffs together with grasses mainly of the coarser varieties. There are 145,000 acres mapped.

The following is a description of an average Gadsby silt loam profile. It is a solodized solonetz (columnar pan) profile.
Inches

4- 6 A_4—Black silt loam. Weakly prismatic; crushes to a fine grain mesostructure. pH 6.0.

1- 3 A_5—Dark brown silt loam. Structure similar to above.


6 B_4—Dark grey clay. Columnar, breaking to medium blocky. Heavily stained along cleavage lines. pH 7.2.

8 B_3—Brown to dark brown silty clay. Massive with some vertical cleavage lines. pH 7.8.

SO—at 24” to 30” from the surface. pH 7.2.

C—at 30” to 40” from the surface. Brown silty clay. pH 7.9.

In the depressional spots a fairly deep granular dark grey silty clay loam may occur. The areas are practically stone free.

An area of shallow phase Gadsby loam is mapped between Tps. 17 and 18, Range 40. This soil has an average of 3 to 4 inches of A horizon.

Agricultural Use.

Gadsby silt loam is fairly good arable land. It has the same objectionable characteristics as the surrounding Killam loam, namely, the very hard subsurface horizon and a fairly high salt content in the subsoil. In fact the two soils are quite similar but can be distinguished in the field by the fact that the Gadsby loams generally occur in basin-like areas; they are stone free, and the subsoil is a uniform brown clay (the subsoil of a Killam loam is variable and contains stones, small iron-stones and bits of coal).


The soils of this group occur in the wide valleys that lead into the main Drumbeller clay area. South of the mapped area there is a great depth of clay parent material: this deposition, however, gradually thins out towards the edge. In the mapped area, therefore, the underlying glacial till is often within three or four feet of the surface. The clay parent material contains some calcium carbonate and is relatively non-saline. Two profile types, namely, Three Hills and Twining, are mapped.

(a) THREE HILLS CLAY AND SILTY CLAY LOAM
(map symbol Th.C. and Th.Si.C.L.)

Three Hills clay is a heavy textured soil developed on water lain clay parent material. This parent clay contains upwards of 60 percent of the clay fraction. Areas of this soil are mapped along Ghostpine and Three Hills creeks (see Plate III, fig. 3). The main area lies south, namely, adjacent to the town of Three Hills. Small areas of Three Hills silty clay loam are mapped in the moraine north of Elnora and north-west of Big Valley. These are isolated basin-like areas. They are, in the main, on gently undulating topography and are fairly well drained. The surface texture is lighter than that in the main Three Hills area. They are good arable lands.
Three Hills clay is a fairly well drained soil on gently undulating topography. The native vegetative cover is primarily grass; some shrubs grow along the stream courses. There are 21,000 acres mapped.

The following is a description of an average Three Hills clay. It is a granular, thin black earth.

Inches

2 A2 — Dark grey nuiform clay.
6 B1 — Dark grey to grey clay. Large nuiform, somewhat waxy.
12 B2 — Dark grey to grey clay. Large blocky to massive waxy.
Ca — At 12” to 18” from surface. Low concentration.

Associated with the Three Hills clay in this area are small areas of imperfectly drained soil. In the imperfectly drained position the B horizon is of a large nuiform structure and quite waxy. Free lime carbonate is found at 8 to 10 inches from the surface. Salt crystals are often found in this profile at 15 to 20 inches from the surface. This profile type is inferior to Three Hills clay. In the imperfectly to poorly drained positions somewhat marsh-like conditions are found. The surface soil is very heavy and is of a very coarse nuiform structure. In the Three Hills Creek valley these marsh-like areas make up approximately 600 acres.

Agricultural Use.

Three Hills clay can be distinguished in the field by the deep grey stone-free clay deposition. It is slightly darker in color than Drumheller clay found in the main clay areas to the east.

This is a rich productive soil well supplied with plant nutrients, particularly the mineral elements. It is, however, vulnerable to water erosion. Since most of this clay is found on sloping land, at least a modified type of contour farming should be practised on it. Rill and gully erosion are the most common on this soil. Contour strips would control the rill erosion. Gully erosion may require grassing of the vulnerable draws. It is important that these gullies be checked before they get too large and out of control.

(b) TWNING CLAY LOAM AND SILT LOAM
(map symbol Tw.C.L. and Tw.S.L.)

The Twining clay loam and silt loam are medium to heavy textured soils developed on relatively shallow water lain clay parent material. In general, they occur along the rim of the clay basin. The underlying glacial till is usually within 3 to 5 feet of the surface.

Twining is a fairly well to well drained soil on gently sloping to gently rolling topography. There are approximately 13,000 acres mapped.
The following is a description of an average Twining clay loam. It is a thin black solonetzic (mildly columnar pan) profile.

Inches

2 A1—Black granular clay loam. pH 6.2.
5 A2—Dark brown. Mildly prismatic clay loam.
7 A4—Light brown. Mildly platy loam.
10 B2—Slightly lighter in color and less waxy than B1.
C—at 20" to 24" from the surface. Low to medium concentration.
D—at 40" from the surface. Glacial till.

Agricultural Use.

The Twining clay and silt loams are transition soils between the Three Hills clay in the lacine basin and the glacial soils on the uplands. They can be distinguished in the field by the thin light colored A2 horizon, and the greyish heavy textured subsoil.

Twining soils are, in general, good arable lands. Some of the steeper slopes are vulnerable to water erosion; the more friable A horizon may erode exposing the heavier textured B horizon. Keeping the soil well supplied with fibre and practising contour farming should greatly reduce the danger of loss by erosion.

C. Soils Developed on Alluvial-Aeolian Deposited Materials

   (a) IRMA SANDY LOAMS AND LOAM (SANDY)
   (map symbol L.S.L., L.F.S.L. and L.L.)

   The Irma soils are light textured and are developed on mixed wind and water transported materials: that is, they are on re-worked material from the surrounding and underlying drift sheet. The parent material is fairly siliceous material low in lime carbonate and relatively free from salts.

   There are three main areas mapped. The area west of Ghostpine Creek (north of Trochu) is mainly loam (sandy); that is, it is a light loam. This area is level to undulating and there is very little waste land. The till D horizon is from three to five feet from the surface and, in places, there is varving at the contact. It is practically all cultivated and is good arable land. The area south of Stettler is a light fine sandy loam. There is some Torlea loam and numerous sloughs throughout the area. Till or residual sandy shales is the D horizon. The black surface varies from 3 to 9 inches in depth. In general, it is a variable area and on the average is classified as fairly good arable land. The area in the north-east (north of Gadsby) is mainly sandy loam. Patches of Torlea loam are found throughout the area, and sorted residual sandy shale often occurs to within two to four feet from the surface. It is fairly good arable land.

   The Irma soils are well to excessively drained although usually the heavily textured more slowly permeable D horizon is within
five feet of the surface. The native cover is grass with bluffs of small poplar. There are 57,000 acres mapped.

Following are descriptions of average Irma fine sandy loam and loam profiles. The first is a sandy thin black earth, the second a weakly prismatic thin black earth; spots are very mildly solonetzic.

**IRMA FINE SANDY LOAM**

<table>
<thead>
<tr>
<th>Inches</th>
<th>Description</th>
<th>pH 6.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-8</td>
<td>A₁—Black, firm.</td>
<td></td>
</tr>
<tr>
<td>4-8</td>
<td>A₂—Dark brown, indistinct vertical cleavage lines.</td>
<td></td>
</tr>
<tr>
<td>0-2</td>
<td>A₃—Brown to light brown loamy sand. Structure as in A₂. pH 6.3.</td>
<td></td>
</tr>
<tr>
<td>10-12</td>
<td>B₁—Brown loam (sandy). Weakly wide columnar. pH 7.0.</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>Loam to light silt loam, may be varved, contains lime carbonate. pH 8.2.</td>
<td></td>
</tr>
</tbody>
</table>

**IRMA LOAM**

<table>
<thead>
<tr>
<th>Inches</th>
<th>Description</th>
<th>pH 7.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-3</td>
<td>A₃—Light loam. Black—firm.</td>
<td></td>
</tr>
<tr>
<td>4-7</td>
<td>A₄—Light loam—dark brown—wide prismatic, friable crushes to small crumb. pH 6.7.</td>
<td></td>
</tr>
<tr>
<td>8-12</td>
<td>B₁—Loam—brown to yellowish brown, medium well defined prismatic. pH 6.7.</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>B₂—Wide prismatic—less well defined. pH 7.2.</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>At about 36” from the surface. Clay loam. Stone-free, contains lime carbonate, may be varved at till contact. pH 8.2.</td>
<td></td>
</tr>
</tbody>
</table>

**Agricultural Use.**

Irma soils can be distinguished from the surrounding soils by their sandy character, by the lack of stones and by the absence of any well defined structure. They are droughty soils and soil drifting can be a problem. They should not be farmed on a wheat-fallow rotation, that is, a rotation must be used that will keep a fairly high content of fibre in them. With the higher organic content they will have a higher water-holding capacity and might respond to the application of fertilizers.

**DARK BROWN SOILS**

The dark brown soils of Alberta lie as a belt approximately fifty miles wide between the thin black soils and the brown soils. This zone is characterized by a somewhat heavier grass cover than in the Brown Zone and by the presence of isolated clumps of scrub in the locally more humid spots. The Dark Brown Zone cuts into the south-east corner of the mapped area. The average annual precipitation in this zone is about 14 inches. An “average” soil in this zone has five or six inches of dark brown A or surface horizon and the average nitrogen content of the surface foot is about 0.20 percent; this is less than half the nitrogen or organic matter found in the average black soils. They are usually fairly well supplied with the mineral plant foods.

**A. Dark Brown Soils Developed on Glacial Till**

1. **Parent Till Mainly of Edmonton Origin.**

In this area the till is primarily of Edmonton origin. Varying
percentages of Bearpaw shale from farther east is mixed with it and there appear to be local spots principally, east of Big Valley, where there is some Paskapoo mixed in. In general, the till is a brown to grey brown color and of a sandy clay texture. It has a low to medium lime carbonate content and contains a considerable number of Precambrian erratics. The till mantle is fairly deep in the rolling to hilly areas, but in the leveller area from Gough Lake north is quite shallow. In this latter area the underlying bedrock comes to the surface in many places.

The following profile types have been mapped; Hughenden loam and clay loam and Halkirk loam and heavy loam. The Hughenden loam is the principal type in the rougher morainic areas and Halkirk loam dominates on the leveller areas of ground moraine. Following is a description of the two types found.

(a) HUGHENDEN LOAM AND CLAY LOAM
(map symbol Hn.L. and Hn.C.L.)
Hughenden loams are well drained soils found on undulating to hilly topography. The native cover is grass with occasional patches of low scrub. In all there are 188,000 acres mapped.

The following is a description of an average Hughenden loam profile. It is a prismatic dark brown earth.

Inches
4 A—Dark brown, prismatic. pH 7.0.
3 A.—Brown to dark brown, prismatic. pH 6.3.
6 B—Strong brown, prismatic to columnar, friable nuciform meso-
structure, some staining in the cleavage faces. pH 6.4.
10 B—Brown. Friable, with some vertical cleavage lines.
Ca—at about 20 to 24 inches from the surface. Low to medium lime.
C—Brown sandy clay loam to clay till.

The profiles occurring on the knolls are somewhat shallower than the ones described and those in the lower topographic positions may be deeper. The valley soils have received subsequent depositions eroded from the hills and adjoining slopes.

Agricultural Use.
Hughenden loam is the normal dark brown earth and can be distinguished from associated soils (mainly Halkirk loam) by the over all brown to dark brown color and by the relatively gradual change in structure from surface to subsoil. This soil when occurring on the better topographic phase is rated as fairly good arable land. The rougher land mapped rolling and hilly, is mainly pasture land.

In the Dark Brown Zone moisture is the principal limiting factor affecting crop production and, at present, these soils are farmed mainly on a two-year, wheat-fallow, rotation. Due to the relatively short period that these soils have been farmed, and because they have a fairly high mineral plant food content to start with, this
wheat-fallow system has proven fairly successful. It is known, however, that this rotation is very destructive of the soil's organic matter. With the depletion of the soil's organic matter and a decline in available plant food there will come a decline in crop yields, there is a loss of soil structure and there is a loss of resistance to wind and water erosion. Since most of the Hughenden soils occur on areas of rougher topography the erosion problem is very significant. It is obvious, then, that the fibre content of these soils should be maintained as high as economically feasible. This means returning all the straw back to the field; it may mean also the growing of some grass and legume mixtures at periodic intervals. It means also that the steeper slopes including the rough land, should be withdrawn from cultivation and seeded to grass and that the moderate slopes be farmed where possible on the contour.

(b) HALKIRK LOAM AND HEAVY LOAM

Halkirk loams are fairly well to well drained soils usually found on level to undulating topography. The native cover is grass. Eroded pits are associated with this profile type. Some of these pits are devoid of vegetation, some have "regraded" to the point of supporting a thin grass cover. There are 195,000 acres mapped.

The following is a description of an average Halkirk loam. It is a solodized solonetz (hard columnar pan) profile.

Inches

1. 

3 A₁—Very dark brown. Loose. pH 6.3.

4 A₂—Dark brown. Loose to somewhat prismatic.


6 B₄—Brown to dark brown. Less well defined structure than B₃. Ca & SO₄ from about 18" to 24" from the surface.

C—at about 25" from the surface. Brown sandy clay containing lime and salt. pH 7.4.

There is some variation in this profile type: the A horizon varies from 4 to 10 inches in depth and there is some variation in the amount of salt present in the B horizon.

Agricultural Use.

Halkirk loam is the solodized solonetz profile type, and can be distinguished by the hard round topped subsoil horizon and the sharp contact between this and the surface horizon. Torlea loam with which it might be confused, is a shallower soil that usually has less than four inches of top soil over the hard subsoil.

Halkirk loam, in general, can only be considered as fair arable land, varying from marginal to fairly good depending mainly on the depth of the surface horizon (see Plate III, fig. 1). The shallower phases are better left as pasture land. Water and root penetration, through the hard R horizon is difficult, and methods by which this
horizon can be made more friable will increase the soil's productivity. The occasional inclusion of tap rooted plants such as alfalfa or sweet clover will aid materially in this.

It is also important that none of the friable top soil is lost by erosion. This top soil is necessary to make a satisfactory seed bed and to start the young seedlings. Due to the sharp contact between the A and B horizons and the impervious nature of the B horizon, water erosion is a serious problem in these soils, particularly in the sloping areas. Contour cultivation, maintaining a trash cover and making the B horizon more receptive to water penetration will all aid in reducing this erosion.

B. Dark Brown Soils Developed on Glacial Lacustrine Deposited Material


The parent material for these soils was laid down in glacial lake beds: most of the areas are associated with the larger glacial Lake Drumheller to the south. The parent material is relatively non-saline and contains some free calcium carbonate.

Drumheller clay and Michichi clay loam have been mapped. A description of these two soils follows.

(a) DRUMHELLER CLAY (map symbol D.C.)

Drumheller clay is a fair to fairly well drained soil on level to gently undulating topography. The native cover is a fairly thick stand of prairie grasses. Much of the area was of "Turtle-back" micro-relief. Only a small acreage (3,700 acres) are mapped in this area (the main area lies to the south). The following is a description of an average Drumheller clay profile. It is a granular dark brown earth.

Inches
2- 3- B, - Dark grey. Large nuciform.
6 Bn-Dark grey. Very coarse, irregular, blocky; some cleavage lines.
12 Bn & Ca-Dark grey. Coarse blocky to massive, waxy.
C -at about 24" from surface. Large blocky. pH 7.5.

Agricultural Use.

The Drumheller clay soil can be readily distinguished from the surrounding soils by its uniform grey to dark grey color, its granular character and extremely sticky nature when wet. It is good arable land and most of the areas are of gently undulating topography.

The Drumheller clay is the Dark Brown Zone counterpart of the Three Hills clay described on page 60, and offers similar erosion problems as does the Three Hills clay. That is, they are vulnerable to water erosion. It is primarily one of sheet erosion although some gullying has also taken place. These clay soils absorb water slowly and therefore during heavy downpours (of which there is in the Drumheller area a higher incident than elsewhere in the
province) the surface tends to puddle and literally slide down the slopes. Contour farming and the maintenance of an open granular structure will tend to prevent this. Good structure can be maintained by careful cultivation at the “optimum” moisture content and by keeping the fibre content at a relatively high level. The maintenance of good structure is also desirable for satisfactory germination and crop growth. Experimental data, obtained over the past 4 years, indicate that satisfactory yield increases should result from the use of phosphatic fertilizers. The Drumheller clay area has been one of Alberta’s most productive soil areas; every effort should be made to maintain this high level of productivity.

(b) MICHICHI CLAY LOAM (map symbol Mi.C.L.)

Michichi clay loam is a fairly well drained soil usually found on the fringes of the Drumheller clay basin: that is, it occurs where the clay deposition over the glacial till is thinning out and is usually less than 4 feet thick. The areas are usually of gently undulating to gently sloping topography. Only a small acreage (18,300 acres) are mapped in this area.

The following is a description of an average Michichi clay loam profile. It is a solonetzic (columnar pan) profile.

**Inches**


1/2 1 A₂—Grey. Fine platy.


C—Greyish brown clay. Contains some salt and lime.

D—at 30 to 60 inches from the surface—brown glacial till.

There is considerable “tonguing” in this soil. That is, there are narrow tongues where the A horizon is up to 12 inches in depth. In places this soil has a sufficiently deep A₂ and a well enough developed columnar B₁ to be called a solodized solonetz profile. In general, however, these characteristics are not strongly pronounced.

**Agricultural Use.**

Michichi clay loam, in general, is found along the edges of the Drumheller clay basin. Patches also occur on the slopes of some of the higher knolls within the basin proper. It can be distinguished from Drumheller clay by the thin light grey horizon, three to six inches below the surface, and from the surrounding medium textured soils by the grey, granular character of the cultivated soil.

This soil is good arable land. It appears to be fairly well supplied with the mineral plant food with the possible exception of phosphorus and the alkali salt content is not excessive. These soils, however, also offer an erosion problem: one possibly more serious than with the Drumheller clay. The surface horizon absorbs water fairly readily; the heavy subsoil does not. Since
there is a very sharp line of demarkation between these two hori-
zons, and since most of the areas are of sloping topography, sheet
erosion could be of serious proportions. Loss of the surface horizon
and the exposure of the hard subsoil would seriously effect the
farmability of these soils.

C. Dark Brown Soils Developed on Alluvial and Aeolian Materials


The parent material of this group of soils is of Upper Cretaceous
origin. It is supposed that Birch Lake sandstone and Ribstone
sandstone, which lie east of the surveyed area, largely contributed
the parent material of these soils. These two formations together
with the Grizzly Bear shale which divides them are correlated with
the Belly River-Foremost beds farther south.

There is a considerable acreage of sandy soils in the general
area between Sullivan Lake and Wainwright. Only a small acre-
age, however, occurs in the surveyed area. Much of this sand is
water lain and is associated with post-glacial stream courses. Some
of it has subsequently been moved and sorted by wind action. The
depth of the sandy deposition varies from one to two feet on the
fringes of the area to over 50 feet in some of the dune sand areas.
The sand overlies glacial till in most instances; in a few places it
lies directly on residual or sorted residual material.

Three profile types have been mapped, namely, Wainwright
loamy sand, Metisko sandy loams and Sullivan Lake sandy loam.
Following is a description of these three types.

(a) WAINWRIGHT LOAMY SAND (map symbol Wt.L.S.)

Wainwright loamy sand is an excessively drained soil that most
frequently occurs adjacent to the dune sand areas. The topo-
graphy of the areas is mainly gently undulating. The native caver
is grass, containing much sand grass and stipa, as well as rose bush
and some scrubby poplar. There are only 1,700 acres mapped in
this area.

The following is a description of an average Wainwright loamy
sand. It is a sandy dark brown earth.

Inches

3 A—Very dark brown. Bound with grass roots.
4-8 A/B—Brown to dark brown. Weakly developed vertical cleavage
lines.
10 and down—Loose sand to loamy sand.

In the lower positions the A horizon may be up to 10 inches in
depth. Where a D horizon is within 4 or 5 feet of the surface there
may be a little calcium carbonate in the sand immediately above the
D horizon contact.

Agricultural Use.

Wainwright loamy sand is, usually, found associated with the
dune sand areas. It is the leveller stabilized areas. The surface
horizon is held mainly by grass roots, the remainder of the profile is quite loose: that is, it lacks the structure and firmness of the Metisko sandy loam.

Since this soil has a very low clay content it is very difficult to maintain a cloddy structure: and it is, therefore, quite vulnerable to wind erosion. It is, in general, low in plant food content and has a low water-holding capacity. The maintaining of a relatively high organic matter content will improve all three of these deficiencies. The organic matter acts as a binding agent to resist wind erosion, and it is a source of available plant food, and it increases the water-holding capacity. However, these soils should not be considered as grain-producing soils. In general, they are best suited to grass production, but may be periodically plowed up and grain cropped for a short term. They may respond to the application of artificial fertilizer.

(b) METISKO SANDY LOAMS AND LOAMS (SANDY)


The Metisko sandy loams are well to excessively drained soils usually found associated with the Wainwright loamy sands. The topography of the area varies from level to gently rolling but is generally relatively level. The native vegetation is grass with patches of scrubby growth including clumps of small poplar. There are 42,000 acres mapped in this area.

The following is an average profile of a Metisko sandy loam: it is a sandy dark brown earth.

<table>
<thead>
<tr>
<th>Inches</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-8</td>
<td>A—Dark to very dark brown (the top 2 inches often black). Very weak prismatic structure.</td>
</tr>
<tr>
<td>0-1</td>
<td>A—Brown (may or may not be discernible). Loose.</td>
</tr>
<tr>
<td>0-6</td>
<td>B—Brown—usually present, very weakly prismatic.</td>
</tr>
<tr>
<td>10-20</td>
<td>B—Brown to dark brown. Firm, weakly developed wide, irregular prisms.</td>
</tr>
<tr>
<td>C</td>
<td>at about 30&quot; from the surface. Loose sand, may contain a low content of calcium carbonate.</td>
</tr>
<tr>
<td>D</td>
<td>Till or sorted residual material. At times within 40 inches of the surface but more often deeper.</td>
</tr>
</tbody>
</table>

Some of the areas contain gravel lenses and an area of gravelly sandy loam is mapped. One small area of loam is mapped. This is a light loam and the parent material is quite sandy.

Agricultural Use.

Metisko sandy loam is usually found on fairly level land and can be distinguished from Wainwright loamy sand by the firmness and discernible structure in the exposed profiles in the road cuts.

These soils have limited arable possibilities. If the organic matter is maintained at a fairly high level they should produce fairly good crops. However, they suffer, to a lesser degree, the same deficiencies as the Wainwright loamy sands and the same
remedial measures are suggested. In general they will stand a higher percentage of cereal cropping than will the loamy sands.

(c) SULLIVAN LAKE SANDY LOAM (map symbol Sul.S.L.)

The Sullivan Lake sandy loams are soils in which the surface is well to excessively drained and in which the subsoil is strongly resistant to water movement. The topography of the areas is generally level to gently undulating and often basin like. The native cover is grass, most of it of a coarse character and some of it alkali tolerant species. Only 6,000 acres were mapped in this area.

The following is a description of an average Sullivan Lake sandy loam: it is a solodized solonetz (hard columnar pan) profile.

Inches
4-6 A₄—Dark brown sandy loam. Loose, bound by grass roots.
4-6 A₅—Brown to dark brown. Fairly loose.
1-2 A₆—Light brown, loamy sand. Loose.
4-6 B₅—Dark brown clay loam to silty clay loam. Hard wide columnar, may have round topped columns.
5-10 B₆—Dark brown clay loam to silty clay loam—massive.
C or D—Sandy clay loam, often fairly saline.

This soil, although of the solonetz group, appears in places to suggest an A/D profile. The contour of the heavy subsoil is quite irregular and therefore the depth of sandy deposition varies from a few inches to over 20 inches in depth.

Agricultural Use.

Sullivan Lake sandy loam can be distinguished in the field by the sandy surface soil and the abrupt change to the heavy textured columnar B horizon.

If the surface is fairly deep and the subsoil is not too saline, it makes fair arable land. These soils are not as droughty as are the deep, sandy Meisko soils. Those, however, that are shallow and/or saline are inferior and are no better than pasture land.

The surface is vulnerable to wind erosion. Loss of the surface and consequent exposure of the heavy subsoil would be extremely detrimental and every precaution must be taken to prevent this.

D. Dark Brown Soils Developed on Coarse Outwash Materials

These soils are characterized by a very gravelly parent material. In general, there is sufficient fine textured material on the surface to make the soil of some agricultural value. The areas in which the gravels come practically to the surface are mapped simply as gravel.

(a) SCOLLARD LOAM (map symbol Sc.L.)

Scollard loam is an excessively drained soil that is found primarily in drainage channels. The areas are usually fairly level and often terraced. The principal areas of Scollard loam is in Big Valley. This is a wide post-glacial channel that connects the large
The following is a description of a Scollard loam: it is a gravelly dark brown earth.

Inches

2 An—Dark brown to black loam to sandy loam. Bound by grass roots.

4- 6 Ar—Brown to dark brown loam, sandy. Loose, some root binding.

0- 6 B—This may or may not be discernible. If present it is brown to dark brown, is somewhat firm and is weakly prismatic.

Gravel—At 6" or lower from the surface there is mixed sand and gravel. The gravels are generally lime coated.

There is considerable variation within the areas, namely, from very gravelly and stony streaks that come practically to the surface, to areas with upwards of 30 inches of loam to sandy loam deposition over the gravel.

Agricultural Use.

Scollard loam can be distinguished by its very gravelly subsoil.

In general it is not arable land excepting for the growth of grass or hay. It is shallow, has a low water-holding capacity, dries out quickly and, if bare, is vulnerable to wind erosion. Seeding down permanently to grass should tend to give the greatest water retention capacity.

E. Soils Developed on Relatively Undisturbed Residual Material

The residual material in this area is mainly lower Edmonton formation. The areas have been glaciated but, in general, the till has eroded off leaving only scattered erratics on the surface.

1. Dark Brown Soils Developed on somewhat Saline Sandstones and Sandy Shales.

(a) TORLEA LOAM AND HEAVY LOAM (map symbol T.L. and T.H.L.)

The Torlea loams are poorly to fairly well drained soils. The areas are of level to depressional topography. There is a fair covering of native grasses, some of it alkali resistant species. The flats produce native hay. Willows often occur around the edges of the depressions.

Torlea loams are also mapped in the Thin Black Zone. However, since they have a very shallow surface (A) horizon and are often found in the more humid topographic position, no average difference could be seen between those in the Dark Brown and those in the Thin Black Zones.

The main area mapped lies between Gough and Sullivan Lakes northward. A total of 154,000 acres are mapped.

The following is a description of an average Torlea loam: it is a solonetz-like profile.
Inches
3  A.—Dark brown loam, the top 1 or 2 inches may be black. Grass root binding. pH 7.5.
1-2  A.—Light brown loam, sandy, porous. pH 6.9.
7-10  B.—Dark brown clay loam to gritty clay. Round topped columns breaking to hard medium blocky mesostructure.
C & S.—At 12 to 24 inches from the surface. Lime concentration low to medium. Salt concentration medium to heavy.
C—At 20 to 30 inches from the surface; partly weathered sandy shale bed-rock. pH 7.6.

Agricultural Use.
Torlea loam areas are characterized by the shallow surface horizon, the hard round topped subsurface horizon and the level to depressional nature of the topography. Bed-rock exposures can often be seen in the road-cuts.

Torlea loam is marginal arable land. Numerous marshes and large marshy flats occur throughout the area from which some hay is obtained. Its value depends to a great extent upon the depth of the profile over the parent bedrock. In wet years there is a danger from flooding as the water has great difficulty penetrating through the compact subsurface horizons. The high salt content of the parent material combined with poor drainage presents the greatest problem. Crop production on this soil should be restricted mainly to the growing of legumes and cultivated grasses.

MISCELLANEOUS SOILS
A. ALLUVIUM (map symbol Av.)
Alluvium or recent river deposits is mapped in the valleys of Red Deer River, Blindman River, Battle River and Pariby Creek. The largest area is adjacent to the city of Red Deer (see Plate V, fig. 1). In general the soil profile has very little development (it is immature) and is usually dark brown to grey brown in color with little evidence of horizon differentiation. The texture varies from light loam to light silt loam. These flats are often badly cut up by oxbows and old stream courses, so large fields rarely occur. They are mapped as fairly good to good arable land and are usually utilized for the growing of coarse grains and hay crops. The river flat adjacent to Red Deer has some fairly large fields. The soil averages a fine sandy loam texture (with occasional gravelly spots) and is somewhat limy. There are 12,000 acres mapped.

B. SALINE MEADOW (map symbol S.M.)
There is considerable depressional land in the mapped area. The better portion (that is usually arable) has been mapped as meadow soil and named. Some of the areas are mapped as marsh or slough. These are usually non-arable but grow a fair crop of native hay. The remainder are mapped as saline meadows. These have a fairly high salt content, the native vegetation is poor and they are usually medium to heavy textured. Occasionally cultivation is attempted on the saline meadows, usually with very little
success. Any attempt at reclamation would entail flooding and drainage. In a year of fairly high rainfall it might be possible to get some alkali tolerant grass established that would increase the pasture value. There are 14,000 acres mapped.

LAND TYPES

A. SLOUGH (map symbol SL)

Sloughs are found in the depressional spots, particularly in the kettle holes of the moraines. They have, in general, received material eroded from the surrounding hills. They collect runoff water in the spring which in most years remains for only a few weeks. Those that are not too saline grow marsh grass which may be harvested as a hay crop or used as pasture.

Usually these sloughs have a muck-like surface underlain by a heavy textured glei-like horizon. They are usually quite fertile and in years of low rainfall are often cultivated and grow satisfactory crops. There are 38,000 acres mapped.

These sloughs occur across the mapped area. In the Black Soil Zone some of these depressional spots develop a grey surface horizon (depressional podsol). These are briefly described on page 42.

B. ERODED LAND (map symbol Er)

Steeply sloping land, particularly river banks, is mapped as eroded land. That is, this category refers to geological erosion and not to recent erosion on cultivated land. These creek banks have at one time been subjected to severe erosion; however, many of them are now fairly well stabilized by grass and/or tree cover. Most of the areas in the Black Zone are so covered and are of value as pasture and woodlot. As such they serve a useful purpose and overgrazing, indiscriminate cutting of the trees or cultivation should never be practised on these slopes. Along Red Deer River (south of Nevis) and along Battle River and Paintearth Creek there is considerable bare bed rock exposures. Erosion is still going on on these slopes and they are of very little value even as pasture land. Generally these areas are referred to as the “Bad lands”. They are picturesque and a source of Cretaceous fossils. There are 102,000 acres of eroded lands mapped.

CHEMICAL COMPOSITION OF THE SOIL

One or more complete profile samplings was made of each of the mapped soil series. The samples so obtained were taken to the laboratory for analysis. Most of the analyses made were for the purpose of assisting in the classification of the soils although most of these analyses have significance in determining the productive ability of the soil. This latter phase will be discussed in the next section. Nitrogen, phosphorus, pH, silica, sesquioxides, calcium and magnesium determinations were made as well as the physical analyses of color and texture. Analyses of representative profiles
are given in Table IX. The following is a brief discussion of these analytical results more specifically in so far as they apply to averages.

The average nitrogen content of soils across the sheet varies, in general, with the soil zone. The total nitrogen in the surface foot of the dark brown soils averages about 0.16 percent; in the thin black soils 0.20 percent; in the black soils 0.36 percent; and in the grey-black soils about 0.19 percent. In general the heavy textured soils contain more nitrogen than do the light textured soils, and the meadow soils were the highest analyzed. In the Black Zone no difference was noted between soils formed on glacial parent material and soils on transported parent material. Usually there is a sharp drop in nitrogen content from the surface down. In practically all cases the B\textsubscript{2} horizon had less than 0.1 percent nitrogen and often less than 0.05 percent. The exception to this is the strongly solonized profiles where there appears to be some accumulation of organic matter in the B horizon. In these soils there is usually less nitrogen in the A\textsubscript{2} horizon than in the A\textsubscript{1} or B\textsubscript{1} horizons.

There was very little variation in the total phosphorus content of the parent material across the area. Most of the parent materials fell within the range of 0.04 to 0.05 percent phosphorus; that is about 0.1 percent P\textsubscript{2}O\textsubscript{5}. The A horizon averaged about 0.075 percent phosphorus varying from 0.050 to 0.10 percent. In general there was little difference noted in the phosphorus content of the parent materials of intermediate to heavy texture across the area: the sandy parent materials were usually lower. The surface foot of the soils of the Thin Black and Black Zones contained slightly more phosphorus, on the average, than did the dark brown and grey wooded soils.

Total calcium and magnesium determinations were made on type samples throughout the area. Considerable variation exists. There was insufficient data obtained on parent material samples to report satisfactory averages, but the following data from the lime carbonate horizon are indicative. The calcium content of the lime horizon of soils formed on glacial till of Edmonton formation origin averaged about 3.0 percent (mainly in the form of CaCO\textsubscript{3}), in soils developed on till of Paskapoo formation origin about 5.0 percent. The highest calcium content is in the Penhold series where the calcium content of the lime horizon averages about 10.0 percent (14.0 percent CaO); some of the Penhold meadow soils analyze as high as 15 percent calcium. The grey-black transition soils, formed mainly on till of Paskapoo formation origin had from 3 to 4 percent calcium in the lime horizon. The A horizons of most of the soils analyzed contained about 0.6 percent calcium (0.8 to 0.9 percent CaO).

The magnesium content of the A horizon averages about 0.3 percent. Compared on a molecular equivalents basis the magnesium
content was about equal to the calcium. In the lime carbonate 
horizon, however, the magnesium content is, in general, about one-
third to one-quarter, or less, by weight of the calcium content: 
rarely does the Mg content exceed 1.5 percent.

Only a limited number of silica and sesquioxide totals were 
obtained from this area. Three profiles so analyzed are reported in 
Table X: the data are expressed as a percentage of moisture free 
soil (105°C). These represent three great soil groups, namely, 
the grey-black (transition) soils, a black earth and a black solodized 
solonetz. The removal of sesquioxides from the A horizon of the 
grey-black and solodized solonetz soils is noted. Very little, if any, 
movement is noted in the black earth.

pH determinations were made on each profile type; on a 2:1 
dilution basis. These data are reported with the profile descriptions 
given in the body of the report. In general the pH of the A 
horizon of the normal earths varied from 5.8 to 7.0 with most 
failing close to 6.5. The lime carbonate horizon varied from 7.5 to 
8.5. The A horizon of the solonetzic group varied in general from 
5.5 to 6.5 with the lime and salt horizon varying from 7.5 to 9.5: 
only rarely was this latter horizon below 8.0 and rarely over 9.0. 
Those that had a pH up to 9.5 were quite saline, and contained 
considerable sodium. The soils with the very high lime parent 
material averaged pH 7.0 to 8.0 in the A horizon and about 8.5 in 
the subsoil. One sedge peat was analyzed; its surface was pH 6.5. 
In general, then, there are no definitely “acid” soils in the area, 
and very few that are dangerously alkaline.

The colors reported in the profile descriptions were determined 
by comparison with the revised Munsell color chart. Textures were 
determined in the field and later checked against the results ob-
tained by mechanical analyses of representative profiles.

| TABLE IX—CHEMICAL COMPOSITION OF REPRESENTATIVE SOIL PROFILES |

<table>
<thead>
<tr>
<th>Sample No.</th>
<th>Depth in Inches</th>
<th>Horizon</th>
<th>N</th>
<th>P</th>
<th>Ca</th>
<th>Mg</th>
<th>pH</th>
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<td>18-24</td>
<td>C₆ &amp; B₃</td>
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<td>0.063</td>
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## TABLE IX—CHEMICAL COMPOSITION OF REPRESENTATIVE SOIL PROFILES—Continued

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<th>Sample No.</th>
<th>Depth in Inches</th>
<th>Horizon</th>
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<td>Thin Sedge Peat—6-40-27-4</td>
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TABLE X.—SILICA AND SESQUIOXIDE DATA
(Expressed as percent of moisture free soil (105°C))

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<th>Horizon</th>
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<th>SiO₂</th>
<th>Fe₂O₃</th>
<th>Al₂O₃</th>
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<td>2.9</td>
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<td>79.7</td>
<td>2.6</td>
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</tr>
<tr>
<td>2337</td>
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<td>30-40</td>
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<tr>
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<td>10.71</td>
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<td>Wetsukiwin Heavy Loam—Black Solodized Solonetz.</td>
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<td>2197</td>
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<td>3.78</td>
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<td>B₃</td>
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<tr>
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<td>C</td>
<td>30-35</td>
<td>61.47</td>
<td>4.85</td>
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</tr>
<tr>
<td>2204</td>
<td>C</td>
<td>48”</td>
<td>63.06</td>
<td>4.81</td>
<td>14.83</td>
<td>6.91</td>
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</tbody>
</table>

THE PLANTS FOOD

The plant food content of a soil can be divided into two categories, the total amount present and the amount in such form that it is readily available to the plant. The readily available food forms, in general, a very small percentage of the total amount. One of the objects, then, of good farm husbandry is to maintain an adequate supply of this available food. Since organic matter is one source of this, it is advisable to maintain as high a content as possible. Under natural conditions, the darker soils have the highest organic matter content. The surface foot of the “average” soil in the Dark Brown Zone contain about 2½ to 3 percent organic matter; in the Thin Black Zone from 3 to 4 percent, in the Black Zone from 6 to 8 percent, and in the Grey-Black Zone from 3 to 4 percent. Much of this organic matter, however, is in a fairly stable form and decomposes very slowly; that is, it releases plant food very slowly. Any of these soils, if under a grain fallow rotation, will soon reach a point where yields begin to drop due to a shortage of available plant food. To maintain an adequate supply of available food, then, the following must be done: (1) maintain an adequate supply of fresh organic material which on decomposition releases the plant food elements it contains; (2) maintain good air and moisture conditions in the soil including the subsoil—this provides conditions favorable to the decomposition of the mineral soil particles, hence releasing new available food; (3) if these two are in-
adequate, it will be necessary to supplement the plant food artificially, that is, by chemical fertilizers. Many of our soils are now showing signs of deterioration exclusive of the deterioration caused by erosion (which is another, though no less important, factor). If adequate returns are to be maintained, then one or more of the above conditions must be supplied. The maintenance of an adequate supply of organic material is fundamental to good husbandry, because it is a source of plant food, it has a high water-holding capacity, it keeps the soil in good tilth and aeration, and it fibrous will resist soil erosion. Farming so that a fresh supply of organic material is available, generally provides conditions conducive to the second point, namely, providing for a constant release of food from the rock particles. Deficiencies beyond this must be met with fertilizer applications.

Organic material is the principal source of nitrogen, an important plant food. The nitrogen is obtained from the air by soil bacteria and by bacteria associated with leguminous plants.

Exclusive of nitrogen, carbon, hydrogen and oxygen (which come from the air and water) all the plant food elements come originally from the decomposition of the rock material in the soil. Therefore the amount of these foods present is in proportion to the amount in the soils parent material. That is, if a plant food element is in limited supply in the parent material, it may soon become a limiting factor to plant growth. Most of the plant food elements are present in ample supply. One exception to this, however, is phosphorus. It is in limited supply in the parent material of this area and, therefore, as the readily available supply of phosphorus that accumulates is used up, it becomes a limiting factor to crop production. Some of the soils in this area have now reached that state and it is reasonable to suggest that as time goes on others will reach it. When this happens it is necessary to supplement the native supply artificially, that is, by the addition of phosphatic fertilizers. Other plant foods used by the plant in smaller quantity, but nevertheless essential, may also be in limited supply. That is one of many problems still to be solved before we have complete knowledge of our soils potentialities and limitations.

In the more humid areas there is a tendency for the plant foods to be carried from the surface to the lower horizons. This may mean that although ample plant foods are present at lower depths, the surface horizons may be deficient. This is most pronounced in the grey wooded soils of which there is a very limited acreage in this area. Some of the grey-black soils, however, are somewhat affected by this washing down or leaching process. Keeping a good supply of organic matter in the surface horizons of these soils will go a long way towards maintaining an adequate supply of available plant food for the early stages of growth, that is, until such time as the roots can penetrate to the lower horizons. Light application of artificial fertilizers may also be beneficial in this regard.
No soils in the area were found to be very acid (sour). The soils are all well supplied with lime and therefore no beneficial results can be expected by liming the soil.

**WATER SOLUBLE (ALKALI) SALT**

Water soluble salt analyses were made of a number of samples from the Red Deer sheet: some of these are reported in Table XI. Analyses and observation indicate that over most of the area there does not appear to be any serious alkali problem. Some salt does occur, however, in the eastern side of the area and along the Three Hills and Ghostpine drainages; particularly in soils of the solonetz grouping.

Alkali salts originally come from the weathering or decomposition of parent rock material. In the areas of higher rainfall these salts tend to wash or leach out of the soil as they are formed; excepting in the areas of restricted drainage. In the more arid sections there is much less movement of water through the soil and therefore a greater tendency for the salt to accumulate.

The alkali salts are commonly classed as brown, black or white. Brown alkali consists chiefly of the nitrates. Black alkali includes mostly the carbonate and bicarbonate of sodium. White alkali consists chiefly of the neutral salts such as sodium or magnesium chloride, or sodium, calcium or magnesium sulphate. Black alkali is the most toxic, and when present in quantities exceeding about 0.1 percent in the surface soil, it is often detrimental to plant growth. However, practically no black alkali or brown alkali was found in this area. The white alkali is the least toxic and seldom causes excessive injury unless present in excess of about 0.5 percent in the surface soil. Most Alberta soils contain less than 0.1 percent of water-soluble salts in the surface horizons, and in most of these soils there is less than 1 percent salt, mostly white alkali, in the subsoil. In such cases the injury due to alkali is relatively light. This is particularly true if the salt present is calcium sulphate or gypsum, since this salt ameliorates the toxic effect of other alkali salts.

High salt concentrations are found in some of the inland basins where salts have been washed in from the surrounding higher land. Most of these are small and are considered as non-arable. If the salt concentration is not too high they produce a crop of native hay.
<table>
<thead>
<tr>
<th>Sample No.</th>
<th>Horizon</th>
<th>Remarks</th>
<th>Percent</th>
<th>N.V.S.</th>
<th>(-\text{HCO}_3)</th>
<th>(\equiv\text{CO}_3)</th>
<th>Ca++</th>
<th>Mg++</th>
<th>Na+</th>
<th>pH</th>
</tr>
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<tbody>
<tr>
<td>2029</td>
<td>C</td>
<td>Beaverhills Loam</td>
<td></td>
<td>0.04</td>
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<td>2087</td>
<td>C</td>
<td>Antler Loam</td>
<td></td>
<td>0.11</td>
<td>0.02</td>
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<td></td>
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<tr>
<td>1983</td>
<td>C</td>
<td>Elnora Loam</td>
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<td></td>
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<tr>
<td>2000</td>
<td>C</td>
<td>Twining Clay Loam</td>
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<td>1.50</td>
<td>0.01</td>
<td>0.97</td>
<td>0.24</td>
<td>0.05</td>
<td>0.125</td>
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<tr>
<td>2001</td>
<td>at 20&quot;</td>
<td>Meadow in Three Hills clay</td>
<td></td>
<td>1.27</td>
<td>0.02</td>
<td>0.90</td>
<td>0.22</td>
<td>0.07</td>
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<td>2047</td>
<td>A</td>
<td>Penhold Meadow silt loam</td>
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<td>0.05</td>
<td>0.14</td>
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<tr>
<td>2050</td>
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<td>Penhold Meadow silt loam</td>
<td></td>
<td>0.11</td>
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<td></td>
<td></td>
<td></td>
<td>8.4</td>
</tr>
<tr>
<td>1941</td>
<td>Bca+SO₄</td>
<td>Tortia Heavy Loam</td>
<td></td>
<td>2.13</td>
<td>0.016</td>
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<td>0.70</td>
<td>0.07</td>
<td>0.37</td>
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<tr>
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<td>Bca+SO₄</td>
<td>Halkirk Loam</td>
<td></td>
<td>0.25</td>
<td>0.10</td>
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<td>0.01</td>
<td>0.01</td>
<td>0.06</td>
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<tr>
<td>1945</td>
<td>Bca+SO₄</td>
<td>Tortia Loam</td>
<td></td>
<td>0.24</td>
<td>0.08</td>
<td>0.10</td>
<td>0.01</td>
<td>0.01</td>
<td>0.05</td>
<td>8.3</td>
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<tr>
<td>2094</td>
<td>Seepage</td>
<td>Drain in Niobe silt loam area</td>
<td>5.09</td>
<td>0.03</td>
<td>3.34</td>
<td>0.09</td>
<td>0.09</td>
<td>0.06</td>
<td>1.40</td>
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<td>1976</td>
<td>Salt crust</td>
<td>Flat in Elnora loam area</td>
<td>13.78</td>
<td>0.08</td>
<td>9.00</td>
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<td>2070</td>
<td>B</td>
<td>Lowspot in Wetaskiwin Loam area</td>
<td></td>
<td>0.25</td>
<td>0.12</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>9.5</td>
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</tbody>
</table>
Table XI gives the salt content of some soil types. The C (subsoil) horizons of the "normal" earths, namely, Beaverhills, Antler and Elora, have a very low salt content in comparison to the soils of the solonetz group reported, namely, Twining, Torlea and Halkirk. The soils of the solonetz group, however, usually have less than 0.05 percent total salts in the surface horizons. It is believed that a detrimental effect to plant growth results from the salt in these soils. However, due to the low content in the surface horizons, and also to the presence of considerable gypsum, that detrimental effect is, in general, not great.

Table XI indicates that calcium sulphate (gypsum) and sodium sulphate (Glauber's salt) are the dominant salts present in this area. However, in interpreting these analyses it must be remembered that sodium sulphate has a high solubility in water and that calcium sulphate a very low solubility. That is, in many of these soils there may be considerably more calcium sulphate present than the analyses indicate.

There is no appreciable amount of black alkali in this area. Most of the analyses showed the surface horizons had practically none, and that most of the subsoil horizons had less than 0.2 percent. One exception to this is the last analyses reported in the table. This sample was taken from a basin-like area in which Wetaskiwin and Navarre loams predominated. It had 0.12 percent carbonate and bicarbonate and a pH of 9.5 (this is very alkaline).

SOIL RATING MAP

Accompanying this report is a soil rating map of the Red Deer sheet on the scale of six miles to the inch. This map divides the area into 8 land classes: 3 pasture and 5 arable. No attempt has been made to state the type of crop that should be produced on the arable land, and the map is applicable only under dry land conditions. As stated on page 30 this survey was conducted on a one mile traverse basis. The rating map should therefore be regarded as giving an average rating for an area rather than a specific rating for individual land parcels.

The data on this map are based mainly on the physical characteristics of the area. In making the map, such physical data as soil type, degree of stoniness, topography, rainfall, and rainfall variability were all taken into consideration. The groups carry a number and a legend on the map: group 1 is poor to fair pasture, group 2 is fair to good pasture, group 3 is good to excellent pasture, group 4 is poor to fair arable land, group 5 is fair to fairly good arable land, group 6 is fairly good to good arable land, group 7 is good to very good arable land, and group 8 is very good to excellent arable land. It is realized that this grouping is based on past performance under existing farm practices.

The introduction of new varieties of farm crops, the introduction of improved farming methods as well as a change in economic
requirements might, for example, shift the dividing line between pasture and arable land. It must also be noted that the number of quarter sections of land necessary to constitute a self-sustaining unit varies from class to class.

It is practically impossible to set any definite productivity limits for these groups. The following tentative limits, however, are suggested to give an approximate idea of the productive capacity of the various groups. Group 1 areas would take over 40 acres to pasture one head of cattle, group 2 areas would require between 20 and 40 acres per head and group 3 areas would require less than 20 acres per head. Group 5 soils over a long term of years have produced from 12 to 15 bushels of wheat per seeded acre, and group 6 soils have produced from 15 to 20 bushels of wheat per seeded acre. Group 7 soils have produced from 20 to 25 bushels per seeded acre and group 8 soils have produced over 25 bushels. Group 4 soils in general have produced less than 10 to 12 bushels. Some farmers in this area have exceeded these yields. In some instances it has been possible to make some subdivisions within each rating group. This is taken care of in the description of each soil type. For example, two areas may appear on the rating map as group 6, that is fairly good to good arable land. However, in the description one may be listed as fairly good, that is near the bottom of the group, and the other be listed as good, that is near the top of this class.
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 granule or crumb, etc.

Alluvium a group of soils developed from water transported, recently deposited, material and characterized by a weak (or no) modification of the original material by soil forming processes.

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

Calcareous material material having a high percentage of lime carbonate.

Cleavage the capacity of the soil on shrinkage to separate along certain planes more easily than on others.

Complex an intimate mixture of soil associations, types, or phases which cannot be indicated separately upon maps of the scale in use.

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.

Drift an accumulation of earth, stones, etc., carried and finally deposited by a glacier.

Erratic (glacial) boulders or rocks transported and deposited by glaciers and isolated from any others of the same kind.

Erosion the wearing away of the land surface by running water, wind and other geological agents. This term includes the normal geologic erosion and accelerated soil erosion which is brought about by changed conditions due to human activity; in the latter category are, sheet erosion, rill erosion and gully erosion.

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.

Glei a soil horizon in which the material has been modified by a fluctuating water table. It is frequently mottled with rusty brown and grey and is generally very compact and sticky.

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

*This is not a complete glossary, but is primarily to define some of the terms used in this report.
Humus —— the well decomposed, more or less stable part of the organic matter of the soil.

In situ —— refers to bedrock that is in its original position and is undisturbed.

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

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

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

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

Moraine —— is formed when the glacier deposits material it is unable to carry any farther or leaves as it retreats.

Terminal moraine —— is formed when the glacier dropping the materials carried by it. The surface is usually gently rolling to hilly.

Ground moraine —— when a glacier recedes, its debris, instead of being concentrated in a terminal moraine, is scattered over the surface left by the retreating ice, and is more or less stratified. The topography is usually level to gently rolling.

Phase (soil) —— is defined on the basis of characteristics of the land or of the landscape, of which the soil is a part, that are of importance in land use, but are not differentiating characteristics of the soil profile. Separation of phases is based on external physical characteristics, such as stoniness.

pH —— is a measurement of the relative acidity or alkalinity of a soil or other materials.

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.

Silicious material —— materials having a high percentage of silica such as quartz.

Soil Type —— the named soil that formed the mapping unit in the Red Deer sheet. These soils are also given a general profile type name. In the report the soil types are reported under their respective parent material groupings. This larger grouping may be called the soil association.

Solonetz group —— a group of soils usually developed on somewhat saline parent material under fair to poor drainage conditions. The following soil types are included in this grouping: solonetic, solonet, solodized-solonetz and solodic.
Soil Survey of Red Deer Sheet

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

Stones in this report stones refer mainly to granitic and sandstone erratics that hinder cultivation. The following broad classification of numbers is used:

Stones few indicates that the stones are only sparsely scattered over the fields, possibly less than a load to the acre.

Stones some indicates numbers in sufficient amount that they must be removed, possibly three to five loads per acre.

Stones many indicates fairly stony land, possibly ten or more loads per acre.

Very stony indicates land on which it may be unprofitable to clear the stones.

Structure (soil) the aggregates into which the individual soil particles are arranged. Often one type of aggregation occurs within another. For example, the columnar structure of the solonetz soils will break down into smaller blocky aggregates. Where this occurs, macrostructure may be used for the larger columnar structure and mesostructure for the smaller blocks. It is possible at times to break the mesostructure into still finer divisions and these divisions can be referred to as the microstructure. The following structures are recognized in this report.

Blocky block-like aggregates with sharp angular corners.

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

Fragmental firm aggregates with irregular cleavage lines and more or less sharp corners and edges often wedge-shaped.

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

Columnar fairly large aggregates with the vertical axis longer than the horizontal and with well defined and regular edges and surfaces. The tops may be rounded. Is usually found in the subsurface or Bt horizon.

Nuciform nut-like aggregates with more or less clearly defined edges and faces.

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

Massive large uniform and cohesive masses of soil, almost amorphous or structureless with irregular cleavage faces.
Texture (soil) this refers to the size of particles in the soil, that is the relative percentage of sand, silt, and clay. Size groups larger than .05 mm. in diameter are called sand, those from .05 mm. to .002 mm. are called silt, and those less than .002 mm. in diameter are called clay. The relative proportion of these soil separates in the soil classes most commonly referred to in this report is as follows:

- Sand: contains over 90% sand sized soil grains.
- Loamy sand: contains from 80% to 90% sand sized soil grains.
- Sandy loam: contains from 50% to 80% sand sized soil grains.
- Silt loam: contains over 50% silt sized soil grains.
- Clay loam: contains from 25% to 40% clay sized soil grains.
- Clay: contains over 40% clay sized soil grains.

Till

an unstratified heterogeneous deposit of clay, silt, sand, gravel and boulders transported by glaciers.

Till plain

a level or undulating land surface covered by glacial till.

Varving

a succession of thin seasonal sedimentary beds each grading from coarse grained at the base to fine grained at the top.

Zonal soils

a soil having well developed soil characteristics that reflect primarily the influence of climate and living organisms, chiefly vegetation. Sometimes referred to as a "normal" soil for one climatic zone.