SOIL SURVEY

OF THE

PRINCE GEORGE AREA

BRITISH COLUMBIA

BY

C. C. KELLEY
PROVINCIAL DEPARTMENT OF AGRICULTURE

AND

L. FARSTAD
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REPORT No. 2
OF BRITISH COLUMBIA SOIL SURVEY
KELOWNA, B.C., MARCH, 1946

The British Columbia Department of Agriculture in Co-operation with Experimental Farms Service, Dominion Department of Agriculture.

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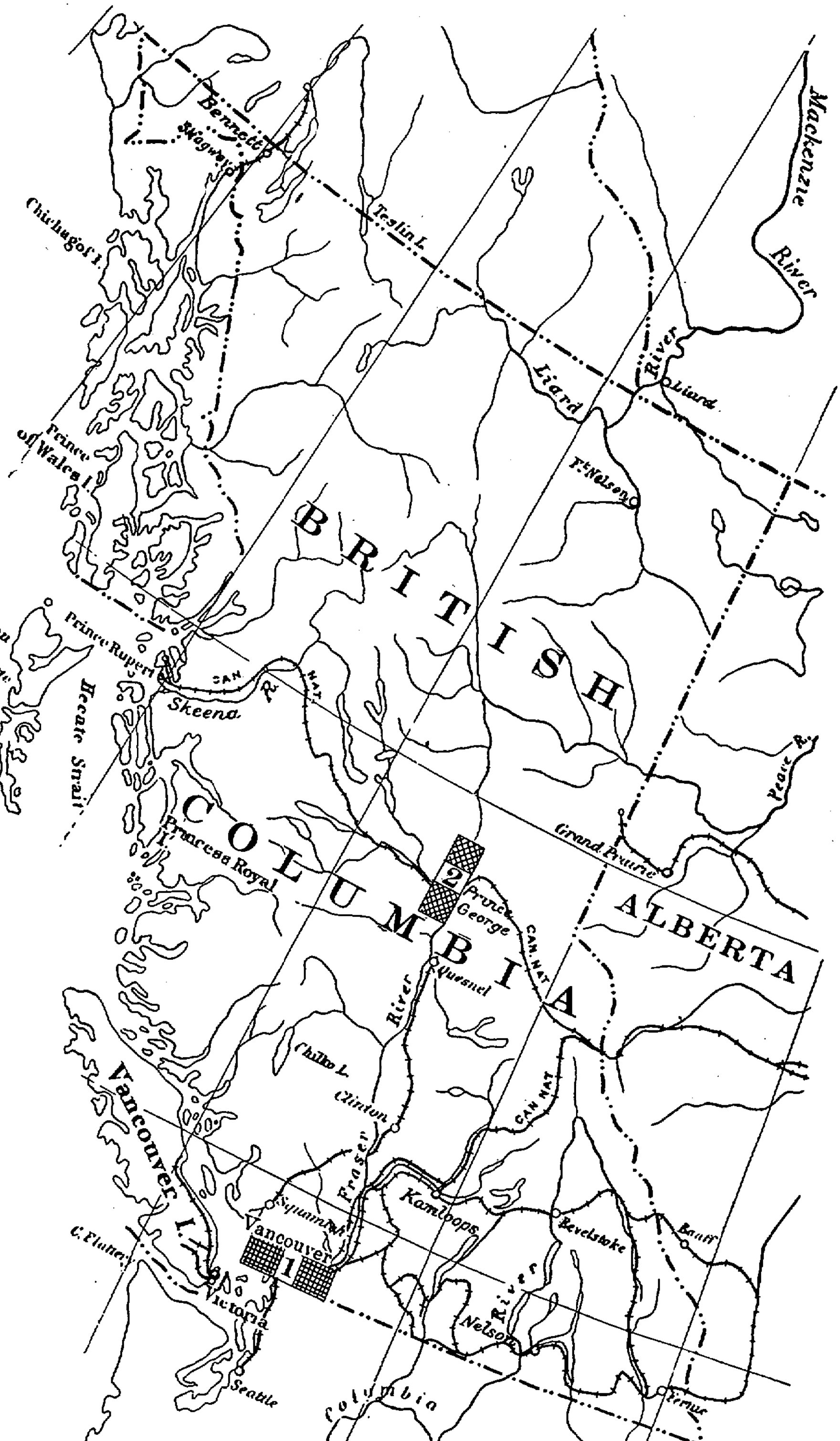

Map of British Columbia showing locations of surveyed areas for which reports and maps have been published: 1. Lower Fraser Valley. 2. Prince George Area.

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CONTENTS

Introduction

This report is the second of a series of soil survey publications describing important agricultural areas in British Columbia. Each report, complete in itself, is intended to be a brief description of the surveyed area. A description of the soils is the primary purpose but the report includes other data bearing on their nature and utilization.

The parent materials from which the soils are derived were deposited during glacial and post-glacial time. The pattern of deposition forms part of the system of soil classification and some of the deeper and older formations have importance as a source of underground water. The surface geology plays a major role in determining the uses of the soils and other resources.

In British Columbia no two agricultural communities have exactly the same climate, and the distinctions of climate that occur have a governing influence on the class of farming practiced in each area. In this pioneer district a detailed study of the climate will play a part in directing the course of agricultural development.

Since the native vegetation is of unusal importance from the agricultural point of view, a study has been made of the forest types in order to divide them roughly into divisions based on the cost of clearing land. The distribution of heavy and light forest cover on arable soils defines the areas in which agricultural development may take place with the best chance of success.

The soil map is published in one sheet on a scale of 1½ miles to an inch. It gives the location and extent of the classified soils, and the location of roads, rivers and streams. An added feature is the land class map, which suggests the possibilities for agricultural expansion in the surveyed area.

GENERAL DESCRIPTION OF THE AREA

Location and Extent

The mapped area consists of a rectangular block situated in the central interior of British Columbia on the eastern side of the Nechako Plateau. The southern limit is latitude 53°-30′, located a mile south of Woodpecker, and the northern boundary cuts through Summit Lake on 54°-17′ north latitude. The east side of the area is on longitude 122°-30′ and the west boundary follows longitude 123°-00′.

This area centres on Prince George and covers approximately 714,597 acres. Of this amount there are about 690,869 acres of land and 23,728 acres of lakes and rivers.

Topography

The Nechako Plateau is a region of mature relief. Surface features consist of a rolling till plain, pierced here and there by a few rock knolls and carved into several parts by valleys of the Fraser and Nechako Rivers and their tributaries.

The highest elevation is along the east side of the map-area, where Six Mile Mountain rises 4,125 feet above sea level. Other high points include Pilot Mountain, 3,275 feet, which is located on the east side of Swamp Lake, and several rocky knolls of about the same elevation to the south of Nadsilnich Lake.

The higher parts of the till plain range up to about 2,700 feet above sea level. At elevations below 2,600 feet the rolling till has been covered by glacial lake deposits. In the laked area there are three topographical distinctions. The surface is mainly undulating, in part hilly and partly reduced to coulees and stream channels by erosion.

The most striking topographic features are the great post-glacial channels of the Fraser and Nechako Rivers and their tributaries. The trenches of the Fraser and Nechako are from one to two miles wide, and in places they attain a depth of 370 feet or more below the surrounding plateau. These valleys are lined with a series of terraces, some of the lower ones being suitable for agriculture. Where they join at Prince George, the Fraser and Nechako Rivers are at 1,860 feet elevation. At Woodpecker the elevation of the Fraser is about 1,700 feet above sea level.

Drainage

The main drainage outlet is the Fraser River and its chief tributary is the Nechako. The Willow and Salmon Rivers enter the Fraser from east and west in the northern part of the district, and the Chilako River flows into the Nechako to the west of Prince George. A number of small creeks and streams connect the lakes and muskegs with the main drainage channels.

A limited area in the northeast corner of the district drains into Summit Lake. This comparatively small body of water at 2,315 feet elevation was reserved for a national park in 1942. It lies on the north side of the Arctic-Pacific Divide and drains northward into the Parsnip River.

Originally the rivers were used as a means of entry into the country, and steamers on the Fraser transported most of the freight. They are still utilized by prospectors, trappers and by the lumbering industry. The Fraser and Nechako Rivers transport large quantities of logs to downstream mills, and the Chilako, Salmon and Willow Rivers can be used for the same purpose when log jams are removed. None of these rivers is important for sport fishing.

The classified district is noteworthy for numerous lakes of assorted sizes. In many of the smaller ones fish cannot survive the winter season. This is due to the absence of inflowing streams, which limits the air supply to the amount in the water when the surface is frozen over. Some of the larger lakes contain only coarse fish, which in part may be replaced by stocking. The local Rod and Game Club maintains a small hatchery for the annual distribution of Kamloops trout. Trapping Lake, Tabor Lake and Summit Lake are favourites for trout fishing, and Summit Lake also contains char. There are about 23,728 acres of water in the classified district, of which approximately 11,250 acres comprise river water and 12,478 acres represent the area covered by lakes.

Soil drainage varies throughout the area. Imperfect drainage is common in the arable soils before cultivation, but the degree of wetness is small and amelioration is not difficult. Owing to the density of the natural vegetation the spring runoff from melting snow is normal, but the depth of the main river channels helps gully formation on the plateau for some distance from the river banks. Measures of prevention against gully erosion will be necessary when the land is cleared and cultivated.

Surface Geology

During the Pleistocene epoch the district was overridden by glacier ice. It is probable that more than one glaciation occurred, but the final ice movement was of such intensity as to demolish any substantial evidence of an earlier glaciation.

There are still a few ill defined remains pointing to a glaciation which holds the same position as the Admiralty Till in the Lower Fraser Valley and on Vancouver Island*. Faint markings with a northwest to southeast direction were observed on aerial photographs, and two layers of till serarated by from 10 to 20 feet of stratified sands were seen on a few river bluffs. The only find which pointed to an interglacial epoch was a good specimen of lignified driftwood. This was located several feet beneath the upper till and lodged in stratified gravel on the face of a gravel pit.

The final glaciation is strongly outlined as a rolling plain in areas where the till is exposed, the direction of flow being from the northeast to the southwest. As the ice vacated the lower elevations a temporary lake was formed in the depressed valley areas. When at its greatest extent the lake water spread beyond the east, west and south limits of the map-sheet.

One of the chief contributors of lacustrine deposits was the Stuart River, whose abandoned channel now forms a remarkable topographic feature. During a stage of ice decay the Stuart excavated a channel about two miles wide downstream to Mandalay Creek. From there the river turned eastward and emptied at the present junction of the Nechako and Fraser Rivers.

The abandoned river course is well illustrated in the aerial photographs. Starting eastward with well defined banks at the mouth of Mandalay Creek, it becomes a maze of parallel ridges in the vicinity of Taginchil Lake, which lies west of the present map-area. The ridges are broken and irregular. In places they become a vein-like network containing boat-shaped depressions. Most of these depressions are dry but many contain small lakes.

Where it enters the classified area near the road junction to the south of Nukko Lake the course narrows to less than a mile and extends to the Nechako River north of Miworth. From this point ridged and hilly land turns east along the north bank of the Nechako to Prince George, and northward along the west bank of the Fraser for about six miles.

The materials of the river course are partly washed gravels and sands from which the Gunniza series is derived, and in part sands. The outwash material near the river mouth is mainly sand and silt. The sand and silt were laid down in separate masses over ice and over glacial till. The decay of buried ice caused collapse of the surface and the formation of hilly land. Where the sands and silts were deposited over till the rolling till topography was smoothed to an undulating surface. The sands of the river course and the outwash sands were named Eena series. Soils derived from the stratified river silt were designated Bednesti series. The parallel ridges of the abandoned river course and the hilly land in the vicinity of its mouth were grouped as a hilly phase on the soil map.

In the lower parts of the Fraser and Nechako River Valleys the glacial lake was first bottomed with silt, and later on the silt was overlaid with a 10 to 25 foot stratum of varved clay. The lake attained its greatest size when the upper limit of clay deposition was about 2,450 feet above sea level.

While the lacustrine deposits of the Stuart River are important, the enormous volume and distribution of clay suggests that the Fraser, Salmon, Willow and Chilako Rivers were additional carriers of fine sediments. This clay formation is the parent material of the Pineview Clay Association.

The temporary lake in which the varved clay accumulated was formed by submergence of the lower parts of the till plain. Sections of the shoreline were composed of till and drumlin tops were exposed as islands. These features are illustrated at Summit Lake, which exists as a remnant of the old glacial lake.

*Geology of the Fraser River Delta Map Area, Memoir 135, Geological Survey, 1923, Ottawa.

Gravelly beachlines were formed as the glacial till was sorted by wave action along the lake margin and around the islands. Many of the lower lying islands were reduced to gravel by the sorting out of fine materials. These gravel deposits are now of great value for local use.

As the ice dams melted, the lake level was lowered and its clay bottom exposed. At this time the Fraser and Nechako Rivers began to excavate their post-glacial channels and to build terraces along their banks. The stratified clay and silt were soon removed and the rivers cut deeply into the glacial till. The fine materials were carried away and discharged into the Fraser delta, but the gravels and sands washed from the till remained to form the first terraces. These gravelly and sandy terraces are the parent materials from which the Giscome and Saxton series are derived. When the rivers finally reached their pre-glacial beds the rate of flow decreased and the more recent bottoms are of finer textured material. These first and second terraces from present river level provided most of the material from which the soils of the Fraser Soil Complex are derived.

The glacial till is the parent material of the Chilako Stony Soil Complex. Where exposed on river sections the till is of mixed origin, without any signs of limey efflorescence. Along the Fraser and Nechako Rivers the thickness of the till is from 100 to 200 feet or more, and the texture varies from loam to clay with varying amounts of stones and gravel. The stones differ in size, but are mainly small. They are present in considerable variety, most of them being from formations of great age.

On a river cut the stones in the compact till have from one to several inches of fine material between them. On the surface of the drumlins, however, this uniformity does not exist. Part of the finer materials have eroded into the hollows and the soil becomes more sandy and gravelly with increased elevation. At the top of a hill boulders from one to two feet in diameter are often encountered, and these lie in a mixture of washed sand and gravel. The materials are coarse at the top and fine at the bottom of the larger hills.

The thickness of the till on the drift covered Nechako Plateau is unknown, but the river valleys have exceptionally thick till underlaid by older stratified deposits. Near the Nechako River bridge are horizontally bedded sands and gravels which underlie the till. These sands are grey and they contain particles of lignite from upstream sources. The exposed sand above the sloughed material is unconsolidated and it appears to be somewhat younger than a similar deposit along the Fraser River to the east of South Fort George.

The deposit that outcrops on the bank of the Fraser River consists of yellowish brown sands and gravels, and it underlies the till with a thickness of about 140 feet. These materials are of inter-glacial or pre-glacial age, and some of the layers are consolidated to weak sandstone.

Beneath the sandy and gravelly materials a lacustrine deposit, assigned to the Middle Tertiary*, overlies bedrock. The lacustrine materials are recognized as greenish clay-grits. They outcrop on the side of an isolated hill at the north end of the Prince George municipal airport and on both sides of the Fraser River near the mouth of Tabor Creek. The surface of this deposit is a probable source of farm water supply under the Pineview locality, to the southeast of Prince George.

Climate

The main climatic features correspond with those that prevail along the southern fringe of the northern forest or taiga. The winters are cold and the summers mild, with rather abrupt seasonal changes. Locally this northern interior climatic regime is modified to correspond with conditions usually found

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*Lay, Douglas, Fraser River Tertiary Drainage History in Relation to Placer Gold Deposits. Bull. 11, 1941, Dept. of Mines, Victoria, B.C.

farther south. Summer and winter temperatures are increased by northeasterly air movements from the Pacific Ocean and precipitation is greater than in any other low level area along the eastern fringe of the Interior Plateaux. This important feature is probably due to the arrangement of the mountain systems to the east.

A striking feature of the local climate is its variability, the moist Pacific air from the southwest being in more or less continuous conflict with polar air from the north and northeast. The constant battle of air masses is characterized by strong temperature contrasts, cloudiness, and a succession of dry and wet weather.

The intermittant southward penetration of polar air brings from three to six cold spells each winter. These last from a few days to two or three weeks, and extreme temperatures of from three to seven days duration are experienced during the larger ones. The low temperatures reached at such times range from 15 above to 50 below zero, and unprotected ground may freeze to a depth of six feet or more. Between cold spells the warm fronts from the southwest Pacific Ocean moderate the winter climate and day temperatures are from 32° to 60° F.

The beginning of winter is marked by a definite change during the last week of October, often with light snow which melts away. Around November 10, there is generally a snowfall of from four to six inches, which remains on the ground.

Ice generally forms around November 15, and the lakes are soon frozen over. In winter the ice builds up to a thickness of about 24 inches on lakes and rivers, and in the rivers anchor ice may form. Since records were kept the departure from this general outline occurred in the winter of 1925-26, when zero was the lowest temperature.

Spring breakup comes around April 9, when the ice begins to move on the rivers. The breakup on the lakes is from a week to 10 days or more later. During most years April and May are cool months with low precipitation and humidity. The low humidity cuts away the snow and helps dry the land for seeding.

Summer precipitation and higher temperatures begin with frequent thunder showers in June. The thunder showers continue to the middle of July, after which there is a period of warm weather with less rainfall until September, when precipitation is slightly greater and temperatures cooler. These conditions are more or less uniform within the whole map-area.

The climate is responsible for the species of plants that flourish, for the volume of native growth and for the kind of soil development that occurs. The chief climatic factors are the moisture supply and the temperature, which shape the environment.

The amount of rain that falls is of greatest importance in more southerly areas, where the season of growth is long and temperatures reasonably high. In this district temperature plays the leading role by virtue of its limiting effect, and the moisture supply takes second place.

A short growing season with long warm days and cool nights has a selective effect on native flora and upon the rapidity and volume of growth. The natural requirements call for a frost-resistant native flora with a short growing season, and crops must meet the same conditions.

The Grey Wooded Soils of the region developed in response to the cool temperature regime. For five months the soils are frozen and during about three months they are cool and growth is limited. It is thus apparent that eight months of comparative rest in a cool and frozen state is essential for effective response in the growing season. From about May 15 to September 15 the soils provide the substance for great biological activity.

Temperature

The only temperature station in the map-area is located at Prince George, where complete records go back to 1916. Prince George is about 400 feet or more below plateau level, and the mean temperatures for this station may be from one to three degrees warmer than the average for the district. A summary of the average mean temperatures is shown in Table 1:

TABLE 1—AVERAGE MEAN MONTHLY TEMPERATURES AT PRINCE GEORGE FOR THE YEARS 1916 TO 1943

Month	Mean Average Temperatures Deg. F.	Range of Mean Temperature	
		Highest Monthly Average Mean Deg. F.	Lowest Monthly Average Mean Deg. F.
January	14	29 (1931)	−12 (1916)
February	19	29 (1930, 31)	− 9 (1936)
March	30	37 (1926, 29, 41)	22 (1919)
April	41	47 (1934, 41)	33 (1935)
May	49	55 (1936)	41 (1920)
June	56	59 (1923, 28)	53 (1919, 33)
July	60	64 (1920, 41, 42)	57 (1917, 29, 32)
August	59	62 (1927, 30)	55 (1937)
September	50	57 (1938)	45 (1926)
October	41	45 (1929)	35 (1919)
November	29	42 (1917)	15 (1927)
December	18	33 (1930)	− 1 (1927)

For the 28 years on record the mean annual average temperature is 39°F. The difference between the average temperature of the coldest month and the warmest month is wide, with a variation of 46°. The average for January, the coldest month, is 14° and the warmest month, July, is 60°F. The lowest mean for any month was in January, 1916, with an average of -12°F.

From 1916 to 1943 the record low temperatures is -57°, which occurred in January, 1928, the usual winter extreme being around -40°F. The highest temperature on record is 102·4°F., reported in July, 1941. For most years the extreme high temperature varies between 83° and 95°F.

The district is noted for cool nights with high relative humidity and heavy dew in summer. During clear weather cold air drains into the depressions at night and there is some frost danger. Frost is often prevented, however, by frequent thunder showers, which increase humidity and cause a protecting blanket of fog to form in the depressed areas.

The Growing Season

Growing plants differ in their capacity to resist cold and their growth periods vary accordingly, but some idea of the length of the growing season is necessary in a description of climate. On the basis of 43° mean temperature in spring and fall the growing season begins on April 23 and ends 168 days later on October 8. From year to year during this period the average temperature varies between 53·4° and 56·0° F., and in the dormant season the average temperature lies between 23·1° and 29·3° F.

The season of growth, however, is longer than the number of days suggest, owing to the length of days in June, July and August. If the growing season could be counted as hours of daylight instead of days, it would compare more favourably with growth periods in the southern parts of the province. On the basis of days the growing season varies from 270 to 228 on the southeast coast of Vancouver Island and in the Lower Fraser Valley. In the Okanagan Valley the growth period lies between 226 and 200 days.

The growth period between the last frost in spring and the first frost in fall is important to the group of crops with the least frost resistance, but in the classified area this period is obscured by the occurrance of light frosts in summer. When conditions are favourable the summer frosts follow rapid radiation at night. Night radiation is helped by cool and extensive areas of forest, which fail to store heat in day time. At present there is no dependable period between spring and fall that is always frost free.

In appended Table 1 the summer frosts are differentiated from spring and fall frosts, and their number is given for the years in which they occur. It seems likely that frosts now occurring in June, July and August will gradually disappear as larger areas are cultivated and the district passes from the pioneer stage to a mature agricultural community. Small and isolated clearings are dead air pockets cooled by the surrounding forest, and the ground does not store enough heat to offset the drop in air temperature. As the district becomes more extensively settled the cleared land is connected in long stretches which promote air drainage and greater heat storage in the soil. Such conditions in future should reduce the summer frost hazard and lengthen the frost-free period.

Frost records taken since 1920 show that the last spring frost comes between May 12 and June 3, and the first killing fall frost occurs from August 22 to October 7, killing frosts in August appearing only twice in the record. There are five years in 24 with no summer frosts, but 19 years have frosts averaging three degrees in June and/or July and August, the greatest frequency being in June. The frost-free period ranges from 43 to 120 days, the average being 82 days.

Precipitation

There are two rain gauges in the classified area. The more important station, located at Prince George, has been in continuous operation since 1917. At Woodpecker, in the southeast corner of the surveyed area, is the second station, which began recording precipitation in 1935. From the limited data, this locality has approximately the same precipitation pattern as the Prince George station, with slightly less precipitation for the same period of years. For the nine years on record the annual average precipitation is 24·52 inches compared with 25·26 inches at Prince George.

The precipitation pattern at Prince George is shown in Figure 1. During the period on record February, March, April and May have averaged the driest months of the year. Low rainfall and humidity in April and May are of particular value in drying the heavy clay land for planting, but departures have occurred three times in April and four times in May during the 27-year period.

The average shows that the important growing month of June is well supplied with moisture, and in 27 years there are only three departures which give June less than an inch of rain. These departures did not bring crop failure, inasmuch as the reductions in hay yields were only 30 to 50 per cent and grain crops were reduced by about 30 per cent.

Previous to 1931 July was a comparatively dry month, with nine years during which the rainfall averaged less than one inch. Since 1931 July rainfall nearly equals rainfall in June. This is due mainly to the overlap of June precipitation into the first half of July, caused by more numerous thunder showers from the southwest. The extra rain in July is of little value to the hay crop, since haying begins around July 1. When showers are frequent the quality of the hay in the cock is lowered, and there is added labour of turning and drying before it can be stacked.

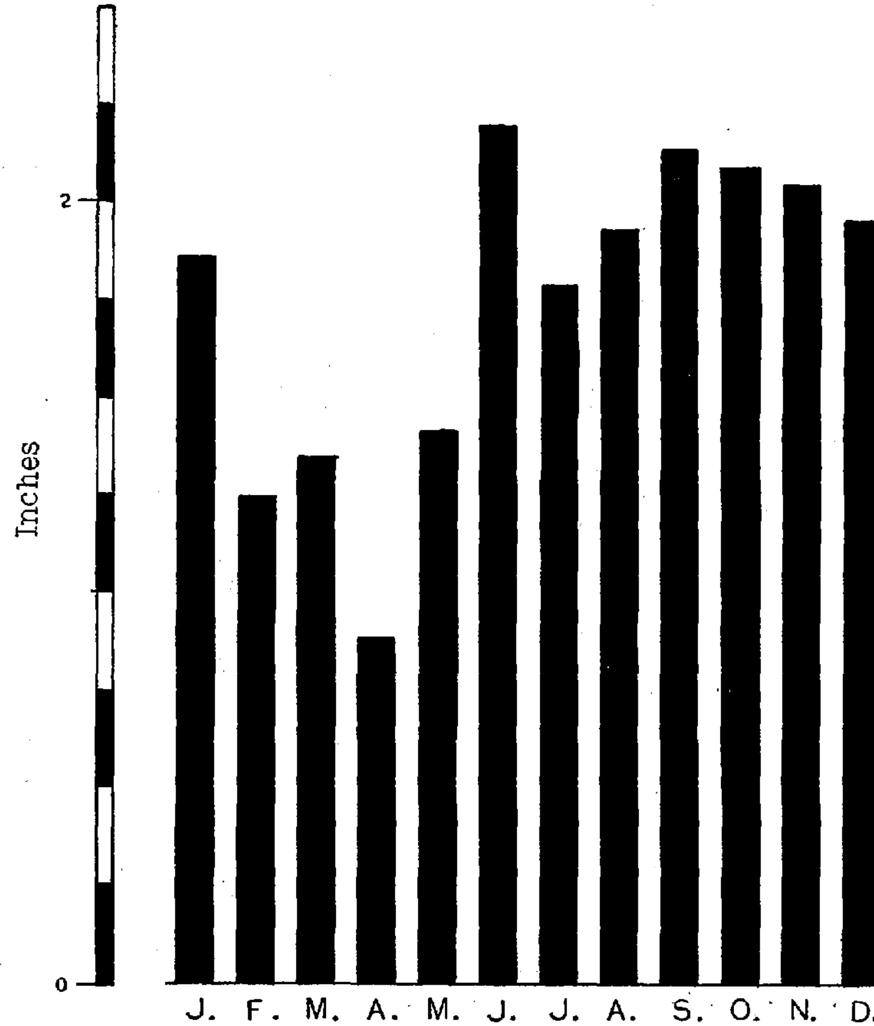


Fig. 1.—Precipitation pattern at Prince George, January to December, showing low spring and heavier summer and autumn rainfall.

August and September are harvest months for grains, clover seed and roots. They are also months when precipitation is on the increase to a September peak. When a wet period begins in the latter part of August and continues through September, damage is done to the grain and clover seed harvest. Probable loss occurred during six years between 1917 to 1943, when September precipitation was in excess of three inches. In 1941 a record September rainfall of 6·12 inches did major damage to the grain and clover seed crops. Crop losses at harvest are always distressing, but damage to six crops in 27 at harvest is fairly low in a district where droughts causing crop losses are comparatively unimportant. Precipitation averages for the period on record are given in Table 2.

Local experience in respect to crop production is still in the pioneer stage and adjustments are necessary before a definite production routine can be established. The precipitation pattern, which features a dry spring and a damp fall, favours hay, pasture and roots with grain as a sideline for feed. Alsike clover seed has been a pioneer cash crop not always easy to harvest, and later on it may be replaced by crops convertible to dairy products and meat.

TABLE 2—MEAN MONTHLY PRECIPITATION AT PRINCE GEORGE FOR THE YEARS 1917 TO 1943

Months	Mean Monthly Precipitation Inches	Mean Monthly Precipitation Range in Different Years	
		Highest Average Mean	Lowest Average Mean
January	1·89	3·99 (1920)	0·50 (1930)
February	1·28	3·35 (1939)	0·29 (1923)
March	1·38	3·19 (1940)	0·37 (1921)
April	0·90	2·96 (1940)	0·06 (1918)
May	1·41	2·91 (1934)	0·38 (1918)
June	2·25	4·06 (1933)	0·49 (1922)
July	1·82	5·08 (1932)	0·36 (1921)
August	1·98	4·05 (1925)	0·20 (1930)
September	2·21	6·12 (1941)	0·04 (1918)
October	2·16	3·84 (1919)	0·47 (1922)
November	2·11	6·00 (1919)	0·60 (1918, 20)
December	2·05	4·41 (1942)	0·45 (1921)
	Yearly Mean 20·88	Highest Year 31·32 (1941)	Lowest Year 14·45 (1926)

The period of snowfall extends from October to April, as shown in Table 3, with the heaviest fall in December and January. Periods of mild weather cause shrinkage and reduction of depth, the average thickness of snow on the ground being from one to three feet. Since 1916 the annual snowfall has varied between 22·40 and 141·75 inches, the average being 63·64 inches for the 27 years of continuous records.

Snow in the past has been of use to the farmer for sleighing, prevention of deep frost penetration and for saturating the soil in years of low frost penetration. In future it may have additional value as a source of water for cisterns and storage ponds in localities where well water is scarce.

TABLE 3.—MEAN MONTHLY SNOWFALL AT PRINCE GEORGE FOR THE WINTERS FROM 1916 TO 1943

Months	Mean Monthly Snowfall Inches	Range of Mean Monthly Snowfall in Different Years	
		Highest Average Mean	Lowest Average Mean
October	1·45	17·40 (1919)	0·00 (13 years)
November	10·03	56·00 (1919)	Trace (1916)
December	15·30	40·50 (1917)	2·50 (1921)
January	16·42	39·25 (1920)	4·00 (1942)
February	11·06	30·50 (1925)	0·00 (1920)
March	7·77	27·00 (1919)	0·00 (1941)
April	0·94	9·00 (1939)	0·00 (15 years)
	Yearly Mean 63·64	Highest Year 141·75 (1919-20)	Lowest Year 22·40 (1929-30)

Relative Humidity

Relative humidity, obtained from wet and dry bulb readings, follows the precipitation curve, as shown in Figure 2 and Table 4. April is the driest month of the year and also the month of lowest relative humidity. Low humidity in April promotes the drying of clay soils, but it also delays the growing season by enabling frosts to occur. These frosts continue through the comparatively dry month of May, to be reduced to light frosts in June and succeeding summer months by increased relative humidity and the rise of mean temperature

Throughout the summer months when nights are clear the temperature is decreased and heavy dew is formed, which sometimes fogs depressed areas and serves as a protection against frost. During periods of low humidity and clear weather in summer, however, the cold air drains into the depressions at night and light frosts occur, while higher ground remains frost free. In the fall these conditions are reversed, owing to heavy condensation and high relative humidity. The frosts occur on the uplands, while river channels and coulees often stay frost free for a considerable period under the protection of heavy fog at night. The frost occurrence from year to year varies with the changing relationships of relative humidity, cloudiness and temperature.

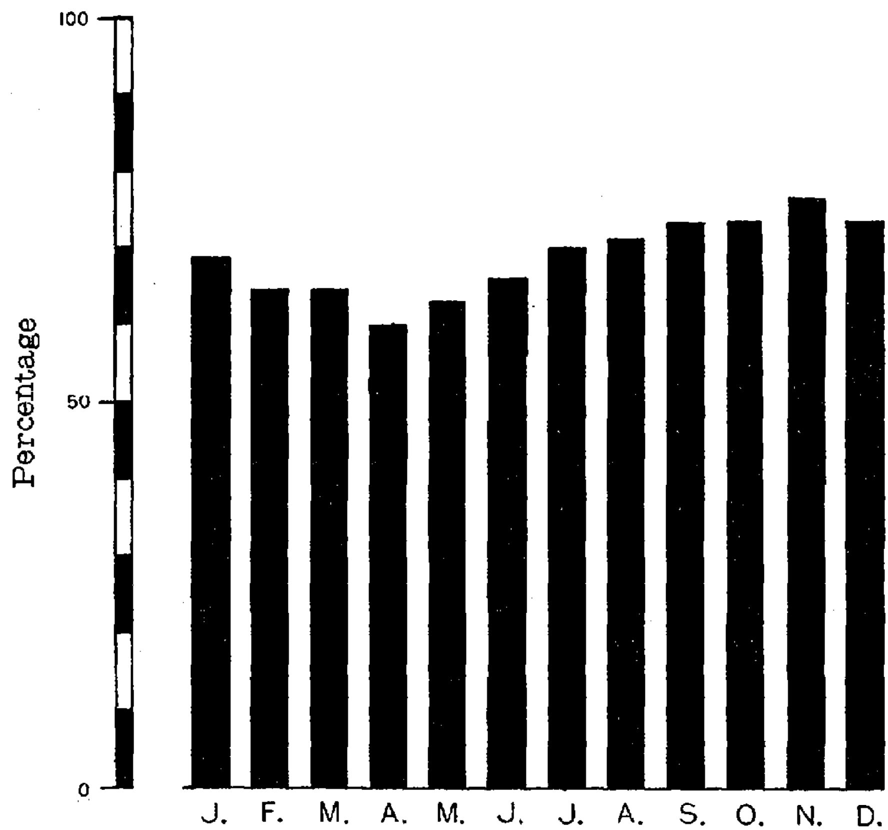


Fig. 2.—Relative humidity at Prince George, January to December. Average for 13 years.

TABLE 4.—MEAN MONTHLY RELATIVE HUMIDITY AT PRINCE GEORGE FOR THE YEARS 1930 TO 1942

Months	Mean Monthly Relative Humidity in Per cent	Mean Monthly Range of Relative Humidity in Different Years	
		Highest Average Mean	Lowest Average Mean
January	71	88 (1931)	48 (1930)
February	68	81 (1940, 42)	48 (1933)
March	68	80 (1931)	44 (1933)
April	63	73 (1937)	38 (1933)
May	65	74 (1939)	37 (1935)
June	69	77 (1941, 42)	46 (1936)
July	73	77 (1936)	68 (1933)
August	74	82 (1937)	68 (1930)
September	77	85 (1941)	68 (1937)
October	78	85 (1938)	69 (1931)
November	79	87 (1940)	59 (1931)
December	76	89 (1930)	57 (1933)
	Yearly Mean 72	Highest Year 78 (1941)	Lowest Year 65 (1933)

Cloudiness and Bright Sunshine

November, December and January are cloudy months with the fewest hours of sunshine. Cloudiness in winter is associated with mild weather, and during the coldest winters the hours of bright sunshine are increased. In comparison with 16 sunshine stations in British Columbia, there are nine stations with more sunshine than Prince George. This is due to the frequency of broken clouds and general cloudiness obscuring the sun.

In summer bright sunshine reaches a peak in July, with an average of 262 hours, and in succeeding months it gradually drops off to a low of 40 hours in December. The distribution of sunshine by months throughout the year is shown in Figure 3, and average monthly figures are given in Table 5.

TABLE 5.—HOURS OF BRIGHT SUNSHINE AT PRINCE GEORGE FOR THE YEARS 1930 TO 1943

Months	Average Hours of Sunshine 1930 to 1943	Upper and Lower Limits of Sunshine in Different Years	
		Highest Month	Lowest Month
January	58	127 (1930)	19 (1941)
February	90	138 (1934)	63 (1933)
March	131	163 (1941)	71 (1940)
April	183	237 (1934)	124 (1937)
May	232	282 (1938)	196 (1943)
June	235	272 (1932)	162 (1933)
July	262	306 (1931)	206 (1932)
August	246	306 (1933)	174 (1937)
September	159	209 (1937)	85 (1941)
October	97	129 (1940)	64 (1941)
November	51	64 (1937, 41)	34 (1940)
December	40	70 (1943)	26 (1933, 35)
	Yearly Average 1784	Highest Year 1968 (1930)	Lowest Year 1664 (1933)

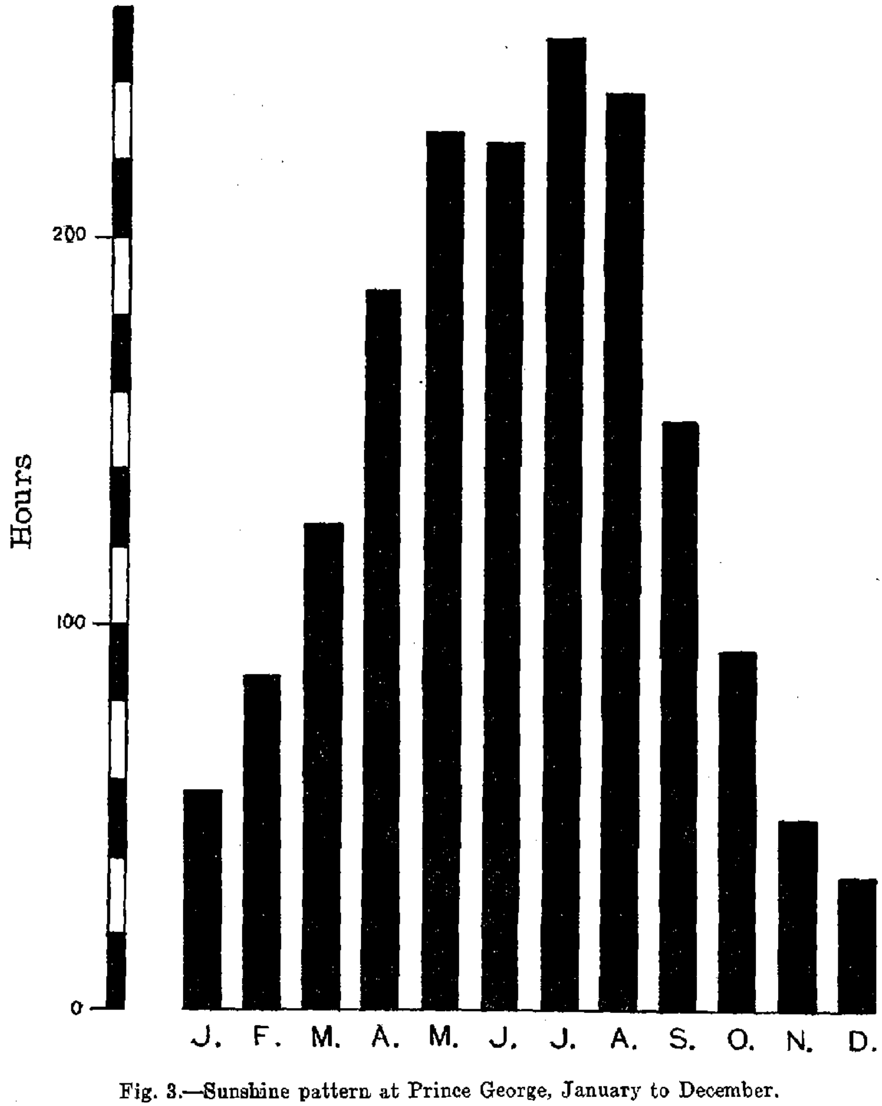


Fig. 3.—Sunshine pattern at Prince George, January to December.

Prevailing Wind

The anemometer at Prince George, installed in 1937, gives prevailing winds as follows: South southwest to southwest 72 per cent, northerly 26 per cent, westerly two per cent. The maximum velocity of southerly winds is 30 miles per hour, excepting thunder storms from the southwest in summer, which attain 35 m.p.h. for short periods. Higher velocities are prevented by the terrain and forest cover. Northern winds have a maximum velocity of 18 m.p.h., and east winds are negligible. The maximum velocities of wind are attained during the equinoxes, and the yearly average for the six years on record is 37,899 miles. During this period the variation is from 33,362 miles to 45,993 miles per annum. Cloud observations indicate that winds aloft swing five to ten degrees west per 1,000 feet elevation.

Native Vegetation

The present vegetation of the surveyed area consists of three main forest types resulting from recurring fires. These have been recognized as (1) aspen-willow, (2) lodge-pole pine and (3) white spruce.

The first type is a medium to medium-open forest dominated by aspen (*Populus tremuloides*). There are also a number of willow species and a lesser amount of alder and birch (*Betula papyrifera*). The shrub and herb layers are well developed, while the moss layer is scanty. The main shrubs are hardhack (*Spiraea Douglasii*), thimbleberry (*Rubus parviflorus*), twinberry (*Lonicera involucrata*), red osier dogwood (*Cornus stolonifera*) and wild rose. Important herbs include giant fireweed (*Epilobium angustifolium*), two species of asters, twinflower (*Linnaea borealis*), *Canada* bunchberry (*Cornus canadensis*), wild strawberry and lesser amounts of yarrow (*Achillea millefolium*), pea-vine (*Lathyrus ochroleucus*), American vetch (*Vicia americana*), painted bush and common wintergreen (*Pyrola secunda*). The scanty moss layer consists chiefly of spike moss (*Polytrichum juniperum*) and a foliose lichen.

In the second type the dominant tree is lodge-pole pine (*Pinus contorta*), while aspen, birch and young spruce are fairly common. The tree cover is denser than in the aspen-willow type and the shrub and herb layers are reduced. The moss has medium development.

The principle shrubs are wild rose, soopolallie (*Shepardia canadensis*), twinberry, high-bush cranberry (*Viburnum opulus*) and dwarf spiraea (*Spiraea lucida*). Important herbaceous species include twinflower, giant fireweed, two species of asters, Canada bunchberry and wild strawberry. The moss layer consists chiefly of two lichens—foliose and erect cup types, along with spike and semi-spike mosses and the feather moss (*Hylocomium splendens*).

When fully developed the third type is a forest of medium to high density, dominated by white spruce (*Picea canadensis*). Sub-alpine fir (*Abies lasiocarpa*) is common and lodge-pole pine often remains long after it has ceased to be dominant.

The shrub and herb layers are sparse, while the moss stratum is highly developed. Common shrubs include high-bush cranberry and twinflower on normal sites, while devil's club (*Echinopanax horridum*) occurs frequently on poorly drained areas. The herbaceous cover consists chiefly of such plants as Canada bunchberry, two species of ferns, rattlesnake orchid (*Goodyera Menziesii*), wintergreen and queen's cup (*Clintonia uniflora*). The moss layer is composed of feather and foliose mosses and a number of lichens.

It is evident that the above types represent the growth that occurs after fires and the spruce forest develops over the longest period of time. The aspen-willow and lodge-pole pine types occur at an earlier stage, but not in any regular succession. Where the original stand was spruce and the fire very severe, the seeds in the ground litter were destroyed and the first growth consists of species having light wind-carried seed. These conditions produce the aspen-willow forest.

Where lodge-pole pine formed a part of the original stand it can generally reproduce after fire. This is particularly true on the gravelly and sandy soils where it is most abundant. The seed is heat resistant and fire does not usually crown through the pine trees. In some cases this allows the lodge-pole pine to produce a crop of seed after being killed at the base. Fires vary in their severity and fire may pass over an area leaving trees that survive. Where this occurs there will be reproduction of spruce or pine, according to the species left standing.

As the aspen-willow type reaches maturity on the finer textured soils it is gradually replaced by spruce, which reaches dominance with the decline of the shelter crop. Spruce will also gradually shade out lodge-pole pine on fine-textured soils where it was once dominant. The spruce is usually considered to be the climax type, but it may deteriorate when over-mature to a spruce-balsam type and finally to the more rarely occurring stand of pure balsam.

The spruce forest is related to the cool, moderately humid climate of the Prince George district, with annual precipitation around 21 inches and an average of about 1·93 inches of rain per month from May to September inclusive. The mean minimum temperature for this five-month period is 41° and the mean maximum 66·4° F. In the Fraser River Valley the southern edge of this forest type appears to be around Quesnel, where the climate is slightly drier and warmer.

West of Prince George there is a gradual change in the vegetation. The tree cover becomes slightly more open and certain species confined to coarse dry soils around Prince George are more commonly found. Douglas fir (*Pseudotsuga taxifolia*), bearberry and the lichen called reindeer moss (*Cladonia rangiferina*) are prime examples of the new conditions. The records show that this is probably due to a gradual drying off to the westward, while temperatures remain the same or are slightly lower than those at Prince George.

In any climatic zone the native vegetation plays an important role in soil development, and in the surveyed area certain modifications were observed in the effects of coniferous and deciduous forest types. The structure of the solum in the heavy soils begins in horizon A_1 in the form of very small angular granules which become progressively larger as the lower part of horizon B_1 is approached. The best development of this structure occurs under spruce forest, which maintains a substantial cover of ground moss. The moss layer is low in bases and it contributes about two thirds of the decaying organic matter of horizon A_0. Since the solum attains the highest acidity under these condtions, this type of cover is mainly responsible for the angular structure and the production of organic acids which bleach horizon A_2. Under the coniferous forest the cost of clearing is considerable and the soil itself requires treatment before satisfactory crops can be harvested.

When the spruce forest is destroyed by fire the granular A_2 horizon is exposed. Until this surface is again protected by vegetation it has a tendency to erode in the freshet season. The amount of erosion depends on the slope, and on the steeper ones the entire A_2 horizon may be lost at this time. Usually the soil erodes from the knolls and accumulates in the hollows of the undulating surface.

Development of the soil under deciduous forest is far more favourable from the agricultural point of view. The fall of leaves and decay of annual plants produces a base-rich organic matter on soil with previously developed angular structure and high acidity. The result is a modification of the structure and the soil reaction.

The observed structural change is conversion of horizon A_2 from granular to platy structure, while the angular structure in the remainder of the solum becomes less sharply defined. At the same time the soil reaction is increased from pH 4·5 to pH 6·0 or even 6·5 in the solum. This reaction is approximately the same as the reaction of the C horizon under the coniferous forest.

The effect of this conversion on the value of the soil for agriculture is considerable. The land under deciduous forest is most cheaply cleared and the soil itself has been ameliorated. On reclamation good crops are produced by settlers without applications of lime or other fertilization.

History and Development

Alexander MacKenzie was the first European to pass through the Rocky Mountains into the district and the first overland traveller north of the Gulf of Mexico to arrive on the shores of the Pacific Ocean. He came by way of the Crooked River and Summit Lake in 1793. From Summit Lake MacKenzie portaged to the Salmon River and went downstream on the Fraser.

In 1806 Simon Fraser followed MacKenzie's route to Summit Lake and down the Fraser to the mouth of the Nechako. Turning west up the Nechako he ascended the Stuart River to Stuart Lake, where he established Fort St. James. In 1807 he established Fort George on his voyage down the Fraser River.

From this time onward the country became a fur trading territory and Fort George figured largely in further explorations. Hopes for development of the district were high during the C.P.R. surveys, which were made from 1871 to 1874. Some of these surveys were run through Fort George. After location of the route through the Selkirk Range, however, the central interior fell back from its railway expectations until 1907. At this time surveys were made preceding the construction of the Grand Trunk Pacific Railway, which was completed by 1915.

The construction of the Pacific Great Eastern Railway was planned in 1912 as a line to connect Vancouver with the Peace River Block. By 1916 the steel was laid about 15 miles north of Clinton, but at this point work was stopped following the collapse of financial arrangements. In 1918 the railway was taken over by the Provincial Government and on July 26, 1921, the track reached Quesnel. Although the grade was completed to Prince George and some track was laid the Cottonwood Canyon was not bridged and Quesnel remained the northern terminus. This left an 80-mile gap between Quesnel and Prince George which is served by a gravel all-year road.

Between 1910 and 1916 interest in the land was keen throughout the Province. Most of the land in the vicinity of Prince George was surveyed and much of it was pre-empted or purchased by individuals and companies in anticipation of great expansion when the railways were built.

Local settlement was stimulated by the market for produce in construction camps. Horses were used for grading and hay commanded from $75.00 to $100.00 or more per ton. These high prices induced workers to leave the railway and take 160-acre units with the intention of clearing a few acres and growing hay.

By 1914, however, the price of hay was already declining and settlers were joining the armed forces in considerable numbers. Those who remained imported a few cattle, but their interests in many cases did not lie in developing farms. Many settlers utilized the land as a means towards making a living by prospecting, logging, tie making and road building.

During the land boom most of the accessible land with arable soil was sold. At this time about 209,476 acres of arable land with heavy and light forest cover was privately owned and 74,980 acres in the more outlying areas remained as crown land. The public also acquired about 148,753 acres of sandy, gravelly and hilly soils which are classed in this report as forest land.

In 1916 the government began to take action designed to solve some of the problems which followed the land boom. The objective was to make farm lands more easily available to settlers. Machinery was set up to get back desirable lands from absentee owners and to acquire crown lands by application. Settlement areas were established in the Prince George district and about 31,000 acres came under the scheme.

These lands are situated on the Pineview and Fraser soils at reasonable distances from Prince George and Woodpecker. The bulk of the land had light forest cover and about 23,858 acres were sold to bona fide settlers. By 1942 only 7,142 acres remained in government ownership.

Since the time of the land boom the reversions have amounted to about 106,676 acres of forest land, 48,108 acres of arable soils with heavy forest and 63,470 acres of arable soils with light forest cover. In 1942 absentee owners were in possession of 14,972 acres of forest land, 13,707 acres of arable soils with heavy forest and 17,086 acres of arable soils with light forest cover. Local owners possessed 24,658 acres of forest land, 21,298 acres of arable soils with heavy forest and 40,062 acres of arable soils with light forest cover. Aside from the non-arable soils the government was in possession of 95,679 acres of arable soils with heavy forest and 96,624 acres of arable soils with light forest cover.

The history of the area indicates premature expansion of speculative land ownership which was not followed by real development. The general result has been a steady reversion of lands purchased during the boom period. Lands have reverted without regard to possibilities for agriculture. Non-agricultural soils and arable soils with heavy and light forest cover have reverted in approximately equal amounts. The present status of land ownership leaves the government in possession of enough arable land with light forest cover for the development of a new settlement scheme.

Population, Towns, and Industries

The number of rural people amounts to about 1,000, the main nationalities being northern European, Canadian, American and English.

Prince George is the only town in the district and its population in 1931 was 2,479. The population declined during the depression and the 1941 census totaled 1,989. Since 1941 there has been a large temporary influx due to military activity.

Prince George has an ideal location on a large delta-shaped terrace formation of post-glacial origin, which lies at the mouth of the Nechako River. This area consists of about 6,000 acres of Giscome, Saxton and Fraser soils. With the exception of a few abandoned channels of the stream the whole area lies above flood level, and excellent drainage makes it one of the best townsites in the Province.

The town is served with electricty from a 300 h.p. municipal diesel plant. The water supply is pumped into the town system from wells located near the Nechako River Primary schools and a high school serve local children and meet standard educational requirements.

Placer gold mining along the Fraser River was one of the earliest industries, but it never grew to large proportions. With the exception of one small company, most of the placer mining is done by individual prospectors who work on the bars and terraces in summer. Other local industries are in the pioneer stage of development. They consist of a number of small saw mills and a creamery. Surveys have been made in the past concerning the possibility of establishing a pulp mill at Prince George, and this is still in prospect.

The chances of industrial development are increased by at least four hydro-electric power sites within the economic limit of transmission. The nearest of these is at Isle Pierre on the Nechako River, about 20 miles west of Prince George, where 20,000 h.p. awaits development. At greater distances are undeveloped sites on the Nechako Quesnel and Fraser Rivers, with a potential output of 436,000 h.p.

The town is a railway division point and a local administrative centre for the Provincial Government. Railway workers and government employees are important elements of support at the present stage of development. Other support for local business comes from trade with farmers, trappers, loggers and sawmills in the outlying districts.

Schools, Churches and Communications

There are 12 small country schools scattered throughout the district. These are situated in localities having 10 or more school-age children. In addition to their use for teaching, the school buildings are utilized for community gatherings, farmers' institute meetings and church services. A high school, primary school and various church denominations are established at Prince George.

In addition to the post office at Prince George, there are country post offices at Woodpecker, Red Rock, Shelly, Beaverley, Mud River, Chief Lake, Salmon Valley and Summit Lake.

There is a telephone system at Prince George with branch lines that extend to Chief Lake and along the Cariboo road to Ashcroft. Telephones are located at convenient farms along the line to provide a measure of service for the country district. Prince George is in contact with the outside world by telegraph and telephone, and a small radio station has been established there by the Canadian Broadcasting Commission.

Transportation

The only railway serving the district is the C.N.R. line between Redpass Junction and Prince Rupert. The railway enters the mapped area near the mouth of Willow River and follows the Fraser to Prince George. From Prince George it was built westward in the Nechako River Valley. Extreme north and south ends of the district are about 24 and 28 miles from the railway line.

During the past few years air transport to Alaska and the Yukon has become important and Prince George is now a main stopping point for the Pan American Airways and the Yukon Southern Transport Ltd., the latter being a C.P.R. subsidiary. In 1941 the Department of Transport built a large airport a few miles southeast of Prince George to serve the needs of air travel. By this route the district is only two or three hours from Vancouver, which is about 500 miles by road and an even greater distance by railway.

The local population is well supplied with trunk roads and laterals, which show annual improvement. The Cariboo road from Vancouver and Ashcroft enters the mapped area on the east side of the Fraser River and extends to Prince George. Improvement of this road to a first class highway would stimulate the export of local vegetables to the large Vancouver market by truck. There is an all-year road westward to Prince Rupert. To the east a road extends from Prince George to Sinclair Mills and the unfinished section to Jasper Park is under construction. Other all-year gravelled roads link Prince George with Chief Lake, Ness Lake, Isle Pierre and Summit Lake. Gravelled lateral roads have also reached an important stage of development and many ungravelled trails may be used by cars and trucks in dry weather. Taken as a whole the situation in regard to local roads is satisfactory and much new development could take place without large expenditures for road extensions.

Agriculture

Agricultural development in the district has been slow and the acreage under cultivation is comparatively small. There are numerous scattered clearings of from 5 to 20 acres in area. The average achievement has been about 10 acres cleared and cultivated before further attempts to clear land have ceased to be operative. In the mapped area the land that has been cleared and cultivated amounts to about 10,053 acres, one third of which has been abandoned. A few farmsteads have larger acreages cultivated and they prove that a family can maintain itself by farming with 80 to 100 acres in crops. The abandoned properties generally have small acreages cleared. These improvements are seldom more than the requirements for a Crown Grant.

The development of agriculture in the district has been held in check by the attitude of the early settlers towards farming. Many of these were single men used to making a living by construction, tie making, logging, trapping and prospecting. They took up land but few intended to become farmers. Some of the married settlers had the same attitude, and this confined the number of real farmers to a struggling minority.

Farming was stimulated by inflated prices during railway construction, but after the railways were built the farmers found themselves in competition with outside production. Older districts producing graded goods could ship long distances and compete on the local market with small-scale and unsystematic farmers in a new country. Shop keepers complained that local products were ungraded and deliveries unreliable. They shipped in the bulk of their goods and took a smaller amount of local produce in trade.

The farmers were faced with the need of a profitable market for small quantities of produce until the second world war. Between 1920 and 1930 the lack of a market was in part offset by tie contracts, lumbering and road building. Tie making in winter and road building in summer kept a number of settlers on their homesteads, while those employed in lumber camps either temporarily or completely abandoned their holdings.

During this period the government gave aid in co-operation with farmers' institutes. This was intended to bring development and stability by promoting the kind of products that could be shipped out. Since no proper outlet for cream existed in the central interior, assistance was given to establish a creamery at Vanderhoof in 1920. At this time there was a small group of dairy farmers between Smithers and Quick who sent their milk to Prince Rupert, and a still smaller number who furnished the domestic requirements of Prince George.

The creamery was organized on a co-operative basis and it operated with gradually increasing volume until 1924, when it became insolvent. Thereafter it was operated at a loss by the Provincial Department of Agriculture for several years and then leased until 1934. After a period of idleness it was sold and reopened in 1940. Since 1934 a creamery has been operating at Prince George, but the general increase of dairying has not been rapid.

Cash crops suitable for export, which paralleled the slow increase of cream production, were timothy and clover seed. Timothy seed growing was a natural outcome of construction days, when the hay was highly valued. First established, it eventually declined in favour of alsike clover seed and alsike-timothy mixtures. The clover added much needed organic matter to the soil and in good years produced up to 250 lb. of seed per acre. Being small in bulk the seed could be shipped to distant markets, where it sold at a higher price than timothy.

Winter killing when snow protection is inadequate and danger of loss at harvest are the minor and major disadvantages. September rains often lower the quality of the seed and sometimes cause partial or total loss of the crop. Other leguminous crops such as red clover and alfalfa have been produced in a small way, but they have not spread so widely as alsike.

The onset of the world depression brought a reduction of tie making, public works and lumbering after 1931. Without these sources of cash income many settlers were forced on relief. At the same time, interest in their farms was increased and land clearing became a more common practice. Land cleared during the depression played an important part in building up the agriculture of the district.

The main field crop is a mixture of timothy and alsike for pasture and hay. This crop, harvested from July 1, produces two tons per acre and forms the basis of mixed farming. While slight loss may occur at times during harvest, the danger of loss is less than for alsike seed or grain. Substantial hay sheds built of poles, with open sides and shingle roofs are essential for housing the hay crop.

Spring wheat is sown when the land is ready at the rate of two bushels per acre, Garnet being the leading variety. Medium early varieties of oats at the rate of three bushels per acre, and barley (O.A.C. 21), two bushels per acre, are sown about the same time. The average harvest time for wheat and oats is from August 15 to September 15, and good yields are 30 bu. wheat, 75 bu. oats and 35 bu. barley per acre.

Fall wheat, usually Kharkov or Dawson's Golden Chaff, is sown around August 1, and grows best in well drained fields. It stools better than spring wheat if pastured in the fall. On light soils it ripens about two weeks earlier than spring wheat, but on clay the harvest dates are about the same.

At harvest the self binder with six-foot swath is most generally used and small bundles and stooks are preferred. Stook threshing can be practised in average years and this is generally preferred to stacking.

When a spell of rainy weather begins in the latter part of August and extends into September the grain crops suffer damage. However, the grain is produced for feed and the lowered quality, when it occurs, is to some extent discounted. Continuous grain is hard on the soil structure of the clay land and it should be produced in a rotation. About one crop of grain in four is a satisfactory relationship with other crops.

Vegetables that do well under cool climatic conditions give heavy yields. These are the very hardy vegetables not usually injured by freezing and those that survive moderate frost damage. The very hardy vegetables include cabbage, brussels sprouts, turnips, rutabagas, kohlrabi, horseradish, spinach, beets, mangels, parsnips, rhubarb, kale, swiss chard, radish and parsley.

Crops that grow well in the district and survive varying degrees of frost damage include potatoes, cauliflower, lettuce, carrots, celery, onions and peas. Commercial pea growing is a local possibility that requires careful investigation.

Crops with still less frost tolerance are grown in farm gardens and in favoured locations. These include many varieties of squash and beans, vegetable marrow, tomatoes, cucumbers, pumpkin, citron and sweet corn.

Edible wild fruits include huckleberries, blueberries, gooseberries, raspberries, strawberries, high-bush cranberries and bog cranberries. Cultivated small fruits such as raspberries, gooseberries, black berries, black currents and strawberries are grown and the wild high-bush cranberry gives greatly increased yields when transplanted to gardens. Specimens of other fruits seen in favoured locations include pin cherries, sand cherries, Sapa plums, Opata plums and crabapples.

The need of pollinating clover for seed production brought experimental work with bees, and the number of hives shows an annual increase. A three-pound package of bees with tested queen is placed in a 14-frame brood chamber early in April and fed until the honey begins to flow. With good management a hive will yield 50 lb. or more of honey without impairing the store for winter use. Beekeeping is still in its infancy and room exists for great expansion, particularly as more acreage is cleared and sown to leguminous crops.

Insect pests consist of the native species and a few importations just beginning to spread. The most important pest at the present time is the mosquito, which is abundant in May, June and early July. In some years the horsefly is also abundant. The wireworm, root maggot and warble fly have been reported, but as yet they have caused no widespread damage. Periodically the tent caterpillar puts in an appearance and strips the foliage from many acres of aspen.

SOILS

Soil Formation

Soils are the products of the environmental conditions under which they have developed. These conditions are the mineral parent materials plus topographic, climatic and biological factors. The climatic and biological factors are the major forces acting in soil development, but under some conditions other factors have a dominant influence. Soils with well developed characteristics that reflect the native forces of soil genesis, climate and vegetation, are classified as *zonal soils*. In this report the soils with more or less well developed characteristics that reflect the influence of groundwater are grouped as *groundwater soils*.

Glacial drift supplied the bulk of the soil parent materials. Glacial till, the main part of the drift, is composed of an unsorted mixture of clay, silt, sand, gravel and stones. Next in importance are the glacio-lacustrine deposits of stratified clay, silt, sand and gravel. More recent sorting of the drift produced alluvial clay, silt, sand and gravel which formed the river terraces, floodplains and the fans of tributary streams.

The Chilako soils developed directly from the glacial till. The Gunniza series is derived from gravelly material sorted from the till by glacial waters. The Eena, Bednesti and Pineview soils are derived from sands, silts and clays originally sorted from till by the action of glacial water and deposited in temporary lakes. The Giscome, Saxton and Fraser soils are derived from gravels, sands and fine-textured materials that were sorted and deposited by post-glacial streams and rivers. The organic soils are derived from post-glacial deposits of organic matter, which accumulated under conditions of restricted drainage.

The biological forces, including native vegetation, micro-organisms and the rate and nature of their decomposition are subject to external control by the cool and moderately humid climate. The climate regulates soil temperature, substances in solution and the movement of water in the soil. The products of these conditions are moderately leached and acid soils which belong to the Grey Wooded Soils, a division of the Podsol Zone.

The Grey Wooded Soils occur along the northern limits of grassland in the western provinces. They are not uniform as to quality, however, and local distinctions of climate and parent material can influence their agricultural value to a marked degree.

In the classified area the soils are productive and adequate precipitation for crops is more or less reliable. In these respects they rank with the best soils on the southern or warm fringe of the Grey Wooded Soil region. When reclaimed from deciduous forest, these soils return good crops without commercial fertilizers, but there is a general deficiency of organic matter. The need of liming may also appear when it becomes necessary to change the present cropping practice.

The Soil Profile

Soil classification is based on the characteristics of the soil profile. This is the cross-section of that part of the soil mass that has been altered by biological activity and actively used as a feeding ground by plant roots. It consists of a natural succession of layers or horizons extending downward into weathered or unweathered parent material. Its main divisions are called A, B, and C horizons, beginning from the surface. Taken together the A and

B horizons form the solum, which represents the true soil formed by soil-building agencies. The C horizon is the weathered or unweathered parent material which lies in contact with the soil above. If the profile is underlaid by geological material unrelated to the parent material of the solum, but of significance to the soil, it is designated horizon D.

The several divisions of the profile vary in response to the time period of weathering and other differences such as climate, vegetation, drainage, chemical composition and texture. These variations are accounted for by subdivisions of the main horizons into A_1, A_2, B_1, B_2, etc., for more detailed description.

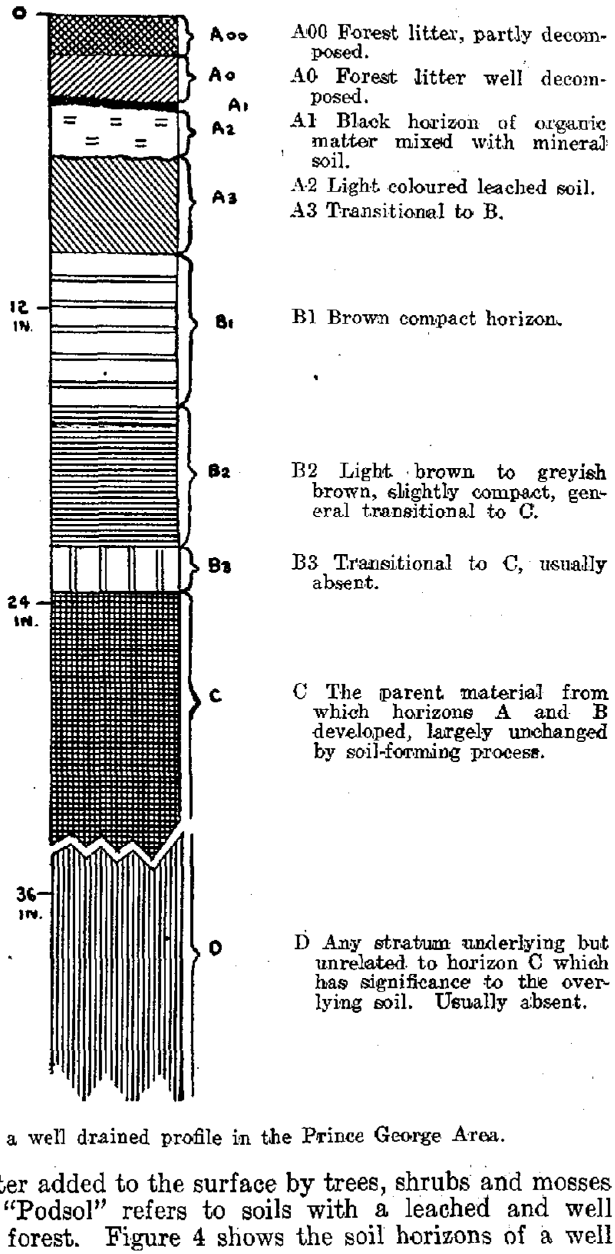


Fig. 4. Sail horizons of a well drained profile in the Prince George Area.

The mat of organic matter added to the surface by trees, shrubs and mosses is designated horizon A_0. "Podsol" refers to soils with a leached and well developed A_2 horizon under forest. Figure 4 shows the soil horizons of a well drained profile as found in the Prince George area. Under field conditions the depth of horizons vary in different soil types and in some instances one or more sub-horizons may be absent.

Each soil horizon has a distinctive colour, texture and structure. Soil colours range from white, through many shades of brown to black as organic matters increases. Organic staining, however, is found mainly in grassland soils and in soils with restricted drainage. Well drained podsols derive the bulk of their distinctive colours from the leaching of parent materials.

The degree of maturity attained by the soils of the area varies with the length of time during which they have supported plant growth. The oldest soils are those derived from glacial till and glacio-lacustrine deposits. Those of intermediate age occur on the higher river terraces and the youngest soils are derived from first and second bottom materials.

The leached horizons of the oldest group are from four to six inches thick, whereas in the intermediate group the leaching has a depth of two and a half to three inches. In the second bottom soils the A_2 horizon is only from one to two inches thick.

In the oldest group the B_1 horizon is strongly developed, particularly in the Pineview Clay Association. On the higher river terraces, however, the B horizon is only slightly compacted, due in part to the coarse-textured soils that occupy these positions. On the second bottoms the fine-textured soils again occur, and in these the B horizons are defined mainly by colour.

Soil Classification

The natural effects of climate on similar parent materials under different conditions of topography, texture and drainage is the basis used for grouping soils into series units. The term "series" is used to designate a group of soils on similar parent material, with the same colour, depth and structure of horizons and similar conditions of drainage and topography.

Where several soil series on similar parent material form a natural pattern as a result of variable drainage or some other factor they may be grouped together as a "soil association." When two or more soil associations are included in a mapping unit the term "complex" is used.

Soils may be excessively drained, well drained or poorly drained, depending on the topographic position and the texture of the whole soil profile. Those derived from sands and gravels have excessive drainage when above the level of runoff water and their profiles show different development from soils in the same positions with finer-textured profiles. Fine-textured soils on slopes or terraces that are free from the influence of groundwater are well drained soils. As a general rule they are more productive than excessively drained soils.

Poorly drained soils are those affected by groundwater. Their profile characters are usually fixed by fluctuation of groundwater in the soil or above it for short or long periods each year.

Within the soil series are soil types based on the texture of the surface soil or A horizon. The class name of the soil texture, such as clay loam or clay, is added to the series name to give the complete name of the soil type. Thus Eena loamy sand and Eena sandy loam are different soil types based on surface textures found in the Eena series. With the exception of the surface texture the Eena profile has the same characters throughout.

External variations within the soil type that have importance from an agricultural point of view are known as phases. Phases are based on such characters as gravel, stoniness, topography and others.

Soil series, associations and complexes are given convenient geographic names taken from the localities in which they are found. These include the names of rivers, lakes and districts. Several land classes not included as soil series, associations or complexes form a group of miscellaneous areas.

In the Prince George area the classified soils represent the soil distinctions found within one climatic area. These distinctions are as follows:—

Zone: Podsol

Sub-zone: Grey Wooded Soil.

1. Soils derived from glacial till: Chilako Stony Soil Complex.
2. Soils derived from glacial river and lake deposits:
   Gunniza Gravelly Sandy Loam.
   Eena Loamy Sand.
   Eena Sandy Loam.
   Bednesti Silt Loam.
   Pineview Clay Association.
3. Soils derived from post-glacial river and stream deposits:
   Giscome Gravelly Sandy Loam.
   Saxton Loamy Sand.
   Fraser Soil Complex.
4. Groundwater Soils:
   Muskeg.
   Meadow.
   Shallow Muck.
5. Miscellaneous Areas:
   Rough Mountainous Land.
   Rock Outcrop.
   Bluffs and Ravines.

Field Methods

This is a detailed reconnaissance soil survey, orginally planned to include all surveyed lands in the area. Lands suitable for settlement were given special attention, so as to give a reasonably accurate soils report on every quarter section. Limitations of the base map did not permit the differentiation of waste land resulting from erosion, hence the amount of plough land on each quarter section is not indicated.

Roads and trails had to be located on the map, many slash lines and wooden corner posts were burned out and visibility was poor, owing to the thick vegetative cover. These conditions made extensive use of the band chain necessary in order to keep location.

Location points were established at mile intervals and boundaries were sketched between them according to the lay of the land. The aneroid barometer was useful for finding approximate elevations and extensive use was made of the surveying compass. When chaining, the soil was turned every 200 feet to test the texture and follow the type, and field notes describe every section surveyed. Bluffs, ravines and forest cover boundaries were established during the soil survey. At a later date this work was checked by the use of aerial photos that were subsequently available.

Parts of the area accessible by car were surveyed from a camp at Prince George. The more distant localities were surveyed from temporary camps reached by boat, pack trail and by car over trails in dry weather. Dry spells during the summer were selected for making trips into the least accessible places. Equipment for temporary camps included small tents with fly screens and sleeping bags. Pack boards were used for carrying equipment to camp sites, but it was desirable to hire the trapper whose trails were used to make any extra trips. Trappers hired for packing also made their equipment available and were able to provide information as to the location of corner posts.

Variations of soil profiles were found by digging pits at selected locations, and numerous examinations were made of A and B horizons by digging shallower holes. Organic soil profiles were studied with the help of a Hiller type peat borer.

Soil textures were determined by feel and the surveyor's judgment was verified by samples taken for mechanical analysis. Soil reaction was determined for each sample by colorimetric methods. Representative virgin profiles are the basis of soil type descriptions and from them samples were secured for chemical analysis.

DESCRIPTION OF SOILS

1. *Soils derived from glacial till*

Chilako Stony Soil Complex

Description

This complex consists of a group of undifferentiated soils derived from glacial till. The soils are distributed on a drumlinized till plain deposited by ice which moved from northeast to southwest. The highest hills rise to about 2,700 feet above sea level and the lowest elevations are bordered by glacio-lacustrine soils at about 2,450 feet.

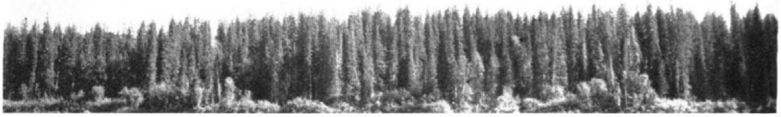
Between these two elevations the Chilako stony soils cover approximately 264,719 acres. About 90 per cent of the area consists of hill-tops and slopes, the remainder being poorly drained hollows between drumlins. In these hollows, which are from 100 feet to half a mile wide, are lakes, muskegs, meadows, temporary stream channels or a layer of muck with forest cover. All of these drainage conditions may be found in one hollow. The most numerous depressions are from a few hundred feet to a quarter mile in length, while the largest are more than a mile long. Only the larger muskegs and meadows in the complex were differentiated.

The Chilako stony soils are distributed mainly on the Nechako Plateau above the great depressions formed by the Fraser and Nechako Rivers. Most of the area is covered by soils whose textures range from sandy loam to clay loam, with variable amounts of stones and gravel. The finer textures are found on the lower and more gentle slopes, the higher and more steeply rolling hills having large amounts of boulders, stones and gravel. The tops of most of these drumlins contain material that was water sorted to some extent during the decay of the ice sheet. The finer-textured soils at the lower elevations have been built up by sheet erosion. Observations indicate that such erosion occurs after fires, when the soil is exposed. At such times there is a tendency for the ash-like A_2 horizon to erode down the slope during the spring runoff and when heavy thunder storms occur.

The underlying till is firmly compacted, its texture ranging from sandy loam to clay loam, with variable amounts of stones and gravel. Its nature and depth are described elsewhere.[1]

The forest cover consists mainly of spruce and lodge-pole pine, together with a few birch, aspen, alder and scattered large fir. In recently burned areas large fir stumps are encountered. In this district it would appear that fir has not held its own in competition with other growth. The only observed reproduction of fir was along lake shores in well drained locations.

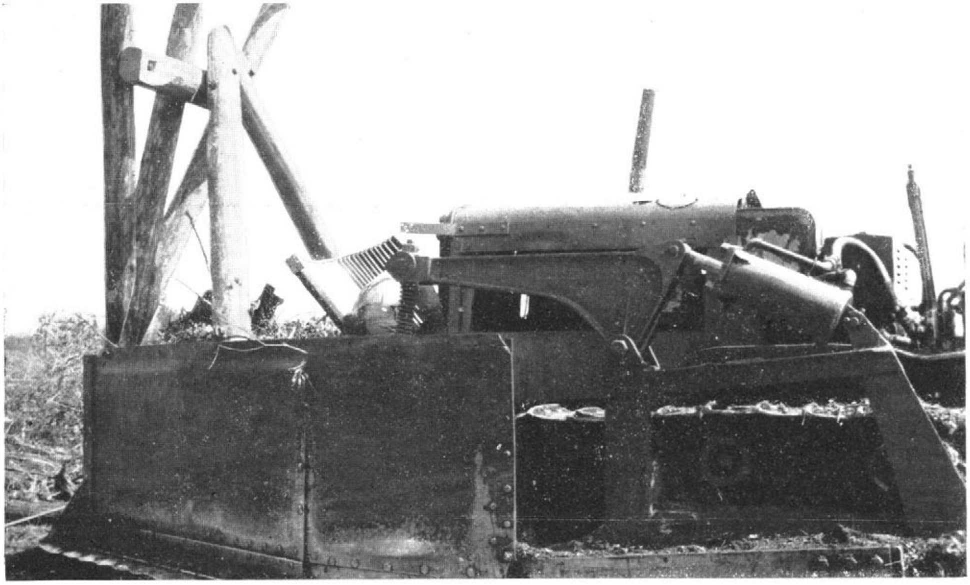
[1] See Surface Geology.



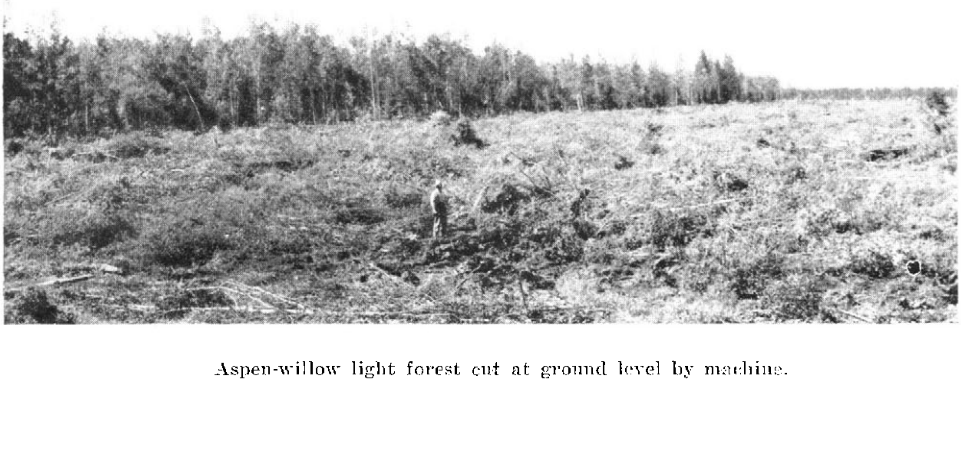
Mature Spruce growing on the Fraser Soil Complex along the Fraser River.

Lodge Pole Pine with a minor inclusion of Spruce Aspen and Willow.

Aspen-willow light forest with scattered Lodge Pole Pine.

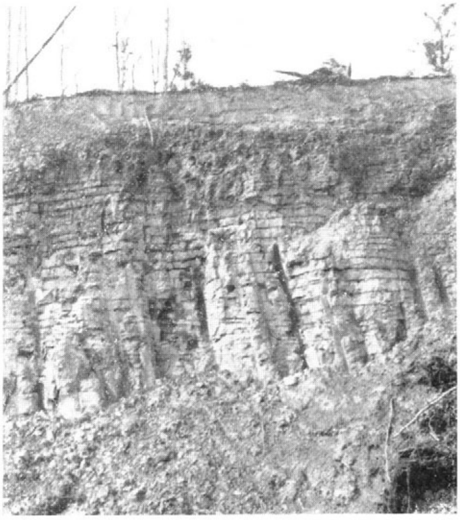


Locally developed brush cutting machine.

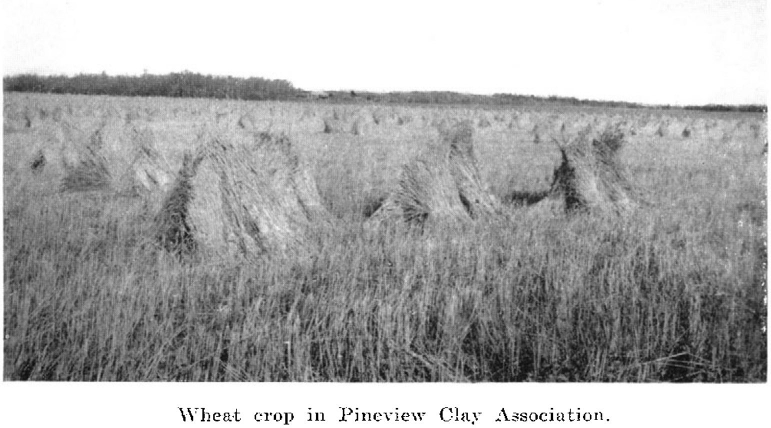


Aspen-willow light forest cut at ground level by machine.

Glacial Till underlying the Pineview Clay Association on the Fraser River. Lot 3831



Varved substratum of the Pineview Clay Association.



Wheat crop in Pineview Clay Association.


Farm Development on the Pineview Clay Association.


Pineview Clay Topography southeast of Prince George.


Black, ill drained and grey well drained top soils,
Pineview Clay Association.

Burned areas are quickly covered by shrubs and pioneer species of trees. The smaller burns are often seized by lodge-pole pine, which grows up in thick stands, but the larger ones are covered mainly by aspen, with pine in isolated groves. As the aspen matures it is gradually supplanted by pine and spruce.

Where the vegetative cover is spruce or lodge-pole pine there is a forest floor of living moss about two inches thick. This is chiefly feather moss in association with a minor flora of other mosses, lichens and fungi. Beneath the moss layer is the soil profile, described as follows:—

Horizon	Depth	Description
A_{00}	0 – 1″	Brown partly decomposed remains of moss, needles, twigs, wood, leaves, etc.
A_0	1 – 2″	Dark brown well decomposed remains of moss, needles, twigs, wood, leaves, etc., with many small feeding roots in the lower part. pH 5·0
A_1	2 – 2¾″	Dark grey sandy loam to loam, fine crumb structure, scattered gravel and many small roots. Sometimes very thin or absent. pH 5·1
A_2	2¾– 5″	Ash grey to whitish and powdery when dry. Textures range from sandy loam to clay loam in different areas. Weak platy structure, with gravel and stones. In places this horizon continues several inches downward in finger-like formations around roots. pH 5·2
A_3	5 –14″	Gravelly and stony sandy loam to clay loam. Coffee brown at the top, becoming lighter and more greyish with depth. Finely granular and friable but firm. pH 5·6
B_1	14-22″	Brownish grey at the top, shading to greyish brown in the lower part. Stony and gravelly sandy loam to clay loam with fragmentary structure. pH 6·0
B_2	22–30″	Grey stony and gravelly sandy loam to clay loam. Fractured unweathered fragments of till mixed with weathered material. Weathered material has fragmentary structure. No line accumulation. pH 6·6
C		Blue-grey till firmly cemented. An unstratified mixture of all separates including stones and gravel. Sandy loam to clay loam texture in different places. Angular fracture with general appearance of compression. Impervious to downward movement of water. pH 7·0

Agriculture

The finer textured soils of the Chilako Stony Soil Complex are drought resistant and capable of producing crops, but a number of defects stand in the way of their utilization under present conditions.

Small areas of fine textured soil containing variable amounts of stones and gravel are spaced between large rolling hills with excessive amounts of stones and gravel. Where these small arable areas lie adjacent to glacio-lacustrine soils they can be cleared as pasture additions to farms. Within the complex, however, areas of stone-free land large enough for development of homesteads are few and far between.

The clearing of land for agricultural use presents a problem of sufficient difficulty to hold back the development of the more desirable glacio-lacustrine soils. In the Chilako soils there is the additional cost of removing stones and excessive wear on farm machinery. The impervious substratum beneath this type also has its disadvantages, inasmuch as it sets up variable drainage conditions where the till is close to the surface.

At the time of the soil survey the disadvantages of the Chilako stony soils were believed to be great enough to disregard their differentiation. They were regarded as a submarginal group with a minor inclusion of fine-textured stony soils that cannot be economically developed at the present time. The whole complex could be used to the best advantage for forestry until agricultural land is in great demand. The complex could then be differentiated by resurvey for the purpose of more closely rating its agricultural possibilities.

In its natural state the complex is a valuable asset to the arable part of the district. Reseeding is quick and vigorous after fires or logging and there is a luxuriant reproduction of aspen and lodge-pole pine. With good management timber, ties and fuel can be placed on a permanent yield basis. At present the aspen has no local use but in future it may become a source of wood pulp. Birch is cut for fuel, but it has other possibilities and it possibly could be used locally for the manufacture of furniture.

The complex is also a source of gravel for adjacent areas of clay, and the large vacant areas are of value for hunting and trapping. Local hunters will be assured of moose, bear and grouse as long as the type is covered by forest.

Surface water is more abundant in the Chilako stony soils than in other types, because of the impervious substratum and the rolling terrain. Temporary streams and springs are much in evidence in the early part of the growing season, but later on they dry up. The permanent streams, ponds and lakes provide ample water for game.

Present development consists of a few small scattered clearings of not more than 10 acres each on lower slopes and bottoms. These clearings produce from fair to good crops of timothy hay and alsike clover, but the arable acreage available at the clearing sites is insufficient to maintain or develop farms.

2. *Soils derived from glacial river and lake deposits*

Gunniza Gravelly Sandy Loam

Description:

The Gunniza series is derived from gravels and sands that were sorted from the till during the decay stage of glaciation. The elevation varies from 2450 to 2600 feet above sea level and the differentiated area covers approximately 7,858 acres.

A hilly and a rolling phase were mapped. The hilly phase is formed of steep, irregular hills, knolls, and long winding ridges with undrained basins between them, some of which may contain small lakes, muskegs or grassy meadows. The parent material is water worn sand and gravel with the stratification showing frequent change in the character of the layers of which they are composed. The hilly phase occurs with the Eena series in glacial river formations.

The rolling phase is generally found in the vicinity of glacio-lacustrine soils. These areas suggest beach and island formations. The beachline areas overlie the till bordering the Pineview Clay Association and the islands consist of knolls that were former drumlins. Some of the island and beach formations had their entire surfaces reduced to gravel by wave action, and the till remains from two to six feet or more beneath the surface.

Most areas of the type have been burned over in recent years and the subsequent stand of aspen and lodge-pole pine is scanty. In burned areas the soil is exposed and excessively drained.

After examination of the scanty vegetation and exposed soil of burned areas, the most striking feature in mature forest on the type is the abundance of growth. While more open than on fine-textured soils there is a comparatively heavy forest of pine and spruce. Old, rotted fir logs and a few surviving trees are seen, and the fir shows a tendency to reseed.

The gradual development of coniferous forest after fire is accompanied by shading down of aspen and plants of the undercover. This enables mosses to cover the ground and to contribute largely to the thickness of the A_0 horizon. The moisture-holding capacity of the moss covered organic mat is great enough to alter the moisture relationship of the whole profile, and under these conditions an extremely porous soil can support a heavy forest.

The following profile was examined in mature forest about two miles south of Summit Lake. Living moss was about one inch thick on the surface:—

Horizon	*Depth*	*Description*
A_{00}	0– 1″	Brown partly decomposed moss, needles, twigs and wood.
A_0	1– 2″	Dark brown shading to black well decomposed products from above. Many small feeding roots in the lower part. pH 4·8
A_2	2– 7″	Whitish grey ash-like gravelly sandy loam. Porous, with weak platy structure. pH 5·3
B_1	7–17″	Rusty brown sandy loam, with fine granular structure. Gravelly and stony; porous and well drained. Small amounts of iron stain on stones. pH 6·4
B_2	17–41″	Greyish brown loamy sand. Structureless, with many stones, grit and gravel. Porous and well drained, with no showing of lime. pH 6·8.
C		Light grey sands, gravel and stones in a mixture. Washed and stratified. Glacial gravels underlaid at depth by cemented till. pH 7·0.

Agriculture

Owing to its very gravelly and stony nature the Gunniza gravelly sandy loam is definitely submarginal as crop or pasture land. Where conveniently located, however, it would make dry sites for farm buildings.

It is of value as a source of farm water supply along boundaries between the gravelly sandy loam and the Pineview Clay Association. Islands of gravel, underlaid by cemented till and surrounded by clay, act to some extent as reservoirs which store precipitation water. Springs are often found along the contact zone, and groundwater may be tapped by digging shallow wells.

In burned over areas where plants of the undercover form the second growth, the gravelly sandy loam has value as a source of wild huckleberries and blueberries. Where abundant these berries are picked for local use. With management this production could be increased and the type may assume local importance as a source of certain small fruits.

During short dry spells in summer, the fire hazard is greater in second-growth areas than on other soils. Even with a high fire hazard, however, the type may produce lodge-pole pine for poles and fuel.

In a district where the area of heavy clay is extensive, large supplies of gravel will be required continuously for road building and general construction. At the time of the soil survey the greater part of the type was in public ownership, and it would best serve the local needs if it remained as part of the public domain. Under the management of the Public Works Department, supplies of gravel could be made available from the Gunniza series that would fill local requirements for many years to come.

Eena Series

The Eena series is derived from sands transported and deposited by glacial rivers. In the classified area the series lies between 2100 and 2600 feet elevation.

The topography consists of hilly, rolling and undulating phases. The hilly phase, which covers about 14,283 acres, is remarkable for two unusual topographic forms. There are areas of pyramid-shaped hills separated by coulee depressions that have no general direction. These were probably formed by collapse of the surface following the decay of buried ice. The other type is the ridged topography found in glacial river channels. Two small areas of the rolling phase are in the vicinity of Nukko Lake, and the undulating phase lies in one area between Pilot Mountain and the Summit Lake road.

The cover of unburned parts of the series consists of tall spruce and lodge-pole pine, with occasional large cottonwood, poplar and birch. Plants of the undercover are well shaded down. The soil is covered by a layer of living moss and an A_0 layer of plant remains. In areas swept by fire the forest is mainly aspen, with a minor content of birch and lodge-pole pine.

Beneath the layer of organic litter the soil is leached to whitish brown, with brown to light brown subsoils. The parent material is greyish brown medium sand containing finely divided mica. Over most of the area it is soft, loose, clean and free from gravel, but in some places there are layers of fine gravel and bands of silt between layers of sand. In parts of the area beds of silt are known to exist beneath the sands, and in the hilly phase silt caps some of the knolls. Glacial till underlies the sands at shallow depth near the boundary of the Chilako soils, and at greater depth elsewhere. In the undulating phase stratification can be seen in the parent material, but it was not observed in the hilly phase.

Two soil types were mapped in the Eena series, covering a total of about 20,431 acres. These are loamy sand 9,304 acres, and sandy loam 11,127 acres.

Eena Loamy Sand

Description

The loamy sand occurs along the north bank of the Nechako River, between Miworth and Prince George. From Miworth it strikes northwest to the Chief Lake road. It is all a hilly phase, covering about 9,304 acres.

On southern exposures the second growth of deciduous trees, shrubs and lodge-pole pine is scanty for a long time after fires and the sandy soil is exposed. Under the same conditions the growth is more abundant on the northern slopes. Along the Nechako River a few of the hills are capped with stratified silt.

Exposures along the Nechako River from Prince George to Miworth and west of the Nechako River bridge show about 30 feet of sandy parent material overlying glacial till. To the east of the bridge several silt capped knolls lie upon horizontally stratified sands about 200 feet thick. These sands are Nechako River deposits that were left undisturbed by glaciation.

The abundant growth in mature forest as compared with the scanty second growth in burned areas is a striking example showing the importance of the A_0 layer to the moisture economy of the soil profile. Apparently the A_0 layer does not become fully developed until the deciduous growth has been shaded down and moss covers the surface. When this has been accomplished the productivity of the loamy sand as a forest soil is almost the same as the finer-textured types.

A profile was examined in an area of mature spruce, with occasional large cottonwood, aspen and birch. The undercover plants were well shaded down and living moss on the surface was two inches thick. The location was on a knoll with a gentle slope on top. This profile is described as follows:—

Horizon	*Depth*	*Description*
A_0	0– 2″	Dark brown partly decomposed and well decomposed moss, needles, twigs, wood, etc. Many small feeding roots in the lower part. pH 5·0
A_2	2– 4″	Whitish brown ash-like fine to medium single-grained loamy sand. Porous; no stones or gravel. pH 5·8
A_3	4– 8″	Light brown single-grained loamy sand, porous, loose and soft. pH 6·4
B_1	8–15″	Brown single-grained loamy sand. Loose and porous. pH 6·4
B_2	15–69″	Greyish brown loamy sand, single-grained, loose and porous. Soft concretions in the lower part coloured the same as the horizon. pH 6·6
C		Greyish brown medium sand containing finely divided mica. Soft, loose and clean, with no stones or gravel. No stratification observed. pH 6·8

Agriculture

A few pre-emptions were taken up in the burned part of this type. These are located in a narrow valley to the northwest of Prince George, and small areas were cleared and cultivated. The pre-emptions never progressed beyond the initial stage, and the sod remaining on the small clearings is very light.

Bottom lands with slopes gentle enough for cultivation amount to only a few acres on each quarter section, and even in bottoms the soil lacks sufficient drought resistance for farm crops. The hilly nature of the land and the light texture of the soil both indicate that the Eena loamy sand is best suited for forestry.

Eena Sandy Loam

Description

The Eena sandy loam occurs along the Summit and Chief Lake roads to the north of Prince George. The hilly phase covers about 4,901 acres, and the rolling and undulating phases occupy approximately 821 and 5,405 acres.

The main distinctions between this type and the Eena loamy sand are greater inclusion of silt in the surface soil and stratified silt here and there in the parent material.

A profile was examined in the undulating phase, in young spruce and lodgepole pine forest, with about two inches of living moss covering the surface. The description is as follows:

Horizon	*Depth*	*Description*
A_0	0– 1″	Dark brown well decomposed moss, twigs, wood, etc. pH 5·2
A_2	1– 5″	Whitish brown ash-like and platy sandy loam. Finger-like pockets extend downward for several inches around roots. pH 5·8
A_3	5–14″	Brown sandy loam, firm and single-grained. pH 6·2
B_1	14–23″	Light brown medium to coarse loamy sand, with scattered small gravel. Firm and structureless. pH 6·5
B_2	23–38″	Greyish brown structureless loamy sand. Small amounts of silt due to thin silty bands in the parent material. pH 6·4
C		Grey stratified sand with brownish colour inclusions. pH 6·8

Agriculture

The hilly phase of this type consists mostly of steep slopes that are definitely of no agricultural value and narrow, crooked, peaty hollows between hills. These hollows, which are productive, amount to from 5 to 20 acres in each quarter section.

Some of the hilly phase has been pre-empted for the timber and when this was taken off or burned a few of the hollows were cleared and farmed. However, there is insufficient arable land for a farm on any quarter section and attempts to develop farms have not been successful.

In an area of the type along the east shore of Nukko Lake the topography is rolling, and a few gentle slopes have been cleared for gardens and fields. This area is underlaid by glacial till near the surface, which improves moisture relations, and good garden crops are produced near the lake shore.

In the undulating phase the texture of the solum varies from fine to coarse, the fine-textured areas being near the boundaries of the heavier soils. Adjacent to the boundary of the Chilako soils the type is underlaid by cemented till and near other boundaries there is admixture of silt and clay. These fine-textured areas, where conveniently located, could be utilized as additions to farms on other soil types.

At the time of the soil survey only about 1,063 acres of light clearing was found in the undulating phase, the remainder of 4,342 acres being spruce and lodge-pole pine forest. A few attempts have been made to develop farms in the area of light cover, but with one or two exceptions the clearings are small and most of them have been abandoned.

The hilly phase of the Eena sandy loam is submarginal for agriculture, owing to the rough topography, and best suited for forestry. The proper utilization of the rolling and undulating phases for settlement would require a more detailed soil survey to differentiate the most desirable parcels. This is not warranted at present, owing to the mature forest on most of the area and the availability of arable land in the areas of Pineview soils.

Bednesti Silt Loam

Description

The Bednesti series is derived from stratified intermediate-textured deposits laid down in temporary glacial lakes near the entry points of glacial rivers. In the map-area the elevation of the type ranges from 2,450 feet to 2,600 feet above sea level.

The topography consists of a hilly and an undulating phase. The hilly phase occurs near the mouth of Willow River and along the boundaries of the Eena series, covering about 5,778 acres. The undulating phase lies to the west and south of Swamp Lake, where it occupies about 10,919 acres. The total mapped area of silt loam amounts to approximately 16,697 acres.

The parent material is stone-free silt stratified in thin layers. The silt has considerable thickness, overlying cemented till. Along the boundaries of the type, and particularly in the area between Swamp Lake and Nukko Lake, the silt is underlaid by the sands from which the Eena series is derived. The more or less porous nature of the silt provides good subsurface drainage.

Where unburned the Bednesti silt loam supports a heavy mixed forest of spruce and lodge-pole pine, the plants of the undercover being well shaded down. Beneath a layer of living moss and partly decayed organic matter the surface soil is leached to ash-grey, becoming yellowish brown to greyish brown with depth. The soil texture over the greater part of the area is silt loam, but there are small included areas of loam and clay loam that were not differentiated. Here and there small iron concretions and gravel were observed in the surface soil.

A profile was examined in a stand of spruce and lodge-pole pine about 60 years old, the ground being covered with mosses about two inches thick. The description of this profile is as follows:

Horizon	*Depth*	*Description*
A_{00}	0- ½″	Dark brown partly decomposed needles, twigs, moss wood, etc.
A_0	½- 1″	Dark brown well decomposed organic matter. Many small feeding roots.
A_2	1- 4″	Ash grey silt loam, fine granular structure in weak platy arrangement. Thickness of horizon varies with tongues extending downward for several inches around roots. Friable and porous. pH 4·65
A_3	4-11″	Yellowish brown silt loam with soft fragmentary structure breaking easily into granules. Porous and leached, with a few scattered iron concretions. pH 5·45
B_1	11-20″	Greyish brown silty clay loam with easily broken fragmentary structure. Compact but fairly porous. pH 5·82
B_2	20-31″	Brown silty clay loam with large fragmentary structure, less easily broken and heavier than horizon above. Compact but well drained. pH 6·00
		Buff coloured stratified silt in compact layers about one eighth inch thick. No stones, grit or gravel. pH 6·65

Agriculture

The hilly phase is non-arable, owing to its rough topography. In the total hilly area of 5,778 acres there are about 1,983 acres of aspen second growth and 3,795 acres of coniferous forest. This phase is best suited to forestry. It produces a heavy growth of spruce and lodge-pole pine, the area near Willow River being featured by the inclusion of Douglas fir.

The undulating phase has several features favouring its use for farming. It dries more rapidly and is warmer in spring than the clays. It is also more easily handled, has good drainage and is moisture retentive.

The main physical defect consists of higher elevation than the clays. Elevations around 2,600 feet may shorten the growing season and the frost-free period in relation to these periods on the Pineview clay at 2,000 to 2,450 feet elevation, and on river terraces at 1,800 to 2,000 feet above sea level.

Between Swamp and Nukko Lakes is a mixed phase which was not differentiated. In this area there are about 1,200 acres underlaid by Eena sands which occur close to the surface. The micro-topography consists of small knolls and depressions, the knolls being sandy and the bottoms filled with silt. This area is potentially arable, but spotty and less desirable for agriculture than the silt areas.

At the time of the soil survey the chief disadvantage in the way of developing the undulating phase was the forest cover. Only about 1,744 acres have aspen second growth as a result of fire. The remaining 9,175 acres are covered with spruce and lodge-pole pine timber that cannot be cleared economically for cultivation of the land.

There are a few settlers in this type along the Chief Lake road. Their clearings are small, but yields of timothy hay, alsike clover, grain and vegetables are satisfactory where the land has been properly cultivated.

Most of the settlers have located near supplies of surface water, hence the status of underground water is somewhat obscure. Water should be obtainable on top of the glacial till which underlies the stratified silt. The conditions beneath the till and the depth to plateau bedrock are unknown.

In the Bednesti series there is a greater tendency among settlers to experiment with fertilizers than in the clay areas, and this may indicate soil deficiency. Deficiency of organic matter is obvious and good results are obtained from applications of barnyard manure. Light applications of gypsum have been tried by settlers and are said to give increases in the yield of alsike clover.

Chemical analysis of the Bednesti silt loam profile described in the preceding section is given in appended Table No. 3, and this shows lower organic matter and nitrogen content than in clay profiles sampled under the same conditions. Exchangeable lime, magnesium and potash are also low compared with the amounts available in the clay profiles. In this profile the exchangeable lime and potash border on deficiency. Exchangeable phosphoric acid, however, is higher than in the clay types. The content of cobalt, necessary in animal nutrition, is above the 6 p.p.m. minimum requirement.

Generally the settlers select areas of deciduous growth for clearing and cultivation. In this type their findings point to the need of adding available plant food. There is need of plot tests to ascertain the growth response to barnyard manure, gypsum, lime, potash and phosphorus. It would appear that the Bednesti series has less organic matter and less available minerals in the soil on cultivation than the clays and it may require the regular use of certain soil amendments from the beginning of cultivation.

Pineview Clay Association

Description

This association consists of a group of soils derived from heavy stratified clay originally deposited in temporary glacial lakes. Its elevations range between 2,000 and 2,450 feet and its area amounts to about 252,740 acres. It occurs throughout the mapped area and extends beyond the map on the east, west and south.

The topography consists of hilly, rolling and undulating phases. The hilly phase occupies about 1,176 acres in one area to the north of Prince George. The rolling phase covers about 18,640 acres in a number of variable, scattered areas. Most of these are too rough and broken for agriculture, but there is one area to the north of Woodpecker covering about 5,258 acres which has agricultural value. In this locality the topography is rolling with included gentle slopes and flats of variable size. In many quarter sections 100 acres can be cleared in several separated fields, but each quarter section has some waste land.

The undulating phase is the most extensive agricultural soil type in the mapped area. Throughout an extent of about 232,924 acres the topography consists of gentle rolls and slopes, with included areas that are almost flat. This topography favours the development of a well drained soil type on slopes and an ill drained type in the numerous and irregular depressed areas.

Only a few places were encountered where the clay was covered by a mature stand of trees. In these localities the trees were mainly lodge-pole pine, with scattered spruce and birch. Although the large pine trees were 8 feet or more apart the undercover plants were well shaded. Even in areas of the most mature forest the A_0 horizon contained charcoal from long past fires.

Where small burns had occurred the second growth is generally a thick stand of lodge-pole pine. Where fires consumed the forest over large areas within the past 30 or 40 years, aspen about two inches in diameter is the principal tree, together with a minor growth of willow, birch, shrubs and herbs, and scattered groves of lodge-pole pine. Under these conditions alder, about two inches in diameter, is abundant in depressed or flat areas.

One fire will often kill a forest of lodge-pole pine and spruce, but many trees remain standing and the ground is littered thickly with fallen logs. One or more subsequent fires are sometimes necessary to clear off the land. In burned areas remarkably few stumps remain in the ground. This is because the trees uproot as they fall and the logs and roots are consumed.

In burned areas the amount of litter remaining on the ground varies from place to place. Over about 75 per cent of the clay area there are very few stumps and the amount of litter ranges from less than 5 per cent to about 15 per cent of the original stand. Near the boundaries of pine and spruce forest and in some of the smaller burned areas from 25 to 50 per cent of the original stand litters the ground.

In coniferous forest the surface is covered by a two-inch layer of feather moss and allied species, beneath which is horizon A_0. Under well drained conditions the A_0 horizon consists of a two-inch layer of litter, dark brown in the upper part and black in the lower part. The dark brown upper section consists of freshly added material partly decomposed, and the black lower part represents finely divided organic matter in a more advanced stage of decomposition. Under good drainage these divisions of horizon A_0 have about the same thickness.

Where drainage is restricted to a minor degree, because of very gentle slopes, flats or shallow depressions, the black lower part of horizon A_0 slowly accumulates well decomposed organic matter. Under different degrees of restricted drainage the thickness of the lower part of this horizon ranges from two to twelve inches or more.

The thickness of the black mineral soil, designated horizon A_1, is related to the drainage conditions that vary the thickness of horizon A_0. Under well drained conditions horizon A_1 is seldom more than one inch thick, but under some conditions of restricted drainage its thickness is increased to four inches or more.

Horizon A_2, the light grey leached layer, also varies in thickness under different drainage conditions. In the well drained associate it sometimes attains a depth of seven inches, whereas it may be only one or two inches thick under the conditions of restricted drainage that develops a deep A_1 horizon.

When the ground is bared by fire the A_2 horizon is subject to erosion. The effects of erosion can be seen in profiles covered by heavy and light forest in many parts of the clay area.

In coniferous forest under moss ground cover the structure consists of granules. These are about half the size of wheat kernels at the top of horizon A_1 and by adherence to one another they grow to the size of corn in the lower part of horizon A_2. After fires, when sufficient time has elapsed to produce an average growth of aspen, the granular structure appears to degenerate to a granular-platy form.

Horizon A_3 is the lower part of the A horizon and the structure is fragmentary. The fragments increase in size from about $\frac{1}{4}$-inch in diameter at the top to $\frac{3}{4}$-inch diameter at the bottom of the horizon. Each fragment can be divided into a number of smaller ones similar in size and appearance to the structure of horizons A_2 and A_1, and similar in shape to the large fragment of which they form a part. Horizon A_3 is heavier than horizon A_2, and where exposed on roadsides it attains a light grey leached appearance.

Horizon B_1 is a very dense, heavy horizon, where the units of the fragmentary structure have now attained an inch or more in thickness. There is a marked accumulation of colloids, and with average drainage the colour is coffee brown.

In several parts of the clay association, particularly in the vicinity of Johnson Ranch, Salmon Valley, near the junction of the Summit Lake and Wright Creek roads, the B_1 horizon is brownish yellow. Small iron concretions in the horizon have brown cores and yellowish fringes on a mottled grey background. Both hematite and limonite have been formed. This condition cannot be assigned to drainage because it does not occur under similar drainage conditions elsewhere. It is regarded as a variation of the parent material that could not be differentiated during the present survey.

Under average conditions horizon B_2 of the clay association is essentially the horizon of transition between B_1 and the unweathered parent material. Its most characteristic features are lighter colour and texture than B_1 and a mixture of weathered and unweathered parent material. Where the parent material is varied the light and dark colours of the annual layers can still be identified among the undecomposed fragments. The lower part of the B_2 horizon does not contain free lime. The only observed lime accumulation was a small amount on cemented till underlying the clay parent material at a depth of 8 or 10 feet, and also in stratified silt underlying the clay at about the same depth.

Horizon C is the parent material of the A and B horizons. It lies from 20 to 36 inches from the surface and consists of heavy clay in horizontal layers $\frac{1}{4}$-inch or less in thickness. The stratified clay ranges from 4 to about 25 feet in depth. It overlies cemented till or stratified silt and till. The glacial till is the parent material of the Chilako soils, and beneath the clay it has the same drumlinized topography. This feature is the cause of topographical variation in the clay areas. The surface relief depends upon the thickness of the lacustrine deposit that overlies the till.

Throughout the mapped area the clay surrounds areas of outcropping till that were formerly islands in a temporary lake. Some of the islands only reached the upper limit of clay deposition and gravel occurs on low, rounded hills in the clay area. These are small areas of Chilako soils, too limited for differentiation with the present map-scale.

In the clay association near the channels of the Nechako and Fraser Rivers a layer of stratified silt occurs between the clay and the underlying till. The silt is a light buff colour on dry river exposures and its thickness varies between 10 and 25 feet. Where the silt occurs the topography has undergone its greatest modification and may be described as gently undulating.

The following Profile No. 1 represents the well drained associate with the brown B horizon. This type covers the major part of the clay area. The profile was examined in spruce and lodge-pole pine forest about 60 years old, in the S.W. ¼ of Lot 951, to the east of Prince George. It describes the soil beneath two inches of living feather moss, club mosses and lichens:—

PROFILE No. 1

Horizon	*Depth*	*Description*
A_{00}	0 – 1 ″	Dark brown partly decomposed needles, twigs, moss, dead wood, etc.
A_0	1 – 2 ″	Black well decomposed organic matter. Numerous small feeding roots.
A_1	2 – 3 ″	Black friable mixture of organic matter and mineral soil. Small granular structure. pH 4·61
A_2	3 – 7 ″	Light grey clay. Wheat sized granules which get larger with depth by adherence to one another. pH 5·10
A_3	7 –10 ″	Light grey clay. Fragmentary structure ¼-inch diameter at top, increasing to ¾-inch diameter in lower part. Heavier than A_2, with the appearance of being leached. pH 5·12
B_1	10 –18 ″	Brown heavy clay, with slightly reddish tinge. Large fragmentary structure and heaviest texture of any horizon. Cracks vertically on drying. pH 5·19
B_2	18 –22 ″	Heavy clay but not as heavy as B_1. Light grey broken laminations alternating with dark ones. No evidence of accumulated lime. pH 6·25
C		Heavy varved clay, with thin horizontal cleavage. Alternation of light and dark layers with range of colour from light grey to greyish brown. pH 7·56

Profile No. 1 is indicative of the soil conditions under coniferous forest. These are less favourable for crop production than the soil conditions beneath deciduous growth. The chemical analysis of this profile, given in appended Table 3, shows a high percentage of organic matter and nitrogen in the shallow A_1 horizon. While these constituents decrease rapidly in horizons A_2 and A_3, the amounts are satisfactory for crop production. Settlers have little difficulty in producing crops on land which was under deciduous growth at the time the land was cleared and cultivated.

In this profile the silica, alumina, iron and lime have a relationship not usually found in a soil subject to the leaching process over a long period of time. Loss of the original A horizon is suggested as a result of erosion after some long past fire, followed by the development of a new A horizon from the heavy B horizon material. Since most of the clay area has been subject to recurring fires, this condition is common at the top of well drained slopes.

It would appear that exchangeable lime is low in areas of coniferous forest, and this is supported by the pH values. In deciduous growth, however, the reaction at the surface is generally close to the pH of the lower part of the profile, and the content of exchangeable lime is probably higher.

Magnesia and potash are high as to totals and availability, but total sodium is less than in other classified British Columbia soils. Total phosphoric acid compares favourably with other classified soils in the Province, but easily available phosphoric acid is low. The content of cobalt is well above the requirements for animal nutrition.

Profile No. 2 represents the well drained associate with the brownish yellow B horizon. This type covers a minor part of the clay area. The profile pit was dug on a gentle slope in a spruce and lodge-pole pine forest about 75 years old, located in the N.W.¼ of Lot 1518, near the Summit Lake road. It describes the soil beneath a two-inch covering of living moss:—

PROFILE No. 2

Horizon	*Depth*	*Description*
A_{00}	0 – ½″	Dark brown partly decomposed needles, twigs, moss, dead wood, etc.
A_0	½– 1½″	Dark brown well decomposed organic matter, with a large number of small feeding roots.
A_1	1½– 2½″	Black friable mixture of organic matter and mineral soil. Small granular structure, some of the granules having a soft core of concretionary iron. pH 4·55
A_2	2½–11 ″	Ashy grey clay with small granular structure at the top, becoming platy in the centre of horizon and platy-granular combination in the lower part. The granules increase in size with depth, some having a core of concretionary iron. pH 5·31
A_3	11 –14 ″	Light grey clay with slight yellowish tinge when damp. Small fragmentary structure. More compact and heavier than horizon above. pH 5·01
B_1	14 –16½″	Brownish yellow clay, the colour being from concretionary iron particles with brownish centres and yellowish fringes on a grey background. Fragmentary structure and vertical cracking, the fragments being one inch in diameter and capable of breaking down into smaller ones of the same shape. pH 5·52
B_2	16½–21½″	Greyish brown clay with iron accumulation and fragmentary structure 1½ inches in diameter. Compact and heaviest horizon in profile. pH 5·80
B_3	21½–29½″	Clay with horizontal layering and some evidence of broken lamination. Alternating brown and light grey layers about ½-inch thick. Partly weathered parent material, compact and heavy. pH 6·40
C		Heavy varved clay, with alternation of grey and dark brown layers. Main horizontal cleavage is about ½-inch apart. pH 6·55

Profile No. 2 has the same soil environment as Profile No. 1, and its chemical analysis is shown in appended Table 3. In comparison with Profile No. 1, the A_1 horizon has a low percentage of organic matter and nitrogen. The relationship of silica, alumina, iron and lime is indicative of greater maturity than in the profile previously examined.

As in the case of the first profile the exchangeable lime is low and the exchangeable magnesia and potash are satisfactory. On the other hand, easily soluble phosphoric acid is high in all A sub-horizons. The quantity of cobalt differs from Profile No. 1, but is sufficient for animal nutrition.

Three kinds of structure in horizon A_2 postulates the addition of soil to the horizon during periods of erosion after fires, a condition opposite to that in Profile No. 1.

The structure of the lower part of horizon A_2 is platy-granular, the centre is platy and top part is granular. In this district granular structure appears to be associated with coniferous forest and a moss ground cover, whereas platy structure is related to deciduous forest. The structure of the lower part is obscured by combination, possibly related to both deciduous and coniferous forests which succeeded one another in the remote past. After the bottom layer was established the forest was destroyed and erosion from upslope covered the surface with new soil. This was followed by deciduous forest and the development of the platy horizon. In turn the deciduous forest was destroyed and erosion from upslope again covered the surface. In this case lodge-pole pine came in directly, and the top layer developed granular structure.

The details of soil erosion expressed in these two profiles are common to fine textured soils in a district characterized by recurring fires. An ideal profile without subtraction or addition of surface material would be difficult to find. In undulating topography at least part of the A horizon at the top of each gentle slope has been washed downward when the ground is bare after fires, and the soil lower down has been built up.

Agriculture

Along with other fine textured soils the Pineview clay association has been divided into two land use divisions based on the density of forest cover. Areas covered by heavy forest are designated "temporarily non-arable land", and areas covered by light forest are called "arable land".

In the undulating phase the temporarily non-arable division consists of about 128,829 acres occupied by spruce and lodge-pole pine forest. Under present conditions this category may be regarded as temporarily unsuitable for agricultural development, owing to the prohibitive cost of preparing the land for cultivation.

The arable land covers about 109,353 acres occupied chiefly by aspen-willow growth, with a minor inclusion of birch, alder and scattered trees and groves of lodge-pole pine. This division is the most suitable for agricultural development at the present time.

Where clearings have been made in thick stands of lodge-pole pine, the soil does not grow good crops for several years. Locally this is thought to be due to undesirable substances in litter shed by the trees, but the soil reaction and available minerals may be low under these conditions.

On the other hand, destruction of the coniferous forest by fire and its replacement by aspen, willow, birch and alder second growth appears to be an ameliorating factor. The ashes from the burned forest and the annual fall of leaves from trees, shrubs and herbs has increased the amount of available minerals in the surface soil. At the same time this process has reduced acidity and contributed organic matter of better quality.

Owing to its extent, accessibility and desirability as farm land, the clay association has the most settlers and the largest percentage of cleared and cultivated land. This acreage was less than five per cent of the arable division at the time of the soil survey, but the lack of development is not related to the quality or productive power of the soil itself.

The natural fertility of the clay association is comparatively high. This is demonstrated by the good yields of grain and hay taken over many years without liming or the application of commercial fertilizers. Land with a deep A_1 horizon produces little after the first breaking, but when well drained and aerated this type is quite productive.

In addition to the use of manure, local experience indicates that the use of inoculated alsike clover is a good method of overcoming the natural deficiency of organic matter in the soil. Following the first crop the organic matter should be continuously built up by means of clover and other sod crops.

The use of superphosphate mixed with manure in one test resulted in slightly increased yield and earlier maturity. In another test an increased yield of alsike clover seed was obtained with ammonium phosphate. These tests were made by farmers and the results were determined by observation. While there in some evidence that chemical fertilizers will increase yields, the pioneer settlers have not used them as a regular practice.

In spruce and lodge-pole pine forest the soil reaction of the clay association ranges from pH 4·5 at the surface to about pH 7·0 in the lower part of the profile, as shown in Table 3. Under deciduous cover the reaction would appear to build up until the surface soil has the highest reaction shown in these profiles. Many tests by colorimetric methods reveal that the average reaction of surface soils under deciduous growth and in cultivated fields is from pH 6·0 to pH 7·0.

This reaction is optimum for certain crops, such as alsike clover and timothy, and both of these plants show remarkable vigour. They compete successfully for many years with deciduous growth in burned areas, along paths and on roadsides where the seeds are spread by animal droppings. These plants give to aspen covered areas a certain value as summer range for cattle.

Alfalfa, however, has not been an outstanding success. The plants germinate well, but the resulting crops have not been good enough to add alfalfa to the local cropping practice. Part of the difficulties with alfalfa have been attributed to heaving of the ground in winter.

While the clay association has many natural advantages, it also has defects due to its fine texture. These drawbacks include coldness in spring, a dense B horizon, the need of greater power for cultivation and difficulty of handling when wet. It is noteworthy that excessively muddy conditions prevail around farm buildings during wet periods, and that all-year roads must be gravelled. Most of these pioneer drawbacks, however, can be modified and in some cases overcome as the district is built up.

Coldness in spring can be ameliorated to some extent with improved air drainage as clearings are enlarged and soil organic matter is increased. Increased organic matter will improve handling qualities and modify the dense B horizon as the fields grow older. The abundance of gravel in nearby Gunniza and Chilako soils is a great boon where clay is farmed. Barnyards will eventually be stabilized with gravel, and concrete will be used more extensively for barn floors and house basements.

Where spruce or pine forest occurs on part of a pre-emption it can often be maintained as a woodlot. This will ensure a continuous supply of farm fuel, together with logs and poles for construction. At present a woodlot does not seem important, owing to the abundance of supplies from vacant land, but this condition will not always exist. The settler should take care of his assets in order to avoid long haulage and extra expense in the future.

3. *Soils derived from Post-Glacial River and Stream Deposits*

Giscome Gravelly Sandy Loam

Description

The Giscome series is derived from the gravelly post-glacial terraces of rivers. In the classified area these terraces have elevations between 1,800 and 2,000 feet above sea level, and the total area of the type amounts to about 28,442 acres.

The topography is undulating on terraces that vary in length and width. Here and there abandoned arms of the stream have left their mark and occasional tributaries have cut ravines at right angles to their length.

On the higher terraces the forest cover consists of fir, spruce and lodge-pole pine, the growing conditions being similar to those on the Gunniza series. On second bottoms near river level there is more moisture and the terraces support a heavy stand of spruce and a few large cottonwood. After burning the growth consists of a thin stand of lodge-pole pine and aspen, and a scanty undercover of blueberries, huckleberries and similar plants. Many years pass before the type regains its maximum producing power.

Before abandonment by the river a veneer of alluvium was spread over the gravels during exceptional freshets. This material consists of silts and fine sands, and its thickness varies on each terrace. Originally the soil was derived from the layer of alluvium on the surface, but in time this fine textured material partly lost its identity by mixing with the upper part of the gravelly substratum. Nevertheless the fine alluvial layer is recognized as the parent material of the soil. The undisturbed gravel beneath the mixed layer is of significance to the soil because it affords excessive drainage, and for this reason it is designated horizon D.

The gravels that lie beneath the solum have considerable thickness, particularly on older and higher terraces. These gravels were originally washed from glacial till to form bars in the stream channels. To-day the till is seen in great abundance on deep cuts where the rivers are widening their channels. Where this type of erosion occurs the fine materials are carried away, leaving the gravel and stones to accumulate in the riverbed.

The soil profile on an old terrace is described as follows:—

Horizon	*Depth*	*Description*
A_{00}	0 – 1″	Brown partly decomposed moss, needles, leaves, twigs, etc.
A_0	1 – 2″	Dark brown well decomposed organic matter. pH 5·0
A_2	2 – 5″	Whitish grey ashy gravelly sandy loam, with weak platy structure. pH 6·0
B_1	5 –10″	Brown sandy loam, single-grained, gravelly and sometimes stony. pH 6·4
B-D	10–18″	Light brown gravelly to stony loamy sand; structureless. pH 6·7
D		Greyish brown stratified sand, gravel and stones. pH 6·8

Agriculture

The gravelly terraces along the Fraser River between Giscome Portage and Woodpecker are all of the older type, which have lost most of their soil. The gravelly and stony solum is seldom more than 18 inches thick, beneath which there is clean stratified gravel. In some of these terraces fine gold occurs throughout the gravels. It also occurs beneath them on bedrock or upon the old lacustrine clay-grits. These terraces have no agricultural value.

The gravelly terraces on the Nechako River and on the delta-like area at its mouth are more patchy than the Fraser terraces. Here and there are parts of terraces where the upper layer of silt and sand is still intact. However, these areas are not large enough for farm units, and attempts to develop them for agiculture have ended in failure.

The Salmon River valley is lined with second bottoms cut into comparatively small areas by the meandering stream and its abandoned channels. Many of these turns and oxbows are not shown on the soil map. The whole bottom of this valley is covered with gravel derived from glacial till. Some parts of the area are still receiving the fine textured products an annual flooding, and most of the valley has a rather streaky surface covering of silt and sand.

Throughout the length of the Salmon River valley, from the west boundary of the soil map to the Fraser River, there are few second bottoms where the soil covering is sufficiently deep and the acreage large enough to support a farm unit. This valley, however, produces a heavy stand of big spruce in areas that have not been burned.

Taken as a whole the Giscome Gravelly Sandy Loam is a submarginal soil type, best suited to forestry. The higher gravelly terraces in burned areas are a source of wild blueberries and huckleberries in season, and where conveniently located the type has great value as a source of gravel for the clay areas.

Saxton Loamy Sand

Description

Saxton loamy sand is derived from sandy terraces formed by rivers during post-glacial time. The type occurs at elevations between 1,800 and 2,000 feet in the classified area and the total acreage amounts to about 11,486 acres.

The topography is undulating to gently rolling on terraces that vary in length and width. Included in the type is a post-glacial channel of the Fraser, floored with loamy sand. This area extends from Lot 871 to Lot 872 on the west side of the river, to the south of Fort George Canyon.

The mature forest consists of fir, spruce and lodge-pole pine in comparitively heavy stands. Undercover plants are well shaded, mosses cover the ground and there is a well developed A_0 horizon. After fires lodge-pole pine and aspen are the main second growth trees. The second growth is somewhat heavier than in the Eena loamy sand, owing to more gentle topography and slightly better moisture relations, but ground litter is often scanty and in many places the sand is exposed. Blueberries are a prominent feature in the thin stand of undercover plants.

The sandy terraces are small and scattered along the Salmon, Chilako and Nechako Rivers. They are equally unimportant in the Fraser River Valley to the north of Prince George. Between Prince George and Woodpecker, however, most of the terraces are composed of sandy materials.

In the vicinity of Prince George there are thick beds of stratified sands of pre-glacial or interglacial origin, which underlie the glacial till. These sands are exposed on the west side of the river opposite South Fort George. Vast quantities were moved downstream to form sandy terraces while the Fraser was carving out its post-glacial channel.

The Saxton loamy sand occupies the same elevations in the river valleys as the Giscome series, but a stratum of finer textured material does not overlie the surface. Beneath the solum the sands are stratified in thick beds overlying gravel, glacial till or bedrock. A profile with moss ground cover, examined in young spruce and lodge-pole pine forest, is described as follows:

Horizon	*Depth*	*Description*
A_0	0- 2″	Dark brown partly decomposed and well decomposed organic matter. Many small feeding roots in the lower part. pH 5·6
A_2	2- 5″	Whitish grey single-grained loamy sand. Tongues from this horizon extend as much as 4 inches downward around roots. pH 6·2
A_3	5- 9″	Yellowish brown loamy sand. Single-grained, no stones or gravel; porous but firm. pH 6·5.
B_1	9-29″	Light brown medium loamy sand, scattered rusty spots becoming more numerous with depth and a few rusty veins. Structureless and compact. pH 6·5
B_2	29-35″	Brown slightly compact loamy sand, structureless, with a few soft concretions of iron-bound sand. pH 6·7
C		Stratified greyish brown sand. No stones or gravel. Porous and well drained. pH 6·8

Agriculture

In the past a few pre-emptions were taken up in the burned part of this type to the south of Prince George, and small areas were cleared and cultivated. These homesteads never progressed beyond the initial stage before being abandoned.

Sandy terraces to the south and west of Prince George are of small importance, owing to their widely scattered locations and limited size, but to the south of Prince George these terraces occupy a considerable area in the Fraser River Valley. In this locality they are of value to adjacent areas of clay as a source of sand, wood and blueberries. From the standpoint of general utility, the dry sandy nature of the soil indicates that the type should be retained in the natural state.

Fraser Soil Complex

Description

This complex is derived from the fine textured post-glacial deposits of rivers and streams in the classified district. These deposits occur on first, second and third terraces from river level, and on the small floodplains of tributary streams. They range between 1,750 and 2,450 feet in elevation and cover about 32,729 acres. The topography is undulating, except where broken by abandoned arms of rivers or streams. The scattered areas vary greatly as to length, width and drainage position. The textural classes, which range from sandy loam to clay, were not differentiated.

A more detailed survey would map the many distinctions found along each river or group of tributary streams and offer a profile description of each soil associate. This survey, however, treats them only as a group of soils with two outstanding features. These are a common mode of formation and surface textures sufficiently fine for agricultural use.

The Fraser River trench is noteworthy for extensive floodplains between Prince George and the Salmon and Willow Rivers. These are low first, second and third bottoms with soils ranging from fine sandy loam to silt loam. The terraced topography has undulating surfaces, the second bottoms being scarred here and there by abandoned arms of the river which fill with water during the freshet stage.

Originally this area supported a heavy stand of tall spruce, with many trees two feet or more in diameter at the trunk, and some large cottonwood and birch. To-day most of the area has been burned over and the land supports a variable but generally heavy growth of deciduous trees, with scattered groves of spruce which escaped destruction.

To the south of Prince George the river trench is deeper and the fine textured terraces are smaller, more scattered and less important. These have been burned over and the clearing is generally light.

The Fraser is a muddy river which carries silt the year around. The freshet stage is reached about June 5, but the height attained by the river from year to year depends on the weather during the month of May. If May is a hot month the volume of drainage water from melting snow in the upstream mountains is increased and dangerous flood stages can occur from Prince George to the delta at the coast. During less important freshets some of the lower bottoms are flooded and a veneer of silt or fine sand is spread over the organic mould on the surface. In such places it is possible to find several layers of silt or fine sand separated by layers of well decomposed organic matter.

The terraces included in the Fraser soil complex were probably built up by silts and fine sands deposited during the greater freshets. These materials were eroded from upstream supplies of till and glacio-lacustrine clays. When freshly deposited the grey material is glittering with finely divided mica. The presence of mica is of interest, inasmuch as it does not occur abundantly in the glacio-lacustrine soils. Mica-schists are known to occur near Averil Creek, a few miles north of Giscome Portage, and there are probably other upstream sources.

A soil profile was examined on a Fraser River second bottom above the flood line. The location is in Lot 817 in the area locally called Fraser Flats. The forest was a mixture of spruce and deciduous trees and the ground was covered with living moss. This profile is described as follows:—

Horizon	*Depth*	*Description*
A_{00}	0 – 4″	Dark brown partly decomposed moss, needles, leaves, wood, etc.
A_0	4 – 5″	Black well decomposed plant remains. Many small feeding roots. pH 7·0.
A_1	5 –6½″	Dark brown granular silt loam and organic matter. Many small roots. pH 7·0
A_2	6½– 8″	Light brownish grey silt loam. Weak platy structure. pH 6·9
B_1	8 –18″	Light greyish brown silt loam. Weak fragmentary structure. Slightly compact; much finely divided mica. pH 6·9
B_2	18 –24″	Greyish brown silt loam, broken stratification; slightly compact; much finely divided mica. pH 6·9
C		Greyish brown silt loam. Soft, stratified with very little compaction. Much finely divided mica. pH 7·2
D		Stratified sands and gravels, grey in colour, present at variable depths or absent.

On other rivers and streams the profile has the same general characters as on the Fraser Flats, but its texture and the nature and position of the D horizon are more variable.

Along the Nechako River in the classified area the fine textured terraces are narrow and relatively unimportant. They are mostly second and third bottoms, standing from 10 to 40 feet above the river, and few of them are large enough to support a farm unit. The topography is undulating and the soils are silt and clay loams underlaid at about two feet by gravel. Most of the area along the Nechako River has been burned and the clearing is light.

In the classified area the Nechako is a fast flowing clear river which carries very little silt, even in the freshet stage. Its terraces are gravelly, with a variable but generally thin overlay of silt. On a few of these terraces the fine textured covering is thick enough for cultivation, and these areas have been included in the Fraser soil complex.

In its lower part the Chilako River trench is about a mile wide, with steep bluffs on each side. Upstream above Lot 4211 the trench gradually narrows, with a loss of depth. The valley floor is undulating and divided into small areas, rarely larger than 30 acres, by the river and its abandoned channels. The unburned portions support heavy stands of spruce and lodge-pole pine. The burned sections are covered with willow, aspen and a minor growth of cottonwood. The soils are deep, fertile silt and clay loams, underlaid by stratified sand and gravel. The floodplains have been formed by the rearrangement of glacial till and glacio-lacustrine deposits. In a general way the fine textured profile resembles the soils on the Fraser Flats.

Other soils included in the Fraser soil complex are the fine textured floodplains and fans of small tributary streams. They occur in small areas along streams draining the Pineview clay association. These soils vary in texture from sandy loam to clay, and the D horizon is glacio-lacustrine clay. In the clay areas the lighter textured floodplains and fans of the smaller streams are highly prized by settlers for vegetable growing.

Agriculture

The greatest drawback to farm development in the Fraser soil complex is the difficulty of clearing land. Located near drainage level where moisture relations are good, these soils support a heavier and more vigorous growth of trees and shrubs after the coniferous forest has been burned than any others in the classified district.

Where this difficulty has been overcome the land is productive, particularly for timothy hay, alsike clover, grain, vegetables and small fruits.

Cultural practice offers the minimum difficulty. There is no strongly developed B_1 horizon to contend with, as in the heavy clay soils, and the A_2 horizon is not strongly leached. Soil moisture conditions guarantee a crop every year.

When clearing the land a belt of brush should be left along the river to protect the bank during the freshet stage. Where this is not done the river may cut the bank away a little each year and gradually destroy the field. Building sites should be confined to the highest ground, owing to the possibility of exceptional flood stages on the rivers. This precaution is of particular importance on terraces along the Fraser River.

A farm water supply can be obtained in second bottom soils more easily than in any other soil types in the classified district. The depth of the well depends mainly on the height of the building site above river level. Usually a gravel stratum can be found near river level that will provide a good water supply.

The main settlements in the Fraser soil complex at the time of the soil survey were situated along the Fraser River to the north of Prince George and in the Chilako River valley. Once cleared and cultivated the land will produce crops without the use of commercial fertilizers, but settlers are faced with the need of building up organic matter by means of manure, legumes and other sod crops.

4. *Groundwater Soils*

Muskeg

Description

The type of peat formation locally called muskeg is moss bog with a partial cover of several other plant species. This bog type is remarkably different from the peat formations in the Lower Fraser and Okanagan Valleys. Its development appears to require a region that is dotted with numerous lakes and ponds. The muskegs occur throughout the district in areas ranging from a few acres to a section or more, the total area being about 12,050 acres.

Most of the peat has been formed in depressions formerly occupied by ponds, small lakes and at the ends of large lakes. The first stage of basin peat formation takes place under lacustrine conditions. Water lilies and similar plants become established near the edge of the pond and their residues accumulate on the bottom. This association gradually moves towards the centre, followed by sedges, mosses and a scanty growth of bog cranberry, Labrador tea, etc. Farther back these are followed by bog birch, willow and finally by black spruce (*P. mariana*) and lodge-pole pine. Many of the muskegs still have open water in the deepest part of the pond. In a few tests this proved to be about 30 feet deep, with a two-foot layer of spongy, finely divided organic matter lying on the bottom.

The largest number of muskegs are in the above stage of formation. There are a few, however, that have progressed into other stages based mainly on changes in the water level. Where the water level has been lowered there is a more or less complete invasion of black spruce, and the bog passes into a woody peat stage of development. Areas of bog in this stage are small and were not differentiated. Another bog type is produced where the outlet is temporarily dammed and the water level is raised. Under these conditions the trees and shrubs are forced to retreat and sedges become the dominant plants. This type was of sufficient importance for differentiation.

Muskegs were cross-sectioned with a special peat sampling tool, and were found to be from two to twenty feet or more in depth. Over any depth the profile appears to have the same general characters. The material is strongly acid and there is no evidence of accumulated lime or other minerals. In central ponds the reaction is pH 6·8, or about the same as local rainwater. The profile of an undisturbed muskeg is described as follows:—

Horizon	*Depth*	*Description*
1.	0– 2″	Surface cover of living moss with bog cranberry, Labrador tea, sedges, etc.
2.	2–10″	Light brown partly decomposed moss, twigs, roots, etc., the moss forming the bulk of the material.
3.	10–45″	Dark brown well decomposed muck residue from water plants, moss, etc. Decomposition increases with depth.
4.		Blue sandy loam underlaid by cemented till.

Agriculture

Aside from a scanty yield of wild bog cranberries the muskegs have no present value for agriculture.

MEADOW

Description

Natural meadows occur throughout the district in small to comparatively large areas, ranging from 5 to 200 acres or more. Some of the smaller meadows were bypassed during the soil survey, but a total of about 2,696 acres was mapped.

Most of the meadows developed from muskegs. Meadows often occur around the edge or at one end of a living muskeg and their origin is probably due to flooding in the early part of the season. The flooding is accomplished by the work of beavers, who dam the small streams by which the muskegs are drained.

The beavers raise the water level for the purpose of making a pond behind the dam for storing food. Under these conditions the whole or part of a muskeg is flooded and in the flooded area the mosses, shrubs and trees are killed. The beavers maintain the dam as long as a supply of aspen and willow are available within easy reach. When the supply runs short they abandon the dam and move elsewhere. Without maintenance a channel soon erodes through the dam and the flooded area is partly drained. After the flood stage the sedges get a good start and for many years thereafter they compete successfully with trees and shrubs, particularly if the water level remains close to the surface. The result is a meadow with a strong stand of sedges, usually dotted with widely scattered lodge-pole pine and stunted willow.

The profile varies with local conditions of formation. Where formed by temporary flooding along stream channels, there is a mixture of moss, sedge, tree and shrub remains and blue mineral soil beneath. Where muskegs developed into meadows the profile is as follows:—

Horizon	*Depth*	*Description*
1.	0– 1″	Partly decomposed remains of Carex plants.
2.	1– 3″	Dark brown to black well decomposed remains of sedges mixed with remains of mosses.
3.	3–13″	Dark brown partly decomposed and highly fibrous mixture of sedges and moss. Many live roots.
4.	13–40″	Dark brown well decomposed muck derived from mosses and water plants.

Agriculture

Meadows developed on organic remains are the only soils of the region which produce native grasses, and from the beginning of settlement they have been a source of swamp hay. In many cases trails have been cut through the woods for miles to the various natural meadows, and each year some settler harvests the hay crop.

At the present time most of the meadows are located some distance from settlements and there are few opportunities to observe their possibilities as crop land. However, the dry edges of a few meadows have been cultivated and planted to timothy and alsike clover, which produced fair crops. It is probable that parts of these meadows can be reclaimed for a variety of crops if properly drained, cultivated and fertilized. Certain garden vegetables can be produced in addition to hay, but the locations are too frosty for potatoes.

Shallow Muck

Description

About 2,776 acres of shallow muck soils were mapped in different parts of the classified area. The muck soils occur in depressed areas with restricted drainage, where forest litter accumulates at a rate slightly faster than decay. The arrested rate of decay permits the building up of the A_0 layer until a foot or more of black muck covers the ground.

In such areas there is a heavy spruce forest, with a minor inclusion of large birch and cottonwood. The undercover plants are well shaded and there is a rich ground cover of living moss. After the coniferous forest has been destroyed by fire, the second growth is generally a thick stand of willow and alder, which is difficult to clear off for farming purposes.

Beneath the living moss ground cover the profile is as follows:—

Horizon	*Depth*	*Description*
A_{00}	0– 4″	Dark brown partly decomposed moss, needles, twigs, wood, etc.
A_0	4–24″	Black well decomposed organic remains derived from horizon above.
G	24–28″	Yellowish iron stained clay.
C		Blue clay.

The character of the soil horizons vary with the thickness of the muck layer. Where the organic layer is thin there is a well developed A_1 horizon.

The above profile was examined in the deeper part of a muck area. Except where the muck layer is thin, the mineral soil is not penetrated by the roots of crop plants.

Agriculture

Shallow muck soils, when properly drained and cultivated are among the best for hay in the district. The valley of MacMillan Creek, to the north of Prince George, is floored with muck, which in some places attains a depth of several feet. This narrow valley is well developed for farming and it produces exceptionally heavy crops of timothy and alsike clover hay.

Elsewhere only small areas of muck have been cleared and cultivated, but wherever utilized the crops are heavy. However, the cost of clearing this type of soil is much higher than on well drained types with aspen-willow cover, and this has reacted against development.

5. *Miscellaneous Areas*

ROUGH MOUNTAINOUS LAND AND ROCK OUTCROP

Rough mountainous land covers about 15,220 acres in two widely separated areas. The topography is steep and there are many acres of exposed bedrock and large boulders. The area includes part of Six Mile Mountain and the whole of Pilot Mountain.

On the Nechako Plateau the bedrock is almost completely covered by a mantle of glacial till. Rock outcroppings are infrequent and in small exposures.

Scattered outcroppings along the rivers occur on eroded banks and in the river beds. Rock outcroppings are located on the soil map with a symbol, but since they are small and widely scattered the acreage was not estimated.

BLUFFS AND RAVINES

Bluffs and ravines fringe the post-glacial channels of the Fraser, Nechako, Salmon, Willow and Chilako Rivers. In places the land is rough and broken for some distance back from embankments, and often it is deeply cut by tributary stream channels.

The soils of the eroded areas consist of the bordering types at the higher elevations, together with a mixture of glacial till on the cuts. This type of land, which covers about 23,025 acres, is too rough for any agricultural use, but it has some value for forestry.

The Farm Water Supply

The problem of securing a farm water supply in the classified district varies with the different soils. The Fraser soil complex is mostly on second bottoms near drainage level and water can be secured from shallow wells. Near the great river trenches the glacio-lacustrine soils occupy drier positions and water is more difficult to find.

The first settlers on the glacio-lacustrine soils solved their water problem by locating near springs and flowing streams. In some cases an opportunity to take up the best land was sacrificed in order to locate near surface water. Subsequent settlers could not have surface water on their land. They had to haul their supply or dig wells.

In the Pineview locality results have varied at depths reached by hand digging. Some farmers have secured a good supply of water, sometimes after more than one attempt, but others have dry holes.

The findings during the soil survey indicate several sources of water in the glacio-lacustrine soils. The first of these is between drumlins on top of the buried glacial till. The cemented till has a rolling surface and a certain amount of water accumulates in the buried depressions. Often the surface indications determine the location of these buried hollows, which lie from 25 to 40 feet or more deep. This is within reach of the hand dug well, but the water should be located before digging.

A small hole from two to four inches in diameter can be drilled through stoneless clay and silt with a posthole auger or home-made hydraulic outfit. Additional pipe will serve for the shaft and remaining equipment consists of block and tackle and a tripod of poles. The sides of the hole will not cave, and when the till is reached it is recognized by hardness, stones and gravel. A layer of water-saturated gravel may occur in some depressions overlying the till. These deposits mark former drainage outlets and they are often a good source of water. After determining the amount of water in the hole, a well can be hand dug and cribbed.

This method has the advantage of locating water before a well is dug. If the drill hole is dry when the till is reached, little time has been lost and another site can be selected. The disadvantages are that water may not be found near the farm buildings or near a desirable building site, and a knowledge of the underlying till topography is essential.

Another source of water is along or near the boundary between the Gunniza or Eena series and the Pineview or Bednesti soils. The gravels and sands rest on cemented till. The coarse soil types restrict surface runoff and promote absorption of rain and snow water. At the lower elevations an underground reservoir is produced which seeks an outlet under the silt or clay soils. Springs occur under these conditions and water may be obtained on top of the till.

A third source of water is at greater depth on Tertiary formations beneath the deposits of the glacial epoch. Knowledge of these formations is confined at present to the rock valleys of the Fraser and Nechako Rivers. The rivers occupy only a small part of their rock valleys and the remainder is filled to plateau level with glacial drift and older deposits. The rock valley of the Fraser is comparatively wide from Prince George to Tabor Lake and south to Red Rock. Considerable rock valley width is also evident between Miworth and the Salmon River.

Beneath overlying sands and gravels a lacustrine deposit of Tertiary age is known to overlie bedrock at from 250 to 300 feet from the surface in the Pineview locality. This is a semi-impervious, greenish clay-grit, on top of which is a water-bearing stratum in at least part of the rock valley area.

On the Nechako Plateau above the rock valleys of the Fraser and Nechako Rivers the terrain is completely covered by glacial debris. No test wells have been drilled in this area, and the possibilities of finding water beneath the till are unknown.

Under the present conditions exploration for water requires time and capital, but a supply for the settler is an immediate need. A temporary source on the farm may be preferable to haulage and for this purpose a cistern for collection of surface water can be of value.

The clay soils have a tight substratum which will hold water with minimum seepage. Cisterns can be built in these soils and filled with snow water in the spring. Small coulees or drainage depressions could be dammed for the use of livestock. The cistern is capable of a variety of forms, which can be adjusted to the lay of the land and the requirements on each farm.

From spring until freeze-up the roofs of farm buildings are a good source of water supply, owing to frequent showers. Rain water can be collected in barrels or wooden tanks for household use.

Lime Rock and Seepage Deposits

Lime has not been utilized to any extent for soil treatment in the Prince George area, and no conclusive experiments have been undertaken. Most settlers agree, however, that lime is of probable value as a soil amendment, and several deposits have been reserved for agricultural use.

An outcropping of limestone, located on the S.W.¼ of the N.E.¼ of Lot 1893, was reserved by the Department of Agriculture on October 24, 1933. This is the most important known deposit of lime rock in the district. It is approached by a trail that leaves the graded road at Beaverley Creek near the S.W. corner of Lot 613.

Two outcroppings occur about 600 feet apart in the Chilako stony soil complex. The larger one has approximately 12,800 square feet of bare rock exposed. The south face stands abruptly about 18 feet above ground and the north slope is covered by glacial till. The dip is 58° and the strike is N. 80° W. About 10 tons have been removed by blasting and about 4 tons were burned.

The second outcropping covers about 3,700 sq. ft. It is largely covered by glacial till and would require the removal of considerable overburden before working. The area in which the outcroppings occur was burned over and the second growth is a light stand of aspen. Fallen logs suitable for roasting the rock are abundant.

The rock in this deposit is a hard, grey, fine grained and finely banded limestone of great age. Owing to its hardness it could be handled most economically by burning. The chemical analysis is as follows:—

	Per cent
Lime ($CaCO_3$)	96·29
Insoluble	3·32
Iron and aluminium	·30
Undetermined	·09
	100·00

A small deposit of marl located in the N. ½ of the S.E. ¼ of Lot 4222 was reserved on May 14, 1934, by the Department of Agriculture. It is crossed by a road which follows an unnamed creek valley northwest of Miworth ferry. Apparently the source of the marl is from limestone which lies buried in the rim of the Nechako rock valley. This deposit has not been worked and its possibilities are unknown. The chemical analysis of the marl is as follows:—

	Per cent
Lime ($CaCO_3$)	75·45
Magnesium Carbonate ($MgCO_3$)	1·21
Iron and Aluminium	5·76
Sand, etc., insoluble in acid	6·46
Moisture, etc., undetermined	11·12
	100·00

There is a small deposit of precipitated lime around the outlet of a spring in the N.E. corner of Lot 7711. This lot includes the bridge across Salmon River and the deposit is on the side of the trench one-quarter mile from the Summit Lake Road. The seepage is about 50 feet square and has not been worked. The lime probably comes from lime rock buried in the rim of the Salmon River Valley. Analysis of a sample taken near the spring is as follows:—

	Per cent
Lime ($CaCO_3$)	76·50
Iron and Aluminium	2·14
Magnesium Carbonate	....
Insoluble	11·86
Undetermined	9·50
	100·00

A deposit of precipitated lime covering an acre or more outcrops at the edge of a gravelly terrace in the W. ½ of Lot 4595, near Fort George Canyon. It is served by a graded road connecting with the main highway. The lime is in coarse granules and lumps The source is probably limestone buried nearby in the rim of the Fraser River rock valley.

At this point bedrock comes close to the surface and further investigation may disclose a limestone outcropping. The deposit could be developed to serve the locality between Redrock and Woodpecker. Chemical analysis of a sample from this deposit is as follows:—

	Per cent
Lime ($CaCO_3$)	93·50
Iron and Aluminium	0·81
Insoluble	3·29
Organic matter, etc	2·50
	100·00

A small area of seepage lime occurs in the S.W. ¼ of Lot 1954 at the edge of a terrace. It is served by a road which connects the main highway with the mouth of Tabor Creek. Where exposed the lime is cemented in hard lumps and slabs. When developed, this deposit may serve the needs of the Pineview locality.

A small marl seepage outcrops in Lot 482, at the edge of Moore's Meadow. This is located on the delta-like area at the mouth of the Nechako River where Prince George is situated. It could be developed for garden use in Prince George.

A glance at the soil map will show that lime deposits are located close to the main areas of arable soil. None of the sources have been worked and the depth and value of most of them is unknown.

The Land Class Map

Included in this report is a suggested land class map which divides the classified area into Forest Land, Temporarily Non-arable Land and Arable Land. Taken together the Temporarily Non-arable and Arable categories are classed as Potentially Arable Land. The soil types and miscellaneous areas grouped into the several land classes are shown in appended Table 2.

Forest Land is characterized by physical features that reduce the value of the land for agriculture. These include sandy, gravelly and stony soils, muskeg, bluffs and ravines, hilly and mountainous land. In some of these types a few acres here and there could be cultivated, but at the present stage of development a type cannot be classed as arable because 5 or 10 acres on each quarter section is capable of producing crops.

As the district passes from the pioneer stage to a fully developed community, some of these small and scattered areas may have increased value. Under these conditions a more detailed survey could separate the small arable areas from the mass of non-arable land.

The Temporarily Non-arable Land amounts to about 153,935 acres. The group of soils in this category are fine textured and potentially arable, but the density of forest cover makes the cost of clearing prohibitive at the present time. These soils are mainly covered by comparatively heavy stands of spruce and lodge-pole pine. Until this cover is destroyed by logging and fire, the soils should be regarded as temporarily non-arable.

Small burns exist in this category and in some of them a few settlers are established. Where timber must be removed progress with land clearing is very slow and the soil is more acid than the same soil type under deciduous growth.

The arable land class covers about 133,367 acres. It consists of fine textured soils, and the forest cover is mainly deciduous. There is considerable variation in the density of forest cover and in the amount of ground litter, but stumps are almost entirely absent. Most of the area could be cleared off with brush cutting machinery, but its use in a settlement scheme requires a more detailed survey to select the best quarter sections for the purpose and the parts of them most easily cleared.

The main purpose of the Land Class Map is to show the location and extent of the most desirable areas in the Prince George district, so that the future development of these areas can be planned.

Land Clearing

The method used in the past for clearing light forest land consists of slashing the small aspen, willow, birch, pine and alder trees with an axe after the leaf is off in fall or winter. In spring or summer the slash is piled and burned.

A team or tractor is used for pulling the larger aspen and pine stumps after the roots have been cut, and the land is broken in June or early July. At this time there is a substantial growth of herbs which add humus to the soil.

A 15-30 h.p. tractor handles an 18- or 20-inch brush breaker at the rate of about 4 acres per 8-hour day. Land in the clay association is ploughed from 5 to 6 inches deep at the start. In subsequent ploughings the depth is increased.

The next step is to clear off the roots. Since this job must be well done, cultivation is often delayed until the following year. When ready for cultivation the land requires about three double diskings. The best equipment for this purpose is an 8-foot tandem tractor disk without added weight. Floats and fixed-peg harrows are the most commonly used implements for breaking lumps, levelling and preparing the seed-bed.

The first sowing consists of alsike clover, 10 to 12 lb. per acre, with a nurse crop of oats sown at the rate of 3 to 3½ bushels per acre. The clover seed, sown by separate attachment, is inoculated with special alsike culture when used on new land, and the resulting nodules are generally healthy and abundant.

With this procedure the amount of land cleared annually is very limited, and the possibility of developing 80 to 100 acres of farm land during the active life of the settler is small. However, if two steps of this procedure were accelerated the results would meet requirements. Slashing is a job for machinery after which the land could be ploughed or disked and sown to rough pasture with minimum removal of roots. During the rough pasture stage the bulk of the smaller roots will decay and lessen the task of root removal.

The light forest cover can be slashed and bunched by machinery. In a small way this has been done by an enterprising local inventor. A large crawler type tractor pushes an implement which cuts off the aspen, willow and small lodge-pole pine at ground level. This machine has a boat-shaped prow which also deals with old logs on the ground. A second device, pushed by the tractor. bunches the brush for burning. With proper machinery it has been demonstrated that the light forest cover and ground litter can be handled in much the same way as methods in use for cutting and raking hay.

APPENDIX

TABLE 1.—FROST DATA, PRINCE GEORGE. (Degrees F.)

Year	Final Spring Frost		First Killing Fall Frost		Summer Frosts			Frost free Period Days	Freeze-up Date
	Date	Temp.	Date	Temp.	June	July	Aug.		
1920	May 31	30°	Oct. 7	28°	3			85	Nov. 6
1921	May 17	30	Sep. 8	24	2	1		63	Nov. 14
1922	May 28	31	Sep. 6	28	5			72	Oct. 31
1923	May 23	26	Sep. 8	29	1	1		46	Oct. 28
1924	May 24	30	Sep. 18	29	2		1	43	Oct. 31
1925	May 31	30	Sep. 5	28	1		1	77	Oct. 24
1926	May 30	23	Sep. 6	26	5		4	53	Nov. 14
1927	May 30	29	Sep. 5	29	2			83	Oct. 26
1928	May 13	29	Sep. 6	29	1		1	81	Nov. 8
1929	May 18	27	Sep. 25	28				106	Nov. 5
1930	May 12	26	Aug. 31	28		1	2	56	Oct. 15
1931	May 28	30	Sep. 16	28	3			79	Nov. 8
1932	May 29	29	Sep. 15	29	3			98	Nov. 12
1933	May 24	28	Sep. 6	23	3		1	66	Oct. 18
1934	May 22	29	Sep. 14	28				113	Nov. 18
1935	May 26	28	Sep. 23	26			4	80	Oct. 28
1936	May 13	29	Sep. 11	25				120	Oct. 31
1937	May 24	30	Sep. 21	29				120	Nov. 9
1938	May 28	27	Aug. 22	29	2		2	73	Nov. 9
1939	May 12	31	Sep. 13	29	1			89	Oct. 23
1940	May 29	28	Oct. 2	29	2			80	Nov. 3
1941	May 26	23	Sep. 18	28				114	Oct. 28
1942	May 15	22	Oct. 7	25	1		2	89	Nov. 2
1943			Sep. 14	24	1			103	Oct. 31
Average	May 24	28°	Sep. 13	27°	1			82	Nov. 2

TABLE 2.—APPROXIMATE AREAS OF DIFFERENT SOILS

Soils	Forest Land	Temporarily Non-arable Land	Arable Land	Potentially Arable Land	Total
	Acres	Acres	Acres	Acres	Acres
Chilako Stony Soil Complex	264,719				264,719
Gunniza Gravelly Sandy Loam	7,858				7,858
Eena Loamy Sand	9,304				9,304
Eena Sandy Loam	11,127				11,127
Bednesti Silt Loam	5,778	9,175	1,744	10,919	16,697
Pineview Clay Association	14,558	128,829	109,323	238,182	252,740
Giscome Gravelly Sandy Loam	28,442				28,442
Saxton Loamy Sand	11,486				11,486
Fraser Soil Complex		14,592	18,137	32,729	32,729
Muskeg	12,050				12,050
Meadow			2,696	2,696	2,696
Shallow Muck		1,339	1,437	2,776	2,776
Rough Mountainous Land	15,220				15,220
Bluffs and Ravines	23,025				23,025
Water					23,728
Total	403,567	153,935	133,367	287,302	714,597

TABLE 3.—CHEMICAL ANALYSIS OF SOIL PROFILES

Soil[1]	Horizon and Depth	Ignition Loss	Organic Carbon	Organic Matter	N	SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	K_2O	Na_2O	Cobalt	P_2O_5	Exchangeable CaO	Exchangeable MgO	Exchangeable K_2O	Easily Soluble P_2O_5	pH
	(inches)	(per cent)	(per cent)	(per cent)	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.c.	p.p.m.	p.c.	p.c.	p.c.	p.c.	p.p.m.	
Pineview Clay Association	A_0 1–2″	88·00	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	A_1 2-3	34·40	17·08	29·42	0·63	36·05	16·70	8·47	3·31	2·10	1·61	1·55	41	0·27	0·21	0·084	0·064	61	4·61
	A_2 3-7	11·83	4·05	7·05	0·31	50·00	21·15	11·71	3·60	2·82	2·00	1·48	50	0·28	0·18	0·082	0·060	32	5·10
Profile No. 1	A_3 7-10	8·18	2·16	3·72	0·20	53·39	20·88	11·86	3·46	2·45	2·03	0·94	25	0·20	0·15	0·084	0·053	28	5·12
	B_1 10-18	6·54	1·29	2·22	0·13	55·15	22·31	10·54	2·77	2·80	1·93	0·71	...	0·15	0·22	0·081	0·038	35	5·19
	B_2 18-22	3·79	0·32	0·55	0·04	58·89	21·98	9·52	2·28	3·66	1·94	0·88	...	0·18	0·29	0·078	0·034	1,585	6·25
	C	3·89	0·22	0·38	0·04	57·59	22·17	9·85	2·07	3·73	2·11	0·82	...	0·20	0·28	0·082	0·028	1,616	7·56
Pineview Clay Association	A_0 ½-1½″	83·24	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	A_1 1½-2½	27·85	13·85	23·87	0·52	46·89	13·78	8·36	2·69	2·26	1·37	0·75	21	0·31	0·31	0·082	0·045	127	4·55
	A_2 2½-11	4·00	1·33	2·29	0·09	67·73	15·66	7·41	2·37	2·26	1·65	0·83	18	0·30	0·12	0·040	0·020	308	5·31
Profile No. 2	A_3 11-14	3·01	0·66	1·13	0·07	65·90	16·12	9·02	2·59	2·46	1·82	1·03	14	0·27	0·11	0·048	0·020	476	5·01
	B_1 14-16½	4·17	0·38	0·65	0·06	60·64	20·43	9·85	1·96	2·81	2·08	0·85	...	0·12	0·32	0·084	0·031	264	5·52
	B_2 16½-21½	4·15	0·39	0·65	0·06	58·94	20·00	10·14	2·75	2·84	1·98	0·91	...	0·11	0·42	0·092	0·030	544	5·80
	B_3 21½-29½	4·05	0·37	0·63	0·05	58·49	20·15	9·82	3·10	2·84	2·22	0·86	...	0·13	0·46	0·085	0·028	926	6·40
	C	3·67	...	...	...	...	...	...	...	...	1·65	0·95	...	0·15	0·46	0·083	0·094	1,189	6·55
Bednesti Silt Loam	A_0 ½-1″	86·36	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	A_2 1-4	2·99	1·06	1·82	0·07	74·04	12·13	5·44	2·58	1·90	0·89	1·08	7	0·22	0·07	0·010	0·011	157	4·65
	A_3 4-11	4·21	1·31	2·25	0·07	69·50	15·11	7·12	2·93	1·85	0·90	0·98	13	0·27	0·11	0·013	0·018	609	5·45
	B_1 11-20	1·98	0·20	0·35	0·03	69·31	13·40	10·92	3·06	1·82	1·30	1·04	...	0·14	0·18	0·047	0·011	933	5·82
	B_2 20-31	2·25	0·21	0·35	0·03	67·22	16·21	8·57	3·38	2·11	1·07	1·09	...	0·16	0·23	0·061	0·021	903	6·00
	C	1·60	0·12	[illegible]	0·02	67·50	14·45	9·57	3·13	2·00	1·59	1·03	...	0·20	0·25	0·068	0·015	1,435	6·65

[1] Moisture free soil.

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