SOIL SURVEY

of

CHILLIWACK MAP-AREA

by

V. K. COMAR, P. N. SPROUT

and

C. C. KELLEY

PRELIMINARY REPORT NO. 4

of the

LOWER FRASER VALLEY SOIL SURVEY

Map Reference:

Soil Map of Chilliwack Area

Scale 2000' = 1", 1962

BRITISH COLUMBIA DEPARTMENT OF AGRICULTURE

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PREFACE

A reconnaissance soil survey of the entire valley was undertaken in 1936. This was published in 1939 as "Soil Survey of the Lower Fraser Valley" by C. C. Kelley and R. H. Spilsbury. For ten years or more, this report has been out of print. Eventually, requirements called for a new survey in greater detail. This began in 1956, and to date reports have been completed on Pitt Meadows, Delta, Surrey, and Chilliwack Municipalities. The new survey will bring the soil classification up to date and make a greater number of soil distinctions. In the new procedure it was sometimes necessary to discard old soil series names.

The new soil survey was undertaken at the request of the Assessment Commissioner, Department of Finance, Victoria, B. C. The primary purpose was to continue with the evaluation of soils in the Lower Fraser Valley in relation to land assessment. The secondary purpose is to provide a soil classification that can be used for general reference.

The Chilliwack map-area covers (1) Chilliwack Municipality, (2) the Chilliwack River valley southeast of the municipality to about five miles east of Slesse Creek, (3) unincorporated areas between the Chilliwack River valley and Chilliwack Municipality, (4) the Columbia Valley, and (5) Vedder Mountain.

Field work began in 1960 and was completed in 1961. The field sheets consisted of 9 x 9 inch air photos, scale 1,320 feet to an inch, 1954. A set of air photos 18 x 18 inches, 1954, with the soils tinted thereon, was supplied to the Assessment Commission. A map "Soil Map of the Chilliwack Area", scale 2,000 feet to an inch, was produced for use by government and municipal agencies. Soil descriptions, ratings and laboratory data are included in this report.

ACKNOWLEDGEMENT

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GENERAL DESCRIPTION OF THE AREA

HISTORY AND DEVELOPMENT

Chilliwack Municipality was incorporated in 1873. The name was derived from the Indian word "Chil-uk-whey-uk", meaning "valley of many streams".

In the early days accessibility was largely by the river route, owing to the lack of roads and railways. Prior to construction of the Agassiz-Rosedale Bridge in 1956, the river crossing was by means of the Agassiz-Rosedale Ferry.

A British Columbia Electric Railway line entered the district in 1911. Railway transportation was increased in 1913 by completion of the Canadian Northern, a part of the trans-continental system later to be known as the Canadian National Railway. Subsequent construction of Highway No.1 brought Chilliwack in easy access to Vancouver by car and truck.

The development of utilities started in 1905 in the town of Chilliwack with construction of a privately owned domestic water system. The Chilliwack Light and Power Co. began the installation of electric light in the same year. A telephone system owned by the municipality was approved two years later. Development of a sewer system began in 1914.

Land Settlement:

The pioneer farmers made great claims about the productivity of the farmland, and immigrants were attracted as settlers. The great land hunger of Europeans and British between 1903 and 1913 increased the population of the townsite from 800 in 1905 to 1,200 in 1908. The favorable farming conditions brought Mennonites from less attractive areas on the prairies. They developed the largest Mennonite community in British Columbia in the vicinity of Yarrow.

Population:

In 1959 the estimated population of the Chilliwack district was 18,300. In a report on land utilization, the Lower Mainland Regional Planning Board forecast an annual growth of 4.4% for the municipality, 1959-79, doubling the population in this interval (8).

Such growth would take over agricultural land for industry and subdivision, but if the new development were concentrated, the situation could be handled with smaller loss of land and greater economy. On the other hand if the projected development is permitted to sprawl, the results would be costly. The effect of sprawl, apart from damage to agriculture and to natural attractions, would be to create social and economic problems.

During the soil survey it was estimated that 60% or more of the farms were of less than 10 acres, and 15% were between 10 and 20 acres. When examining the whole picture, it should be remembered that a so-called farm is not necessarily an economic business. The production from most of these farms does not support their occupants. Small holdings have been acquired by the retired, the semi-retired and persons having off-farm occupations. An increasing number of people employed in industry and in professions are moving to homes with small acreages in the country. It was apparent that the majority of the small farms were not well managed. The owners were not schooled as to drainage, irrigation or the fertilizer requirements of their soils.

PHYSIOGRAPHY

The major features of the region are the Coast and Cascade Mountains, which rise from bordering foothills to maximum elevations up to 5,500 feet, and which are separated by the great trench of the Fraser River valley. The strath of the valley is about seven miles wide, a mile of which is occupied by the river.

Chilliwack Municipality lies northeast of the Municipality of Sumas, from which it is separated by the Vedder Canal Most of Chilliwack Municipality is flat to gently undulating, and less than fifty feet elevation.

South of Chilliwack Municipality the unincorporated district of Ryder Lake occupies Lookout Ridge, which is rolling and hilly. The Chilliwack River flows in a glaciated valley between Lookout Ridge and International Ridge.

The Columbia Valley lies between International Ridge and Vedder Mountain. The elevation of this valley at the 49th parallel is about 600 feet, from which it grades northeast to Cultus Lake at about 150 feet above sea level.

Approximately 90,000 acres were classified in the whole map-area.

CLIMATE

The climate is inshore maritime and much influenced by the Coast Mountains to the north, the Cascades to the south, and the Fraser Canyon to the east. Day to day weather is associated with comparatively small low pressure systems, which are most common in winter. These depressions come inshore more or less rapidly, and each one dominates the weather for several days.

The low pressure systems often come as a series, and may follow one another for several weeks at a time, dumping heavy falls of rain and sometimes snow on the lowland. At the higher elevations snow-falls are more common.

In winter an occasional polar air mass covers the interior, and sometimes drains down the Fraser Canyon and tributary valleys into the Chilliwack lowland. When the polar air meets the warm, damp, maritime air, greater than average snowfalls and "silver thaws" can occur on the lowlands. Polar air also brings the lowest temperatures.

Over the years the precipitation in every month shows very wide margins between the extreme highs and lows. Particularly in summer, high pressure systems bring clear weather inshore, and dominate in July and August. During these months the lack of rain is such as to require irrigation in order to maintain the growth of crops for high yields.

Temperature:

The most important meteorological stations are at Chilliwack, Agassiz, Abbotsford Airport, and Cultus Lake. The following table shows the extremes during the periods of records. The probable long time extremes for the whole lowland are comparable to those at Agassiz, where there is more than half a century of records.

Station	Maximum	Minimum	Annual	Elevation	Years of Record
Chilliwack	100°F	0°F	50°F	26 ft.	10
Agassiz	103	-13	50	50	64
Abbotsford	100	- 6	49	198	11
Cultus Lake	97	- 5	49	190	11

Average monthly temperatures for the stations are given in appended Table A.

Precipitation:

In the times of record at Chilliwack, Abbotsford and Cultus Lake precipitation stations, rainfall has varied in line with the coastal climatic regime. During the most important months for crop growth, May to September inclusive, the number of years in which rainfall was less than two inches per month is as follows:

Station	May	June	July	August	September	Years of Record
Chilliwack	6	16	28	25	8	44
Abbotsford	0	4	7	7	5	11
Cultus Lake	9	7	17	16	9	25

The above figures indicate that in more than half of the years of record at each station, crop growth was restricted in some month of the growing season by lack of moisture. The need of supplementary irrigation is apparent, particularly in July and August. Precipitation data in detail are presented in appended Tables B, C, and D.

Sunshine:

The only sunshine station in the vicinity of the map-area is at Agassiz, where there is a record for 53 years. Over this period the annual average is only 1,401 hours. The limited hours of sunshine in comparison with other stations indicates that clouds drifting up-valley are funnelled and trapped as the valley narrows between the Coast Range and Cascade Mountains. It is evident that clouds lie over this area longer than over any other inland sunshine station in the Province.

Frost and Snowfall:

The coastal areas have the longest frost free seasons in Canada (214 days at Vancouver Airport). At Chilliwack the frost free period amounts to 184 days. Detailed frost data are given in appended Table E. These data indicate the variations between the longest and shortest frost-free season. Such variations are often caused by local influences, such as topography, elevation and proximity to large bodies of water.

The snowfall data in appended Table F show the amount and distribution of snow each year.

ORIGIN OF SOIL FORMING MATERIAL

There are upland and lowland landforms which meet at the low elevations, chiefly at the toe of mountain slopes. Soil forming materials referable to the upland vary in elevation from 50 to 2,500 feet. [The lowland is composed mostly of deposits of the Fraser and Chilliwack rivers, and the elevations range from 10 to 100 feet, the higher elevations being in up-valley sections.]

Upland Soil Forming Materials:

The upland consists of foothills of the Cascades. The foothills are covered by post-Vashon glacial deposits not more than 25 feet thick, which overlie bedrock (1). In places the lower part of the glacial debris is composed of Huntingdon Gravels, the oldest known unconsolidated materials in the mapped area. These appear to have been laid down by streams from a retreating ice-front. The Huntingdon

Gravels are overlaid by sediments left by retreat of the subsequent Sumas ice-sheet. The Sumas Group is composed of retreat material from a glacier which advanced not more than 11,500 years ago, and covered the lowland to a point a few miles west of Abbotsford (1).

In the Ryder Lake locality, Huntingdon Gravels occur toward the valley of the Chilliwack River, underlying Sumas Till. This sandy loam textured till occupies a large part of the uplands. The Sumas Till, and in places bedrock, is mantled by silty loess from about 10 inches to four feet thick. Abbotsford outwash, a glacio-fluvial deposit, covers the floor of the Columbia Valley.

The soils of the Chilliwack River valley, included with the uplands, developed from glacial outwash, glacio-lacustrine and coarse to medium textured stream deposits and alluvial-colluvial fans.

Lowland Soil Forming Materials:

The lowland soils were derived chiefly from floodplain deposits of the Fraser River. At a distance from the river, sedimentation took place by deposition of fine materials in ponds. Closer to the river there were numerous meandering channels, which were a part of the river in the flood stage, and from which sediments were laid down by lateral accretion.

In addition, deposits of tributary streams occupy a substantial acreage, and in places these are intermixed with Fraser River materials. The most important are the deposits of the Chilliwack River, which are up to 50 feet thick, and of which a major part was spread on the floor of former Sumas Lake (1).

Swamp deposits occupy areas of very poor drainage. The deposits of alluvial-colluvial fans consist of more or less recently moved materials which accumulated at the base of the mountains at the efflux of streams. Slide deposits occur in the eastern part of the mapped area.

The relationship of the soils to the geological materials from which they are derived is shown in Table 1.

AGRICULTURE

The Chilliwack area has a diverse agriculture. The value of the more important production, 1945 compared with 1959, was as follows:

	1945	1959
Dairying	$2,228,000	$3,500,000
Beef	300,000	450,000
Swine and Sheep	100,000	60,000
Eggs	850,000	1,000,000
Poultry Meat and Hatcheries	250,000	350,000
Nurseries	200,000	*
Dehydrated Grass	*	200,000
Raspberries	464,000	900,000
Hops	800,000	500,000
Corn	*	250,000
Peas	*	250,000
Beans	*	400,000
Potatoes	*	50,000
Totals	$5,190,000	$7,660,000

* Figures not available.

The outstanding feature in the previous figures, which were supplied by the Provincial Department of Agriculture, is the increase in the production of small fruits and vegetables, which reflect the expanding market for frozen commodities. Of the gross value, dairying accounts for about 45%, followed by the cannery crops and then by poultry products.

Future Agriculture:

The outlook is indicated in the findings of the Gordon Royal Commission on Canada's Prospects. In the report, "Some Regional Aspects of Canada's Economic Development," it is observed that "The large population increase forecast for British Columbia has important implications for the prospects of the agricultural products industry of that province. Centred in the Vancouver area, this greater population will provide the basis for the immediately adjacent farmland areas of a greatly increased internal demand for dairying, poultry production and specialized horticulture."

According to an economic survey (11), Chilliwack Municipality is one of five major farming communities in the Lower Fraser Valley, the others being Delta, Surrey, Langley, and Matsqui. Because of industrial and urban developments in the other municipalities, particularly Surrey and Langley, Chilliwack is coming to the front as a supplier of agricultural products. However, the tendency toward subdivision is already evident, and if this is not checked or confined, the results for the future of agriculture will not be good. The increase of small holdings is detrimental.

Attempts have been made to develop upland soils for farming. Although these soils would be productive if irrigated, a recent groundwater survey (6) indicates severe water shortage on the uplands. Even a domestic water supply is scanty in some places. Lack of irrigation water, combined with rough topography and stony soils, makes most of the upland soil types marginal for agriculture. However, they may find a use for tree farming.

SOIL MANAGEMENT

Although diverse, the focal point of farming in the Chilliwack map-area is dairying. For this purpose the management practices that influence soil productivity include crop rotation, drainage, irrigation, lime and the use of fertilizers.

(a) Crop Rotation:

Two crop rotation procedures are recommended:

(1) The first rotation is designed for permanent pastures. The pasture mixture is sown with oats as a nurse crop. When the oats have attained a height of 8 - 10 inches the field is pastured. On the following year the sward is such that a first cutting may be used for silage and a second one for hay. Alternatively, one cutting may be taken and the field pastured, or it may be pastured without a hay cut. During subsequent years the fields are used as permanent pastures. Cultivation and seeding are recommended every five years. This rotation practice is appropriate for small farms. Large farms may follow a second practice, or a combination of (1) and the second practice described below.

(2) This practice is recommended for the production of hay and silage. After cultivation the pasture mixture is sown with oats as a nurse crop. In the first year the oats are harvested for hay or silage. During the second and third years two or three cuttings may be obtained for hay or silage. The first cutting generally is in May, and the second one in July. A third cut may be taken in early September, or after the second cut the land may be pastured.

The first cutting generally gives the highest yield, the second cutting being smaller unless there is irrigation. A third cutting yield is low. During the fourth and fifth years after seeding, the land is used only for pasture, although an occasional hay cutting may be obtained. Too close grazing before winter is not recommended, except at the end of the rotation. After five years, cultivation is recommended. Peas, corn and oats may be grown for a year or two before the pasture mixture is again seeded.

(b) Soil Drainage:

In the lowland, drainage is the most influential factor in soil rating and classification. In a dynamic sense, drainage refers to the rapidity and extent of the removal of water from the soil.

Good drainage refers to a condition in which the solum contains no free water. One may observe direct evidence of drainage or the lack of it, such as saturation after rains, temporary ponds and levels of the water table. Variations can be related to differences of the soil color pattern. Mottling, the gray colors associated with gleying, and the presence of organic material are characteristic. Thus, an assessment of drainage conditions is partly a matter of direct observation, and in part, inference from a large group of observations.

The internal drainage and the permeability of the various soil types are mentioned where necessary, in the soil type descriptions. The external drainage of the Chilliwack soil map-area, which governs the possibilities of farm drainage, is described below.

External Drainage*:

The boundaries of the Chilliwack Dyking District and the land divide separating the dyking district into two drainage areas are shown on the soil map. The relatively low lying western section of the municipality lowland is included in the Sumas East Prairie section of the Sumas Dyking District.

The area of the Chilliwack Dyking District is at a favorable elevation for drainage, which finds an outlet in the Fraser River. In the northern section, natural drainage has its efflux into Hope Slough, and its tributary, Camp Slough and others. The sloughs are old flood arms of the Fraser between island-like areas. They drain into one another and finally into the river just east of the City of Chilliwack. There is no dyke across the mouth of Hope Slough. Instead, the fairly low Fraser River dykes were built on each side of it, and far enough upstream to give protection from Fraser River high water. Individual farmers have dug ditches which drain into the sloughs, and also there are a number of more elaborate ditch systems which lead into them. Most of the ditch systems were built by the municipality, which has power to recover the cost by taxation.

At high water on the Fraser, from about May 20th to June 5th each year, lowlying land adjacent to the sloughs may be flooded, and land slightly above flood levels has restricted drainage. The extent of the flooding is dependent on the height of the freshet from year to year, the variation between average and high freshets being about 10 feet in this area.

The southern part of the Chilliwack Dyking District drains into Chilliwack Creek, joined at its mouth to Luckachuk and Atcheletz creeks into a single outlet to the Fraser. This outlet is dyked; gravity drainage through the dyke is provided. The southern section

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* W. R. Meighen, Dyking Commissioner, New Westminster, B. C., personal communication.

also has a favorable elevation for drainage provided by natural channels, except at flood stages of the Fraser. The district maintains three pumps, each of 40,000 gallons per minute capacity, at the mouth of Chilliwack Creek. Two are operated during the freshet, the third being a standby.

That part of the municipality between Atcheletz Creek and Chilliwack Creek is above all flood levels of the Fraser. Drainage is provided by stream channels. These lands have fairly good natural drainage; very little ponding occurs in winter.

The East Prairie section of Chilliwack Municipality, in the Sumas Dyking District, is relatively low-lying. The eastern part drains by gravity to floodbox outlets at Wilson Slough, and the western section to similar outlets at McGillivray Slough at its junction with Miller Slough. During the freshet, gravity drainage is shut off and the district operates a pumping station at the McGillivray Creek outlet. This station has four pumps of about 55,000 g.p.m. total capacity, the equivalent in 24 hours of about one-half inch of water over the drainage area.

The gravity drainage of this area is sluggish. In the southern part, several miles from the pumps, and in the Greendale area to the east, flooding is common in wet weather. These areas flood many hours before any large volume of water reaches the outlets. The district regards such flooding as unfortunate but not preventable. Cleaning of the natural water courses accelerates the flow in them. Although this does not prevent flooding, it does reduce its duration.

There are 38 drainage areas in Chilliwack Municipality. Although most of these are located in the dyking district, any part of the municipality can obtain ditch systems as a local improvement.

Several soil types in the lowland would benefit from tile drainage; these are mentioned in the soil type descriptions. However, it is worthy of note in this section, that the Land Clearing Assistance Act was amended in 1959 to include loans to farmers who want to drain their land.

(c) Irrigation:

During the past few years an increasing interest has been taken in supplemental irrigation. The inshore climate, which is characterized by wet winters and dry summers, is responsible for moisture deficiency during the most important crop growing months. This deficiency stunts crops which grow throughout the season. Thus hay, supported by spring moisture, provides a good first cut and a poor yield thereafter. If the hay yield could be maintained through June, July and August, dairy farms could carry more livestock on the same acreage.

The moisture deficiency of the heavier soil types amounts to about eight acre inches, which could be applied by sprinkler irrigation. The slow development of irrigation in the Lower Fraser Valley is in part due to a lack of knowledge of how to irrigate and what irrigation can do. Such knowledge exists in the Okanagan Valley, where irrigation is widely used. The farmers of Chilliwack Municipality should tap this source of information, and thus provide themselves with know-how as to capital cost and the operation of irrigation systems.

There is a lack of water for irrigation in the uplands, which would limit their development for farming, but the lowlands have an adequate water supply. Water for irrigation could be pumped from the network of sloughs and ditches in the northern part of the municipality. Where this source is inadequate, wells and scoop-outs could provide water supplies.

(d) Use of Lime and Fertilizers:

Lime and fertilizer applications are coming into wider use as farm management improves. However, during the soil survey a wide range of application practices were observed, which indicates no particular procedures upon which all farmers are agreed. The applications made by a large number of farmers were inadequate. If these farmers increase their input, an economic crop response would be obtained. A few farmers are applying too much fertilizer. This gives them maximum yields which are not necessarily economic, owing to the cost of excess fertilizer in relation to results. During the survey it was observed that fertilizer response was the best on irrigated land.

The lime and fertilizer requirements of different soils, and of different farms on the same soil, should be determined by the crops grown and the past management history of the farm. There cannot be a standard recommendation. Soil tests should be made to determine the fertilizer and lime requirements. The amount and kind of fertilizer to apply for a given purpose should be discussed with the local District Agriculturist.

SOILS

FIELD METHODS

Three scales of mapping were used in the Chilliwack map-area. In most of the area the field sheets consisted of air photos having a scale of 1320 feet to an inch. In the Chilliwack River and Columbia valleys the large scale photos were not available, and a scale of 2640 feet to an inch was used. In the Columbia Valley the mapping scale was a mile to an inch.

The soils were examined and identified by means of test holes, road and railway cuts and other excavations. Soil boundaries were established by bisecting them on roads and by traverses. Soil colors were placed on record by use of the Munsell color system. The soil profiles were studied in regard to texture, structure, consistance, permeability, drainage, water table and other features. Representative soil profiles were described and recorded in this report for the purpose of soil type identification, and also sampled for laboratory analyses.

SOIL CLASSIFICATION

Soils develop in response to environment from soil forming deposits of geological origin. The type of soil derived from a soil forming deposit depends on the length of time the local genetic processes were at work. The product, or kind of soil formed is governed by the amount of precipitation as rain and snow, temperature, texture of the solum, the nature of the parent material, topography, drainage and other factors of the environment which exert an influence. The soil survey identifies the end-results, and differentiates the soil distinctions.

On the basis of origin and composition the Lower Fraser Valley soils were separated into the older upland and younger lowland soils. The bulk of the upland soil forming materials are coarse, over which is laid a capping of silty loess, the thickness of which varies from place to place.

The soils of the lowland are more recent alluvial materials, chiefly of finer texture than those of the upland, and commonly, their development has been dominated by restricted to poor drainage.

The basic mapping unit is the soil series. A soil series consists of a group of related soils derived from similar parent materials, having similar drainage and topography, and with similar profile characteristics except for the surface texture. Areas otherwise the same but with variable surface textures are distinguished as subdivisions of a series, which are called soil types. Areas in which the surface texture does not vary also are mapped as soil types. Soil types are distinguished by the name of the series (e.g. Monroe) and the texture of the surface soil (e.g. Clay Loam), the full name being Monroe Clay Loam. The series names usually are local place names in the locality in which a series was originally classified.

Phases of a soil series also may be distinguished. These are based on variations of topography within a series, stoniness, gravel, drainage, depth of soil (e.g. in a fine textured soil, if sand is within 18 inches of the surface, the soil is classed as a shallow phase) or any other feature which may have an effect on agricultural land-use.

In some cases it is not feasible to differentiate two or more soil series, owing to small size of areas encountered or intimate intermixing with one another. Such areas are usually mapped together as a soil complex. Where two or more soil series thus intermixed have been described separately, the name of the complex consists of the names of the series of which it is composed. These names are hyphenated (e.g. Grigg-Pelley Soil Complex). The name of the series which occupies the major acreage comes first; the other names are in similar order.

The soil series are grouped according to the pedologic development which signifies their genetic relationship to one another. There are soil groups and sub-groups, differentiated according to the scale on which the soil mapping was undertaken. In the upland the sub-groups were identified as Orthic Podzol, Orthic Concretionary Podzol, Minimal Concretionary Podzol, Orthic Concretionary Brown, Orthic Acid Brown Wooded, Orthic Dark Gray Gleysolic, Orthic Regosol, and Mull Regosol soils. The above order of naming of sub-groups is also a sequence trending from maximum to minimum soil development.

There is a similar sequence of sub-groups going from maximal to minimal genetic development in the soils of the lowland. These are Orthic Acid Brown Wooded, Orthic Meadow, Orthic Dark Gray Gleysolic, Orthic Gleysol, Peaty Gleysol, Orthic Regosol, Gleyed Mull Regosol, and Muck soils.

The above sequences of upland and lowland soils, including the geological materials from which they were derived, is given in Table 1. Short descriptions of the observable characteristics of the pedologic sub-groups head more detailed soil descriptions in this report.

Table 1: CLASSIFICATION OF SOILS IN THE CHILLIWACK MAP-AREA

A. UPLAND SOILS

Parent Material	Orthic Podzol	Orthic* Concretionary Podzol	Minimal* Concretionary Podzol	Orthic Concretionary Brown	Orthic Acid Brown Wooded	Orthic Dark Gray Gleysolic	Orthic Regosol	Mull Regosol
Glacial Outwash (Coarse Textured)	Tamihi	Liumchen	-	-	Columbia	-	-	-
Glacio-Lacustrine (Fine Textured)	-	-	Slesse	-	-	-	-	-
Loess on Sumas Till or Bedrock	-	-	-	-	Ryder	Calkins	-	-
Loess on Glacial Outwash	-	-	-	-	Marble-Hill	Calkins	-	-
Stream Deposits (Coarse to Medium)	-	-	-	-	Cultus	-	Sardis	Lickman
Alluvial-Colluvial Fans (Coarse to Medium Textured)	-	-	-	Sweltzer	-	-	Isar	-
Colluvial Slide Deposits	-	-	-	-	Cheam	-	-	-

* Classification tentative.

Continued:

Table 1: CLASSIFICATION OF SOILS IN THE CHILLIWACK MAP-AREA

B. LOWLAND SOILS

Parent Material	Orthic Acid Brown Wooded	Orthic Meadow	Orthic Dark Gray Gleysolic	Orthic Gleysol	Peaty Gleysol	Orthic Regosol	Mull Regosol	Gleyed Mull Regosol	Muck
Colluvial Slide Deposits	Cheam	-	-	-	-	-	-	-	-
Reworked Colluvial Slide Deposits	Popkum	-	-	-	-	-	-	-	-
Fraser Floodplain Vertical Accretion Deposits	-	Henderson	Pelley Grigg Blackburn Arnold	Prest	-	-	-	-	-
Fraser Floodplain Lateral Accretion Deposits	-	-	-	Prest	-	Grevell	Monroe	Fairfield	-
Chilliwack-Vedder River Deposits	-	-	-	McElvee	-	Sardis Complex	Lickman	-	-
Lacustrine Deposits (Fine Textured)	-	-	-	Vedder Chadsey	-	-	-	-	-
Lacustrine Deposits (Coarse Textured)	-	-	-	Sumas	-	-	-	-	-
Alluvial-Colluvial Fans	-	-	Elk	-	-	Isar	-	-	-
Swamp Deposits	-	-	-	-	-	-	-	-	Gibson Banford
Shallow Swamp Deposits	-	-	-	-	Annis	-	-	-	-

DESCRIPTION OF SOILS

A. UPLAND SOILS

1. ORTHIC PODZOL SOILS

The podzols of this sub-group developed with good drainage under coniferous forest. In their natural state these soils have an L-H horizon of forest litter at the surface, beneath which is a light colored eluvial Ae horizon more than one inch thick. Horizon Ae is underlaid by an illuvial, brown to reddish-brown Bfh or Bf horizon containing an accumulation of sesquioxides and organic matter, but there is no significant accumulation of clay. Such horizons contain less than 10% organic matter. Taken as a whole, the solum is moderately to strongly unsaturated. A generalized virgin profile is as follows:

Horizon	Description
L-H	Forest litter, raw to partly decomposed. From one to four inches thick.
Ae	Gray and eluviated, more than one inch thick. Single-grained to weak granular structure.
Bfh	Reddish-brown to yellowish-red horizon six to sixteen inches thick, the color fading with depth. Single-grained to weak granular or subangular blocky structure. May include a few shotty concretions. Often divisible into subhorizons.
Bf	Yellowish-brown to brown horizon. Color fades with depth. Single-grained to weak granular structure.

In the Chilliwack map-area the Orthic Podzol is represented by Tamihi Sand.

TAMIHI SAND

Description:

Tamihi Sand is derived from sandy outwash terraces. Areas of the type occur east of Slesse Creek in the Chilliwack River valley. The terraces are from level to gently sloping, and they stand high above the river. The elevations are from 1,000 to 1,200 feet. The total area classified was 107 acres, none of which was under cultivation at the time of the survey (1961).

The parent material consists of medium to coarse glacial outwash sand, noteworthy for a yellowish color, containing scattered gravels and cobbles. An occasional gravel and cobble stratum occurs at depths. The soil is well to excessively drained.

The Tamihi Sand is an Orthic Podzol with an Ae horizon generally more than one inch thick, but with tongues which in places extend downward to depths up to six inches. The Ae horizon is discontinuous, owing to its destruction in places by uprooting trees.

A model profile was examined in a stand of mature Douglas fir, cedar and hemlock up to 30 inches in diameter. Most of the understory was young cedar, hemlock, salal, Oregon grape, huckleberry, bracken and moss. This profile was given the following description:

Horizon	Depth	Description
L	1½ - 1"	Raw coniferous forest litter. Needles, twigs, cones, wood, deciduous leaves, moss. pH 5.8
F-H	1 - 0"	Partly to well decomposed organic matter. Bits of charcoal, white mycelia, many fine roots. pH 5.4
Ae	0 - 2"	Gray (10YR 5/1 moist) sand. Very weak granular to single-grained structure. Tongues up to six inches penetrate downward, varies to one-half inch or less in places. Loose, moderate roots. pH 3.9 Irregular boundary to:
Bfh-1	2 - 8"	Yellowish-red (5YR 4/6 moist) medium sand. Very weak medium subangular blocky breaking to weak granular structure. A few soft concretions, occasional gravel and cobble. Very friable, many roots. pH 5.7 Gradual lower boundary to:
Bfh-2	8 - 17"	Reddish-brown (5YR 4/5 moist) medium sand. Very weak medium subangular blocky breaking to single-grained structure. Very friable to loose, occasional gravel and cobble, moderate root content. pH 6.0 Gradual change to:
Bf-1	17 - 24"	Yellowish-brown (10YR 5/6 moist) medium sand. Single-grained when dry, massive moist, loose, scattered gravel and cobble. pH 5.9 Clear change to:
Bf-2	24 - 34"	Yellowish-brown (10YR 5/5 moist) medium sand. Massive, breaking to single-grained structure. Slightly compact dry, friable moist, occasional root. pH 6.2 Clear change to:
C-1	34 - 50"	Yellowish-red (10YR 5/6 moist) coarse sand. Some gleyed or uncolored spots. Single-grained, loose, occasional root. pH 5.9 Gradual change to:
C-2	50"-	Coarse sand. Single-grained, loose, variegated colors. Pockets and lenses iron stained. pH 5.6

Land Utilization:

The 107 acres mapped as Tamihi Sand was under mature forest at the time of the survey in 1961. At present the remote location of this soil type and its unsuitability for dry farming, indicates little potential for agriculture.

Coarse texture is responsible for a low cation exchange capacity and poor moisture holding capacity. The soil profile is very permeable, and is thus subject to excessive leaching in the wet season. However, the parent material contains minerals which are high in phosphorus and potassium.

Tamihi Sand was included in Class VI for land utilization. The soil is regarded as fair to good for forestry, but unfit for a dry farming agriculture. If irrigated it could be included in Class IV.

2. ORTHIC CONCRETIONARY PODZOL SOILS*

The Concretionary Podzols occur on the west coast section of British Columbia in a climate characterized by mild, wet winters and cool, dry summers. On virgin sites there is a heavy coniferous forest cover. They resemble the Orthic Podzol soils, except for the presence of magnetic concretions or "shot".

Soils in the Chilliwack map-area assigned to this sub-group developed on light textured soil forming deposits on the upland. The Concretionary Podzols are moderately well drained in the upper part, but have restricted drainage in the lower part of the solum. This setup is believed necessary in order to produce the concretions.

The undisturbed profile has an L-H horizon of forest litter at the surface, beneath which is a light colored eluvial Ae horizon more than one inch thick. This is underlaid by a brown to reddish-brown illuvial horizon Bfcc or Bfhcc, the upper part of which contains numerous concretions. There is enrichment by sesquioxides and organic matter, but no significant clay accumulation. A generalized virgin profile is as follows:

Horizon	Description
L-H	Forest litter, raw to partly decomposed. One to four inches thick
Ae	Eluviated gray horizon more than one inch thick. Single-grained to weak granular structure.
Bfhcc	Brown to dark reddish-brown, the color fading with depth. Six to sixteen inches thick. Numerous iron concretions. Weak subangular blocky to granular structure.

In the Chilliwack map-area the Orthic Concretionary Podzol is represented by Liumchen Sandy Loam.

LIUMCHEN SANDY LOAM

Description:

This soil type occurs chiefly near and east of Slesse Creek, in the Chilliwack River valley. The topography is level to gently sloping at elevations ranging from 1,000 to 1,200 feet above the sea. The area mapped totals 531 acres; none cultivated and all under coniferous forest.

The soil is derived from outwash terrace materials, which consist of stratified sands containing layers of gravels and cobbles. The average texture is sandy loam at the surface. The upper part of the solum is moderately well drained, but drainage in the lower part is

* Classification tentative.

restricted by a Cc horizon which is indurated, probably by iron-organic cementation. This promotes wetting and drying of the solum by water table fluctuation during the wet and dry seasons.

The Liumchen Sandy Loam is an Orthic Concretionary Podzol with a variable Ae horizon generally more than one inch thick. In places tongues of this horizon extend to depths of four to five inches. In spots the Ae horizon has been destroyed by uprooting of trees and the mixing of the solum horizons.

A model soil profile was examined in a recently logged area, where trees up to 30 inches diameter had been removed. The timber was chiefly Douglas fir, cedar and hemlock. A new growth of cedar and hemlock comprise the understory, along with salal, Oregon grape, huckleberry, bracken, twinflower, and moss. This profile was given the following description:

Horizon	Depth	Description
L	2 - 1"	Coniferous forest litter; needles, twigs, wood, roots. Fluffy, slightly decomposed. pH 5.1
F - H	1 - 0"	Semi to well decomposed organic litter. Many roots, scattered charcoal. pH 4.8
Ae	0 - 2"	Gray (10YR 5/1 moist) loamy sand. Very weak medium granular structure. Very friable, occasional shot which are degraded to gray coating with bright colored interiors. Moderate root content. Thickness varies from one-half inch to four to five inch tongues. pH 4.9 Abrupt change to:
Bfhcc-1	2 - 8"	Dark reddish-brown (5YR 3/4 moist) shotty sandy loam. Weak granular structure. Very firable with firm pockets, occasional gravel and cobble, many fine roots. pH 5.6 Abrupt change to:
Bfhcc-2	8 - 15"	Brown to dark brown (7.5YR 4/4 moist) shotty sandy loam. Weak granular structure. Very friable with firm pockets. Occasional gravel; occasional gleying as grayish spots, many fine roots. pH 5.5 Clear change to:
Cg-1	15 - 35"	Light gray to pale yellow (2.5Y 7/2 - 7.4 moist) stratified medium sand. Weakly gleyed; most of brownish-yellow iron stain (10YR 6/6 moist) between stratified layers. Some layers moderately indurated and very firm, the remainder from friable to firm. pH 5.7 Gradual change to:
Cg-2	35 - 42"	Pale gray (5Y 7/3 moist) moderately gleyed fine sand. Common distinct yellowish-brown (10YR 5/6 moist) mottles. Massive, very friable. Root mats. pH 5.4
Cc	42" +	Brownish-yellow (10YR 6/6 moist) to yellowish-brown (10YR 5/8 moist) stratified medium sand. Slightly gleyed, indurated, hard. Occasional root in the upper part. pH 5.4

Land Utilization:

Most of the area mapped as Liumchen Sandy Loam is occupied by forest vegetation. The sandy loam texture accounts for a moderately low cation exchange capacity and a low moisture holding capacity. There is excessive leaching in the wet season, which is the cause of low base saturation.

Liumchen Sandy Loam was rated as doubtful for dry farming agriculture (Class V), but it could be fairly productive if irrigated and adequately fertilized. Under irrigation it would attain Class III. However, the best land use of this soil at the present time is forestry.

3. MINIMAL CONCRETIONARY PODZOL SOILS*

The genesis of the soils of this sub-group is similar to that of the Orthic Concretionary Podzol. The Minimal Concretionary Podzol developed on heavy lacustrine materials in the uplands of the Chilliwack map-area. The soils are moderately well drained, and are subject to alternate wetting and drying of the profile.

In the virgin state there is an L-H horizon of forest litter, beneath which is a light colored Ae horizon of eluviation which is less than an inch thick. The Ae horizon is underlaid by a brown to dark reddish-brown illuvial Bfhcc or Bfcc horizon, the upper part of which contains numerous iron concretions or shot. This horizon also is enriched by illuvial organic matter and sesquioxides, but there is no significant accumulation of clay. The solum is moderately to strongly unsaturated. The generalized virgin profile is as follows:

Horizon	Description
L - H	Forest litter, raw to partly decomposed, from one to four inches thick.
Ae	A gray eluviated horizon which is less than one inch thick. Single-grained to granular structure.
Bfhcc or Bfcc	Brown to dark reddish-brown, the color fading with depth. From six to sixteen inches thick. Numerous iron concretions in the upper part. Subangular blocky to granular structure.

In the Chilliwack map-area the Minimal Concretionary Podzol is represented by the Slesse series.

SLESSE SERIES

Description:

The major acreage of the Slesse series occupies central and eastern sections of the Chilliwack River valley in the mapped area. The topography is level to gently sloping, with undulating micro-relief which was formed by the uprooting of trees. These soils occur on high terraces, at elevations between 1,000 and 1,200 feet. The area mapped was 383 acres; all under coniferous forest.

The Slesse series is derived from lacustrine materials. The texture of the surface 10 to 16 inches varies from loam to clay loam. The subsoil consists of clay to heavy clay from two to four feet

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* Classification tentative.

thick, stratified in the lower part, and underlaid by stratified sand. Scattered, probably ice-rafted, gravels occur in the clay mass. The roots of trees and other plants concentrate above the clay, but a few penetrate this layer. Permeability of the clay zone is poor, and drainage restricted.

A soil section indicating the main features of the Slesse series, a Minimal Concretionary Podzol, was examined on the north side of the valley. At site the vegetation was a thick stand of Douglas fir containing hemlock, willow, vine maple, thimbleberry, sword fern and others. It was given the following description:

Horizon	Depth	Description
L-F	1 - 0"	Chiefly Douglas fir needles and twigs, raw at the top, partly decomposed in the lower part. pH 6.2
Aecc	0 - 1"	Gray (10YR 5/1 moist) clay loam. Moderate medium granular structure. Many iron concretions with gray coats and brightly colored centres. Friable, occasional gravel, many fine roots. pH 6.0 Abrupt change to:
Bfhcc-1	1 - 6"	Dark reddish-brown (5YR 3/4 moist) clay loam. Moderate medium granular structure. Friable, many iron concretions, occasional gravel, many fine roots. pH 5.5 Gradual change to:
Bfhcc-2	6 - 12"	Brown to dark brown (10YR 4/3 moist) clay loam. Weak medium subangular blocky breaking to granular structure. Many iron concretions, friable, occasional gravel, moderate root content. pH 5.8 Abrupt change to:
C-1	12 - 24"	Pale brown (10YR 6/3 moist) clay. Strong coarse blocky structure. Bleaching along cleavages and some bleaching in interior of peds. Firm, sticky, plastic, occasional gravel. Occasional roots in cracks. pH 5.0 Very gradual change to:
C-2	24" +	Same as C-1 with less bleaching in cleavages and no bleaching in ped interiors. Indications of stratification. pH 4.7

Land Utilization:

The Slesse soils in the Chilliwack River valley are mostly occupied by native forest vegetation. Tree root penetration is limited to the top 10 to 16 inches; only a few roots penetrate the underlying heavy clay. The rooting zone is highly under-saturated with regard to bases. Available phosphorus is high, and the level of exchangeable potassium is moderately high. There is a moderate content of organic matter in the rooting zone, the carbon-nitrogen ratio being optimum.

Heavy texture is responsible for a moderately high cation exchange capacity and good moisture holding capacity. The Slesse soils, rated Class II in the land-use classification, have the highest soil rating in the Chilliwack Rivery valley. Although these soils are suitable for agriculture, the best land-use for some time to come is forestry.

4. ORTHIC CONCRETIONARY BROWN SOILS

This sub-group of concretionary brown soils occurs on the west coastal region of British Columbia. The climate has mild, wet winters and cool, dry summers. The Orthic Concretionary Brown soils resemble Acid Brown Wooded soils, except for the presence of magnetic iron concretions (shot) in the upper part of the solum.

In the Chilliwack map-area the Orthic Concretionary Brown soils developed on the upland with good to moderately good drainage, in medium textured soil-forming materials.

Under the natural conditions the soil profiles have an L-H horizon of forest litter. The solum is brownish, with numerous concretions in the upper part. There is no Ae horizon and no observable translocation of clay or sesquioxides. These soils are from slightly to strongly acid, and there is a low base status. A generalized virgin profile is as follows:

Horizon	Description
L - H	Raw to partly decomposed forest litter, from one to four inches thick.
Bfhcc or Bfcc	Dark brown, dark reddish-brown or dark yellowish-brown, the color fading with depth. Weak subangular blocky to weak granular structure. Numerous iron concretions. Six to sixteen inches thick.

In the Chilliwack map-area the Orthic Concretionary Brown soils are represented by the Sweltzer series.

SWELTZER SERIES

Description:

The mapped area of this series is in the central and eastern parts of the Chilliwack River valley. The topography is level to gently sloping, with a hummocky micro-relief which is due to windfall trees, and which churn the profile, breaking the sequence of soil horizons. Elevations range from 1,000 to 1,200 feet, and the area mapped amounted to 271 acres.

The Sweltzer series is derived from alluvial-colluvial fans. Surface textures vary from loam to clay loam, grading to sands at depths. The finer textured surface soils occur near the lower edges of the larger fans. Underlying clay exists where the fan materials are spread over glacio-lacustrine deposits.

This series consists of moderately well drained Orthic Concretionary Brown soils. Included are small areas of seepage, in which the lower part of the solum is gleyed. The vegetation mainly is a regrowth of hemlock and Douglas fir, containing willow and alder.

A virgin profile, typical of the series, was examined in a thick stand of Douglas fir and hemlock. It was described as follows:

Horizon	Depth	Description
L	2 - 1"	Raw forest litter, including needles, twigs, wood, bracken and moss. pH 4.6
F - H	1 - 0"	From partly to well decomposed black organic material. Many fine roots and white mycelia. pH 4.4

Continued:

Horizon	Depth	Description
Aej		A trace of a gray, bleached horizon, sometimes absent.
Bfhcc	0 - 7"	Dark reddish-brown (5YR 3/4 moist) loam to silt loam. Weak medium granular structure. Moderate number of shot, friable, many roots. pH 5.4 Gradual change to:
Bfc-1	7 - 20"	Reddish-brown (5YR 4/4 moist) silt loam. Moderate medium blocky and pockets of granular structure. A mixture of partly weathered parent material and Bf, caused by tree windfall. Friable, many roots. pH 5.8 Gradual change to:
Bfc-2	20 - 29"	Dark reddish-brown (5YR 3/4 moist) silt loam. Weak medium blocky structure. A mixture of partly weathered parent material and Bf. Friable, scattered roots. pH 5.9 Gradual change to:
C	29 - 36"	Brown to dark brown (10YR 4/3 moist) loam. Massive, breaking to fragmental structure, friable to firm. pH 6.1 Gradual change to:
IIC	36" +	Pale brown (10YR 6/3 moist) glacio-lacustrine clay. Scattered gravels and cobbles, occasional root. The parent material of the Slesse series, which occurs at variable depths. Occasionally this material is on the surface, giving localized patches of Slesse series. pH 5.9

Land Utilization:

The land mapped as Sweltzer series at present is occupied by forest vegetation. Potentially, the soils are good for agriculture, but there is little chance of their development in the near future. In the Chilliwack River valley the Sweltzer soils are surrounded by lands of poor quality for agriculture. However, deep loam to clay loam, with moderately high cation exchange capacity and good moisture holding capacity qualifies this series as excellent forestry land. There are no obstructions to tree root penetration until at depths, underlying lacustrine clay is encountered.

The rooting zone has a moderate content of organic matter and the carbon-nitrogen ratio is optimum for soil nitrogen availability. The levels of available phosphorus and exchangeable potassium are moderately high. But the soils are strongly acid and severely leached of bases. The Sweltzer series was rated as Class III soils.

5. ORTHIC ACID BROWN WOODED SOILS

In the Chilliwack map-area upland the soils assigned to the Orthic sub-group of Acid Brown Wooded soils have developed on medium to coarse textured parent materials. They are moderately well drained, and support a dense growth of forest, which consists chiefly of conifers.

In its upper part, the solum has a bright color, which fades with depth. Eluvial and illuvial horizons are not evident, and the base status is low. A generalized virgin profile is as follows:

Horizon	Description
L - H	Forest litter, raw to partly decomposed. From one to two inches thick.
Bf or Bfh	A brown, reddish-brown to yellowish-brown horizon, the colors fading with depth. Weak subangular blocky, granular or single-grained structure. Medium acid and low in bases. From seven to twenty-four inches thick.

In the upland area the representatives of the Orthic Acid Brown Wooded soils are the Columbia Sandy Loam, Ryder, Marble Hill, and Cultus series.

COLUMBIA SANDY LOAM

Description:

This soil type occurs in the Columbia Valley, south of Cultus Lake between International Ridge and Vedder Mountain. The Columbia Valley is bottomed by a series of glacial outwash terraces with hummocky surfaces and often wave-like ridges and depressions. Both ridges and depressions are alike as to soil development, excepting that on ridges the soils may be stony to the surface, whereas in depressions the stones are from 10 to 14 inches deep. The depth of the solum also is deeper in the depressions. Elevations are from 600 to 750 feet. The area classified totals 3,073 acres of which 356 have been differentiated as stony phase.

The soil is derived from glacio-fluvial Abbotsford Recessional Outwash (5). The thickness of these deposits may be from 50 to 125 feet; there is interbedded sand and gravel within 12 to 18 inches of the surface. The average surface texture is sandy loam. Some moderately to excessively stony areas were differentiated as a stony phase. The stones are 40 to 60% granitic; the remainder are volcanic and sedimentary, chert, argillite and porphyrite being represented.

The Columbia Sandy Loam is a well to excessively drained Orthic Acid Brown Wooded soil. A model profile was examined near the 49th parallel, about one-third mile from the south limit of the valley. The forest cover was Douglas fir, hemlock, birch, maple and alder, and included shrubs, ferns and other growth. This profile was given the following description:

Horizon	Depth	Description
L - H	2 - 0"	Raw litter; leaves, twigs, needles, well decomposed in the lower part. pH 5.2
Bfh-1	0 - 7"	Dark reddish-brown (5YR 3/4 moist) sandy loam. Weak medium granular structure. A few weakly cemented concretions. Friable, porous, many roots. pH 5.5 Gradual change to:
Bfh-2	7 - 17"	Dark yellowish-brown (10YR 4/3.5 moist) sandy loam. Very weak medium subangular blocky structure. A few soft iron concretions. A few gravels and large stones. Friable, porous, many roots. pH 5.8 Abrupt change to:
IIC	17" +	Gravelly sand containing pockets of loamy sand. Excessively stony and gravelly. Occasional root. pH 5.6

Land Utilization:

Most of the acreage of the Columbia Sandy Loam has been cleared and cultivated. It is used for dairying, raising beef cattle, and the production of pure-bred livestock.

This soil type was rated as a Class V soil for dry farming, and thus it is regarded as marginal to doubtful for dry land agriculture. The coarse texture of the solum accounts for the low cation exchange capacity and low moisture holding capacity. The soil reaction is from medium to strongly acid, and the bases are severely leached. Exchangeable potassium is very low, but there is a moderate content of organic matter. The level of available phosphorus is high. Under dry farming this soil type is best suited to early crops. Frequent small applications of lime and nitrogen and potassium fertilizers would be beneficial.

The productivity of this soil type would improve considerably if irrigated. Although there is sufficient groundwater for domestic use, a supply from this source for irrigation requires exploration. The Abbotsford Outwash, which underlies the Columbia Sandy Loam, is regarded as a potential aquifer.

RYDER SERIES

Description:

Areas occupied by the Ryder Series are located in the Ryder Lake, Elkview, Promontory, Elk Creek, and Marble Hill Creek localities, all on the upland.

The topography varies from undulating to hilly, the latter containing frequent outcroppings of bedrock. The range of elevation is from 100 to 2,500 feet above sea level. The Deep Phase of the Ryder series occupies 2,338 acres. In addition a deep and shallow phase were mapped together as a soil complex, which covers 2,895 acres. There is also a shallow phase with frequent rock outcroppings, 15,195 acres, a shallow and deep phase mapped together with moderate rock outcroppings, 4,448 acres, and a Marble Hill - Ryder Soil Complex, 1,013 acres. A considerable acreage is cultivated in undulating to gently rolling areas mapped as a shallow phase with frequent rock outcroppings.

This group of soils is derived from loess, which overlies Sumas Till and bedrock. The texture of the loess is from loam to silt loam, and the till varies from sandy loam to loam. The soils were classed as a shallow phase where the till or bedrock is within 18 inches depth. The shallow phase occupies ridges and knolls; the deep phase (more than 18 inches of loess) is found in level areas and depressions, where soil accumulates from down-hill erosion. Soil areas are slightly stony. The stones were brought up from the underlying till by uprooting trees, and loosened by frost action from rock outcroppings.

The Ryder series consists of Orthic Acid Brown Wooded soils, moderately well to well drained. These soils developed under Douglas fir, hemlock, maple, alder, cottonwood, and willow, and a secondary growth of salal, thimbleberry, red-osier dogwood, ferns, moss and others. A typical undisturbed profile was examined and described as follows:

Horizon	Depth	Description
L	2 - 1"	Forest litter composed of raw leaves, twigs, wood, needles, ferns, etc. pH 4.6
F - H	1 - 0"	Partly to well decomposed forest litter. pH 4.4
Bf-1	0 - 12"	Dark yellowish-brown (10YR 4/4 moist) silt loam. Very weak coarse subangular blocky structure. Friable, many roots. pH 6.2 Clear change to:

Continued:

Horizon	Depth	Description
Bf-2	12 - 20"	Yellowish-brown (10YR 5/4 moist) silt loam. Very weak medium subangular blocky structure. Some admixture with C horizon by windfall trees. Friable, many roots. pH 5.8 Clear change to:
B-IIC	20 - 33"	Brown (10YR 5/3 moist) silt loam. Admixture with underlying till. Moderate medium subangular blocky structure, common gravel and roots, slightly compact. pH 6.0 Gradual change to:
IIC	33" +	Grayish-brown (10YR 5/2 moist) loam. Massive, compact till, common gravels and pebbles, occasional root. pH 5.8

Land Utilization:

A large acreage of Ryder soils has been cleared and used for small fruits, dairying, and beef, sheep and hog production. Chemical analyses of soil samples indicate a moderately low cation exchange capacity. Although the reaction of the soil is only slightly acid, base saturation, nitrogen and organic matter content are moderately low. However, the levels of available phosphorus and exchangeable potassium are high. The Ryder soils should benefit from applications of lime and nitrogen fertilizers.

Based on the physical and chemical characteristics of the soil profile, the deep phase of the Ryder series was rated as Class III for dry farming. The rating of the shallow phase and the Marble Hill-Ryder Soil Complex varies from Class III to Class VIII, depending on topography, stoniness and other factors. The Ryder soils vary from fairly good agricultural land to poor forest land. It was observed that most of the acreage cleared and cultivated is marginal for dry farming.

The cultivated land is all dry farmed. Water supplies are lacking in places even for domestic use. A recent groundwater survey (6) indicates that a limited domestic supply may be available from a perched aquifer. This consists of stratified drift overlying bedrock. Most of the rainfall is lost by surface run-off. Wells do not draw on large enough sources, and go dry in summer. Bedrock consists of shales and argillites, which may yield water from joints and fractures. However, this possibility has not been explored.

Under dry farming the soils should give good yields of early maturing crops. Among pasture crops, alfalfa appears to be doing better than clover, regardless of a low calcium level.

MARBLE HILL SERIES

Description:

Marble Hill soils are distinguished from the Ryder series by a substratum of coarse textured glacial outwash. They occupy areas in the Ryder Lake, Elkview, Promontory, Elk Creek, and Marble Hill Creek localities.

The topography varies from undulating to hilly. Scattered outcroppings of bedrock occur in the hilly areas. The elevations of the series are from 100 to 2,500 feet. The area occupied by differentiated Marble Hill series is 464 acres which is the deep phase. In addition there is a shallow phase 3,798 acres, a shallow phase with rock outcroppings (Shallow Phase-Rock Outcrop Complex), a grouping of shallow and deep phases, 1,586 acres (Shallow Phase-Deep Phase Complex), and

Marble Hill-Ryder Soil Complex, 1,013 acres. A considerable acreage has been cleared and cultivated.

The solum is derived from loess, which overlies coarse materials that range from gravelly sand to gravelly sandy loam. The solum textures are from loam to silt loam, with minor inclusion of fine sandy loam where underlying outwash is near the surface. The shallow phase (less than 18 inches of loess) is confined to ridges and knolls. The deep phase (more than 18 inches of loess) occupies depressions and level areas. Stoniness varies from light to moderate in most of the area; areas of heavy stone content were differentiated. Scattered stones and gravel at the surface, and spotty textural changes are due to the uprooting of trees.

The well drained Marble Hill series was mapped as a group of Orthic Acid Brown Wooded soils. These soils developed under a dense forest of Douglas fir, hemlock, maple, alder, cottonwood, willow, and many shrubs, herbs, ferns, and mosses. A virgin profile indicating the distinguishing features of the series was examined and described as follows:

Horizon	Depth	Description
L - H	½ - 0"	Raw to well decomposed forest litter consisting of leaves, needles, wood, ferns, etc.
Bfh	0 - 6"	Dark yellowish-brown (10YR 4/4 moist) silt loam. Weak medium subangular blocky structure. Friable, many roots. pH 5.8
Bf	6 - 20"	Yellowish-brown (10YR 5/4 moist) silt loam. Weak medium subangular blocky structure. Occasional stone or gravel, friable, many roots. pH 5.6 Clear change to:
Bf-IIC	20 - 26"	Brown to yellowish-brown (10YR 5/3 - 5/4 moist) gravelly sandy loam. Admixture of underlay in solum. Single-grained, very friable, occasional root. pH 5.6 Gradual change to:
IIC	26" +	Brown (10YR 5/3 moist) gravelly loamy sand. Single-grained, loose. pH 5.6

Land Utilization:

Utilization of the Marble Hill soils is similar to that of the Ryder soils. Large areas have been cleared for mixed farming, which includes small fruits, dairying, and beef, and sheep and hog raising.

Chemical analyses of Marble Hill soil samples indicates a moderately low to moderate cation exchange capacity. The soil reaction is medium acid, with very low base saturation. There is a moderately low content of organic matter and total nitrogen. The levels of available phosphorus and exchangeable potassium are high. From these results it is concluded that the Marble Hill soils would respond to liming and applications of nitrogen fertilizers.

The physical and chemical characteristics of the soil profile indicate that the deep phase of the Marble Hill series should be included in Class III for dry farming. However, the rating of the associated soil complexes vary from Class III to Class VIII, depending on topography, stoniness, depth of solum, etc., in each differentiated area. These soils vary from fair for dry farming to very poor forest land.

The cleared acreage is dry farmed. This type of farming will continue because irrigation water is not available. There is a shortage of ground water for domestic use. The soils are best suited to early ripening crops. Among pasture species, alfalfa appears to grow better than clover, regardless of a low calcium status. It was observed that some areas best suited to forestry or tree farming are being cleared for agriculture.

CULTUS SERIES

Description:

A few scattered areas of this series are in the Chilliwack River valley, and the remainder lie north of Cultus Lake. The topography is from gently sloping to gently undulating at from 150 to 200 feet elevations near Cultus Lake, and from 1,000 to 1,200 feet above the sea in the Chilliwack River valley. The total area mapped, all under forest, was 1,196 acres.

The soil is derived from terraces, from 10 to 50 feet above present levels of stream flow, and soil development is confined to the surface six to eight inches. Surface textures vary from loamy sand to gravelly sand, with minor inclusions of sandy loam. Stoniness is from moderate to heavy and the soils are excessively drained.

This series was assigned to the Orthic sub-group of Acid Brown Wooded soils. Such soils developed under coniferous and deciduous forest containing Douglas fir, hemlock, alder, maple, willow, and shrub and ground cover of thimbleberry, bracken, mosses, weeds, and others. A virgin soil profile was examined about one-third mile west of a forest nursery in the Chilliwack River valley. It was described as follows:

Horizon	Depth	Description
L - H	1 - 0"	Forest litter, raw on top and well humified in the lower part. pH 5.3
Bf	0 - 7"	Dark reddish-brown (5YR 3/4 moist) loamy sand. Very weak medium subangular blocky breaking to medium granular structure. Very friable, many roots. pH 5.9 Gradual change to:
C	7" +	Dark grayish-brown (10YR 4/2 moist) loamy sand to sand. Single-grained, many stones and cobbles, a few roots. pH 5.7

Land Utilization:

The Cultus series was assigned to Land Capability Classes VI to VII, which signifies that these soils are non-arable for dry farming and fair to poor for forestry.

The mapped acreage was forested at the time of the soil survey (1961). Very coarse textures, lack of moisture holding capacity, stoniness and limited power to hold nutrients make these soils unfit for dry farming.

6. ORTHIC DARK GRAY GLEYSOLIC SOILS

This sub-group of gleysolic soils developed under the influence of poor drainage. These soils support a swamp forest associated with a high or fluctuating water table.

The soil profile is characterized by a dark colored Ah horizon more than two inches thick, abruptly underlaid by a gleyed horizon or horizons which are dull, grayish and often mottled. A generalized profile is as follows:

Horizon	Description
Ah	Very dark grayish-brown to very dark gray, six to nine inches thick. Granular to subangular blocky structure.
Cg	Light gray to gray with brown to yellowish-brown mottling. Generally divisible to sub-horizons by intensity of gley, or variation of texture of strata.

Upland soils of the Chilliwack map-area which were assigned to the Orthic sub-group of Dark Gray Gleysolic soils consist of the Calkins series.

CALKINS SERIES

Description:

This is a minor series which occurs on the upland in association with the Ryder and Marble Hill soils. In this association the Calkins series occupies areas of seepage, in which there is a fluctuating water table.

The topography is level to slightly undulating. Elevations are from 200 to 2,500 feet. The mapped area totals 803 acres, which is chiefly occupied by forest.

The parent material consists of loess, which thickened in depressions by erosion from higher ground. The profile textures vary from loam to silty clay loam, sometimes with an underlay of sandy loam

This series, which is from poorly to very poorly drained, was assigned to the Orthic sub-group of Dark Gray Gleysolic soils. A representative profile was examined in a stand of alder and willow. The ground cover included sedges, watercress and skunk cabbage. It was described as follows:

Horizon	Depth	Description
Ah	0 - 8"	Very dark brown (10YR 2/2 moist) silty clay loam. Moderate medium subangular blocky structure. Common roots. pH 4.7 Gradual change to:
A - C	8 - 13"	Dark gray (10YR 4/1 moist) silt loam. Massive, firm, few roots. pH 5.1 Abrupt change to:
Cg-1	13 - 22"	Grayish-brown (2.5Y 5/2 moist) silty clay loam. Many reddish-brown (2.5Y 5/4 moist) mottles. Massive, firm, scattered roots. pH 5.4 Abrupt change to:
Cg-2	22" +	Grayish-brown (2.5Y 5/2 moist) silt loam. Many yellowish-red (5YR 5/8 moist) mottles. Massive, firm. pH 5.5

Land Utilization:

Chemical analyses of samples indicate a high potential soil fertility. Inasmuch as these soils occupy small, scattered, poorly drained and swamp forested areas, their reclamation at the present time is not economic. On this basis the Calkins series has been included in Class V of the Land Capability Classification.

MISCELLANEOUS UPLAND SOILS

In the upland section of the Chilliwack map-area, the Sardis Soil Complex and Isar series, which are Orthic Regosols, Cheam series, which are Orthic Brown Wooded soils, and the Lickman series, a Mull Regosol, occupy the following acreage:

Sardis Soil Complex	1,902 acres
Isar series	1,381 "
Cheam series	146 "
Lickman series	227 "

Inasmuch as these soils occur also in the lowland, their descriptions will be included in the section of this report which deals with the lowland soils.

B. LOWLAND SOILS

7. ORTHIC ACID BROWN WOODED SOILS

The lowland soils of the Chilliwack map-area assigned to the Orthic sub-group of Acid Brown Wooded soils are derived from medium to coarse textured parent materials. They are moderately well drained and developed under forest.

In the upper part, the solum has a bright color, which fades with depth. Eluvial and illuvial horizons are not evident, and the base status is low. A generalized virgin profile is as follows:

Horizon	Description
L - H	Forest litter, raw to partly decomposed. From one to two inches thick.
Bf	A brown, reddish-brown to yellowish-brown horizon, the colors fading with depth. Weak subangular blocky, granular or single-grained structure. Medium acid and low in bases. From seven to twenty-four inches thick.

In the lowland area the representatives of the Orthic Acid Brown Wooded soils are the Cheam series and Popkum Sandy Loam.

CHEAM SERIES

Description:

The Cheam soils are derived from colluvial slide deposits, which slumped down the sides of the Cascade Mountains. In the Chilliwack map-area, these soils are at and near the toe of the mountain slopes on the south side of the Fraser River, east of Rosedale.

The topography is from gently undulating to rolling, with slopes running in all directions. In such topography the Cheam soils are associated with the Popkum Sandy Loam, which occupies the depressions. Elevations are from 45 to 400 feet above sea level. The Cheam series, 146 acres and the Cheam-Popkum Soil Complex, 241 acres, are arable, whereas the Cheam Stony Phase, 1,134 acres, is non-arable.

The slide deposits consist of unsorted materials which resemble till but do not have the compaction of till. They vary in thickness and overlie glacial outwash gravels and Sumas Till. The soil textures vary from gravelly sandy loam to gravelly loam, containing angular stones, cobbles and boulders, some of which are fragments of limestone. Buried tree trunks also occur. In a few places at the higher elevations, the surface material has been sorted by running water to form sandy and gravelly fans. Drainage within the solum varies with the depth of the impervious, till-like parent material; the soils are well to imperfectly drained.

The Cheam series is an Orthic Acid Brown Wooded soil which developed under heavy coniferous forest. A profile was examined at the eastern end of Chilliwack Municipality, about half-way between Nevin Road and the old Trans-Canada Highway. The cover was young cedar, cottonwood, birch, maple, and many shrubs, herbs and grasses. It was given the description that follows:

Horizon	Depth	Description
F - H	1½ - 0"	Partly decomposed organic litter containing charcoal and soil. Many fine roots. pH 6.5
Bf	0 - 7"	Dark brown (7.5YR 3/2 moist) gravelly sandy loam. Weak medium granular structure, very friable, angular gravels and cobbles common, many fine roots. pH 5.7 Gradual lower boundary to:
B - C	7 - 19"	Dark yellowish-brown (10YR 4/4 moist) gravelly sandy loam to loam. Weak medium subangular blocky breaking to medium granular structure. Very friable, common angular gravels and cobbles, common roots. pH 5.8 Gradual change to:
C-1	19 - 37"	Olive brown (2.5Y 4/4 moist) gravelly loam with pockets of gravelly sandy loam. Massive, moderately compact in place but friable when handled. Moderately vesicular, common angular gravels and cobbles, occasional root. pH 5.9 Gradual change to:
C-2	37" +	Olive brown (2.5Y 4/4 moist) gravelly loam with pockets of gravelly sandy loam. Similar to horizon above, but no vesicules or roots. pH 5.9

Land Utilization:

About 20% of the arable soils have been cleared and cultivated, and the balance is in forest. These soils are poor for dry farming, owing to coarse texture, low cation exchange capacity, and low moisture holding capacity. Organic matter and nitrogen content of the topsoil also are low. The level of available phosphorus is moderate and exchangeable potassium is high.

Poor physical and chemical condition of the soil, rolling topography and stoniness sufficient to make the use of machinery difficult are features which account for the low rating given to the Cheam soils. They were assigned to Class V for dry farming, meaning that they are of doubtful value for agriculture, but very good forest land.

POPKUM SANDY LOAM

Description:

This soil type developed from sorted sandy material, derived from the erosion of colluvial slide deposits occupied by Cheam series. In the Chilliwack map-area the Popkum Sandy Loam is confined to the south side of the Fraser River, east of Rosedale.

The topography varies from level to gently undulating. In the undulating phase the Popkum Sandy Loam is associated with the Cheam series; it occupies depressions and areas along the fringes of the slide deposits. The range of elevation is from 45 to 400 feet. The Popkum Sandy Loam occupies 525 acres, and the Cheam-Popkum Soil Complex 241 acres, most of which is arable.

The parent material consists of loose, open, sand, underlaid by slide deposits. The average surface texture is sandy loam. The depth of solum may be from 24 to 36 inches, with sand immediately beneath. Scattered stones, cobbles and boulders occur on the surface and within the profile. Soil drainage is moderate to imperfect.

The Popkum Sandy Loam is an Orthic Acid Brown Wooded soil, which developed under heavy forest. A profile was described near the hydro-electric power plant of the B. C. Electric Co., in the vicinity of Cheam. The vegetation was second growth consisting of young cedar, alder, shrubs, etc. It was described as follows:

Horizon	Depth	Description
L - H	1 - 0"	Moss with decayed leaf litter in the lower part. pH 5.5
Ah	0 - 2"	Very dark brown (10YR 2/2 moist) fine sandy loam. Weak medium granular structure. Very friable, many roots. pH 5.4 Gradual boundary to:
Bf	2 - 13"	Dark yellowish-brown (10YR 4/4 moist) sandy loam. Weak medium subangular blocky breaking to granular structure. Very friable, occasional angular gravel or cobble, many roots. pH 5.5 Gradual change to:
Cgj	13 - 23"	Olive brown (2.5Y 4/4 moist) loamy sand. Few to common faint mottles. Single-grained structure, loose, a few roots. pH 5.7 Gradual change to:
C	23" +	Dark micaceous sand. Loose, occasional lenses of gravelly sand. Underlaid by slide materials at depths of two to five feet. pH 5.8

Land Utilization:

Although the Popkum Sandy Loam is potentially arable, a considerable acreage is still uncleared. This soil type occurs as small, scattered areas surrounded by Cheam soils, so that the Cheam soils govern the land-use of the Popkum Sandy Loam.

The Popkum Sandy Loam is below average for dry farming. The cation exchange capacity is moderately low near the surface and decreases with depth. Although moisture holding capacity is low, the extreme effect of drought is prevented by seepage from the associated Cheam soils. The soil reaction is medium acid at a very low per cent base saturation. Organic matter and total nitrogen are low.

The Popkum Sandy Loam has been rated a Class IV soil, fair to poor for dry farming, but excellent for forestry.

8. ORTHIC MEADOW SOILS

The Orthic Meadow soils developed under the influence of a high or fluctuating water table. The resulting vegetation consisted of sedges and swamp forest. In Chilliwack Municipality the soils have an Ah horizon from 12 to 24 inches thick, which grades into a horizon or horizons that are grayish and dull but may be mottled, depending on drainage.

Although Orthic Meadow soils may have a layer of organic muck up to three inches thick at the surface, this feature was not observed in Chilliwack Municipality, where no unreclaimed areas have survived. A generalized but cultivated soil profile of the Orthic Meadow sub-group of Meadow soils in the area has the following characteristics:

Horizon	Description
Aha	Very dark grayish-brown to very dark brown horizon from six to eight inches thick. Weak medium to coarse subangular blocky breaking to granular structure.
Ah	Very dark grayish-brown horizon, six to sixteen inches thick. Weak medium to coarse subangular blocky structure.
Cg	Gray to dark grayish-brown horizon containing yellowish-brown to dark yellowish-brown mottles. Generally divisible into sub-horizons by intensity of gleying or by variations in the texture of strata.

In Chilliwack Municipality the only representative of the Orthic sub-group of Meadow soils is the Henderson series.

HENDERSON SERIES

Description:

These soils were derived from floodplain deposits of the Fraser River. Most areas of the series are in the western part of Chilliwack Municipality.

The general topography is gently undulating, but small, nearly level areas also have been differentiated. In the undulating phase the Henderson soils are associated with the Blackburn, Arnold, and Grigg series. Elevations are between 15 and 35 feet, and the area classified amounts to 203 acres of Henderson series and 53 acres of Henderson-Annis Complex, all arable.

Accumulations of the parent material were by lateral and vertical accretions. The undulating, ridge-and-swale relief stems from lateral accretions during periods of average flooding. During major freshets the sediments were laid as cover deposits or vertical accretions. The average soil texture is silty clay loam; small areas of silt loam and silty clay are included.

The Henderson soils have imperfect to poor drainage. Included very poorly drained areas were differentiated. There is fairly good porosity and root penetration. Permeability is slow to moderate. Internal drainage is from medium to slow. The least permeable horizon in the subsoil usually has heavier texture than horizons above and below.

This series was assigned to the Orthic sub-group of Meadow soils. It developed under the influence of a high water table, which encouraged the growth of sedges and swamp forest. A cultivated soil profile, representative of the Henderson soils, was examined about two hundred yards southeast of the Yale-Chadsey road crossing. It was described as follows:

Horizon	Depth	Description
Aha	0 - 7"	Very dark brown (10YR 2/2 moist) silty clay loam. Weak medium to coarse subangular blocky breaking to crumb structure. Friable, porous, many fine roots and a few earthworms. pH 6.2 Gradual change to:

Continued:

Horizon	Depth	Description
Ah	7 - 17"	Very dark grayish-brown (10YR 3/2 moist) silty clay loam to silty clay. Weak medium to coarse subangular blocky structure. Friable, porous, sticky, plastic, many fine roots. pH 6.0 Clear change to:
Cg	17 - 30"	Mottled brown to dark brown (10YR 4/3 moist) silt loam to silty clay loam. Massive, firm, many visible pores, common roots. pH 5.5 Abrupt change to:
IICg	30" +	Loamy sand to sand. Massive, breaking to single-grained structure. pH 5.8

Land Utilization:

The Henderson soils are used chiefly for dairying. The very poorly drained phase is flooded in winter, which damages the roots of farm crop perennials. Low elevation and slow external drainage make it difficult to improve the drainage of the low spots. But the better drained phase, which occupies most of the acreage, was rated as a Class I soil for dry farming and irrigation.

The chemical analyses reflect the high fertility of the Henderson soils. Organic matter content is high, and there are reserves of nitrogen and phosphorus. The carbon-nitrogen ratio is optimum and the soil reaction only slightly acid; both of which point to high nitrogen-phosphorus availability and vigorous micro-biological activity.

9. ORTHIC DARK GRAY GLEYSOLIC SOILS

Soils of this sub-group are associated with poor drainage. They developed under swamp forest in the presence of a high or fluctuating water table. The profile is characterized by a dark colored Ah horizon more than two inches thick, underlaid abruptly by a gleyed horizon or horizons. The gleyed horizons are dull and grayish, and may be mottled. The number and brightness of the mottles depends largely on water table fluctuations in the wet and dry seasons from a high at or near the surface to depths of several feet.

Mottling depends on oxidation of iron while the soil is damp but aerated after the water table has moved downward. Soils with a fluctuating water table which permits periods of aeration are strongly mottled. Soils which are wet most of the year, but which at times contain no free water in their profiles, permit air to penetrate old root channels and cause oxidation of the channel walls; the mottling consists of rings around root channels.

Under natural vegetation the Orthic Dark Gray Gleysolic soils may have a layer of organic muck on the surface up to three inches thick. When cultivated this material is incorporated into the Aha horizon. A Bg structural horizon may occur, but it contains no appreciable accumulation of clay or sesquioxides.

In Chilliwack Municipality the major characteristics which distinguish the Dark Gray Gleysolic soils from Meadow soils are that, in the former, there is a lower organic matter content in the Ah horizon, which also has an abrupt lower boundary. A generalized cultivated profile is as follows:

Horizon	Description
Aha	Very dark grayish-brown to very dark gray; six to nine inches thick. Subangular blocky to granular structure. Abrupt change to:
Bg	Variable gleying and mottling. Subangular blocky to prismatic structure; this horizon sometimes absent.
Cg	Light gray to gray with brown to yellowish-brown mottling. Generally divisible into sub-horizons by intensity of gleying or variations in texture of strata.

Lowland soils of Chilliwack Municipality which were assigned to the Orthic sub-group of Dark Gray Gleysolic soils are Pelley, Grigg, Blackburn, Arnold, and Elk series.

PELLEY SERIES

Description:

This series is derived from Fraser River floodplain deposits. Most areas of the series were mapped in the central part of the municipality, south of Yale Road. The intensely gleyed Pelley soils have an Ah horizon and very poor drainage.

The topography varies from nearly level to gently undulating. In gently undulating areas the Pelley soils are associated with the Grigg and Annis series in a topographic sequence; the Pelley series is in the intermediate topographic and drainage position. The range of elevation is between 35 and 40 feet above sea level. The area mapped as Pelley series was 474 acres. In addition, Pelley soils were mapped in association with others as follows:

Pelley Deep and Shallow Phase	213	acres
Pelley-Annis Soil Complex	518	"
Grigg-Pelley Soil Complex	781	"
Pelley-Shallow Phase-Annis Soil Complex	72	"

The parent material was deposited during flood stages of the Fraser River. The mode of deposition consisted chiefly of vertical accretion. The load of fine materials was carried by the freshet into ponds in which they settled to the bottom. The surface and sub-surface textures of soils derived from these materials varies from place to place. Within the profile a distinct textural stratification was observed. The average surface texture is silty clay loam, but variations to silt loam and silty clay loam were included.

This is a very poorly drained group of soils. Porosity is limited and permeability is very slow. The least permeable horizon is generally a heavier textured statum or strata in the profile, which occurs at various depths. Internal drainage is very slow; water drains away so slowly that the water table remains at or near the surface during most of the winter.

The Pelley series consists of a group of Orthic Dark Gray Gleysolic soils which developed under swamp forest. A few small, uncleared areas reveal that the native vegetation included Douglas fir, hemlock, maple, cottonwood, thimbleberry, blackberry, nettles, grasses, and others. A profile was examined about 400 yards southwest of Banford Road railway crossing. The description is as follows:

Horizon	Depth	Description
Aha	0 - 8"	Very dark grayish-brown (10YR 3/2 moist) clay. Coarse weak medium granular structure, friable, porous, many roots. pH 5.7 Abrupt change to:
Cg-1	8 - 16"	Gray of dark gray (5Y 4.5/1 moist) silty clay loam. A few faint yellowish-brown mottles (10YR 5/8 moist), confined mainly to root channels. A few cracks, root penetration mainly in cracks, massive, firm. pH 5.9 Clear change to:
Cg-2	16 - 19"	Grayish-brown (2.5Y 5/2 moist) silt loam to silty clay loam. Common yellowish-red (5YR 4/6 moist) mottles; horizon a variable lens, friable, sticky, slightly plastic. pH 6.1 Clear change to:
Cg-3	19 - 30"	Gray (5Y 5/1 moist) silty clay loam. A few distinct yellowish-red (5YR 4/6 moist) mottles confined to root channels. Sticky, slightly plastic, massive, firm, occasional thin organic layer between strata indicating an old surface. pH 6.1 Abrupt change to:
Cg-4	30" +	Gray (5Y 5/1 moist) to olive gray (5Y 5/2 moist) silt loam. Rare to common (5YR 4/6 moist) mottles, mainly around root channels. Massive, firm, texture coarsens with depth to alternate layers of coarse sand and silt loam. pH 5.9

Land Utilization:

Although most of the land occupied by the Pelley series has been cleared and cultivated for dairy farming, efforts to establish good pastures or to obtain satisfactory yields of hay have been defeated by very poor drainage.

The internal drainage of these soils is too slow for good growth of the more important crops. If this is not improved the best use of these soils is for production of grasses such as Reed Canary Grass, which can tolerate poor drainage. In addition to low yields under these conditions, the nutritional value of the feed is below average, owing to the absence of legumes.

Productivity is increased when tile drainage is installed. Some of the areas mapped as Grigg series are believed to have been Pelley before drainage. Observations indicate that drainage increases mottling, improves soil structure, and also increases root penetration and root survival over winter.

The chemical analyses show that the Pelley soils have a fairly high cation exchange capacity, meaning that they can hold large amounts of plant nutrients, and also that drought resistance is good. In terms of soil management, large applications of lime and fertilizers would be available to crop plants for longer periods than in the case of soils having a low cation exchange capacity.

A high organic matter content along with a narrow carbon-nitrogen ratio, high availability of phosphorus and moderate exchangeable potassium, all indicate good potential soil fertility after drainage. Regardless of the high total nitrogen content of the soil, the supply of nitrogen available to crop plants may be low to the point of deficiency when the land is poorly drained.

The growing of a variety of crops, including legumes to improve the nutritional value of hay and pasture, and the best returns from applications of fertilizers, are restricted while the soils are poorly drained. There is no need of irrigation under the poorly drained conditions, but irrigation may become useful after drainage. The Pelley series, deep phase, was assigned to Class III for dry farming and irrigation.

GRIGG SERIES

Description:

The Grigg soils were derived from floodplain deposits of the Fraser River. Most areas were classified in the central part of Chilliwack Municipality, south of Yale Road. Distinguishing features are an Ah horizon, subangular blocky structure in a Bg horizon, and poor drainage as indicated by gleying and mottling.

The topography is from nearly level to gently undulating. In areas of gentle undulations the Grigg soils are associated with the Pelley and Annis series and others. The Grigg soils always occupy the better drained positions. The elevations lie between 35 and 40 feet above sea level. The total area mapped as Grigg series was 2,030 acres, and 453 acres were mapped as Grigg Silt Loam. In addition, the following complexes were classified:

Annis-Grigg-Pelley Soil Complex	213	acres
Arnold-Grigg Soil Complex	641	"
Grigg-Pelley Soil Complex	781	"
Grigg Deep & Shallow Phase-Annis Soil Complex	118	"
Grigg-Annis Soil Complex	648	"
Grigg-McElvee Deep & Shallow Phase Soil Complex	93	"
Grigg Deep & Shallow Phase Soil Complex	128	"
Monroe-Blackburn-Grigg Soil Complex	474	"

The deposition of river sediments was mainly by vertical accretion. In the freshet season the silts and clays were carried into ponded areas on the floodplain. In these quiet waters there was gradual sedimentation. The texture of the surface and subsoil varies from place to place. Within the profile there is textural stratification, indicating slightly different river loads from freshet to freshet. The average surface texture is silty clay loam, but variations to silt loam and silty clay were included.

In general, this is a poorly drained group of soils, but some areas with restricted or imperfect drainage are included. Although porosity is limited, root penetration and survival over winter is better than in the Pelley soils. Soil permeability is slow to moderately slow. The least permeable horizon at depths in the soil profile is generally a heavier textured stratum than the ones above and below. There is slow internal drainage. In winter there is water saturation for periods of a week or more during wet spells.

The Grigg series was assigned to the Orthic sub-group of Dark Gray Gleysolic soils. These soils developed under a swampy forest of hemlock, maple, cottonwood, thimbleberry, blackberry, herbs, and grasses. A representative soil profile was examined about one-quarter mile northeast of Highway No. 1 and the Banford Road crossing. This was described as follows:

Horizon	Depth	Description
Aha	0 - 7"	Very dark grayish brown (10YR 3/2 moist) silty clay. Weak medium granular structure; friable, porous, many fine roots. pH 5.5 Abrupt change to:

Continued:

Horizon	Depth	Description
Bg	7 - 11"	Dark grayish-brown (2.5Y 4/2 moist) silty clay. Rare to common distinct yellowish-brown (10YR 5/6 moist) mottles. Moderate medium subangular blocky structure, many roots. pH 6.1 Clear change to:
Cg-1	11 - 22"	Olive gray (5Y 4.5/2 moist) silty clay. Common distinct yellowish-red (5YR 4/8 moist) mottles. Massive, firm, a few cracks, roots common but decrease with depth. pH 6.2 Gradual change to:
Cg-2	22 - 32"	Olive gray (5Y 4.5/2 moist) silty clay. Many distinct to faint yellowish-red (5YR 4/8 moist) mottles. Massive, firm, rare cracks, a few roots, pH 6.1 Gradual change to:
Cg-3	32 - 43"	Olive gray (5Y 5/2 moist) silty clay. Many distinct and faint yellowish-red to strong brown (5YR 4/8 - 7.5YR 5/6 moist) mottles which give slight color to the mass. Massive, firm, a few roots, an occasional crack terminating with depth. pH 6.0 Abrupt change to:
Cg-4	43 - 52"	Mottled dark reddish-brown (5YR 3/4 moist) silty clay. Massive, firm, sticky, plastic, a rare root. pH 6.0

Land Utilization:

Most of the land occupied by the Grigg series is cleared and cultivated for dairying and some specialized cropping. Since the Grigg soils occupy the largest area with level topography, they should be suitable for crops such as peas, which require uniformity of growth and maturity. Although the soil is at least one class better in regard to drainage than the Pelley series, underdraining is required for optimum crop yields. In winter, saturation of the soil occurs for periods which are long enough to drown and kill roots of perennial crops. In comparison with the Pelley series, however, the Grigg soils have deeper root penetration, better porosity, and it is possible to grow a wider range of crops, including such legumes as alsike and ladino clover.

When the land is underdrained, there is a significant increase in soil productivity. It was observed that the surface and sub-surface structure of the soil improved, and the number of earthworms increase in the surface horizon. An improvement of drainage should also encourage the production of nodules on legume roots, and thus increase the fixation of atmospheric nitrogen.

The Grigg soils have a fairly high cation exchange capacity. The soils have good capacity to hold plant nutrients and good drought resistance. In terms of soil management, large applications of lime and fertilizers would be available for longer periods than in the case of soils with lower cation exchange capacity.

Analyses of composite samples from the surface horizon from different fields indicates a wide range in nutrient levels of the soil. The soil reaction varies from medium acid to almost neutral (pH 5.5 to 6.6), and base saturation is from 49 to 78%. Base saturation generally increases with a rise of pH. The levels of available phosphorus are from 18 to 153 parts per million. Exchangeable potassium varies from 0.12 to 0.55 milliequivalents per 100 grams of soil. These results indicate a wide range of liming and fertilizer practices by farmers. However, the limited analyses point out the imbalance in the nutrient levels in which the potassium supply appears to be lacking. The high content of organic matter, the narrow carbon-nitrogen ratio, and soil conditions that help phosphorus availability, all point to good inherent fertility.

Although the chief limiting factor to soil productivity is poor drainage, irrigation would be profitable in summer. This is because in summer the water table may retreat to several feet from the surface, permitting the surface foot or more of soil to become too dry for shallow rooting crops. Summer drying of the surface soil reduces the response to lime and fertilizers in the growing season. Only a few widely spaced irrigations would be necessary, owing to the substantial water holding capacity of these soils. Groundwater from wells is the main source of an irrigation water supply. Grigg soils are included in Class II both for dry farming and irrigation.

BLACKBURN SERIES

Description:

This series is derived from deposits on the Fraser River floodplain. Most areas of Blackburn soils are located in the western part of Chilliwack Municipality. The distinguishing features of the Blackburn soils are an Ah horizon, a prismatic B horizon and poor drainage.

The topography is level with included small undulating areas. The Blackburn soils are associated with the Pelley, Grigg and Monroe series, at elevations between 15 and 25 feet above sea level. The total area of Blackburn series is 920 acres. An additional 474 acres were grouped as a Monroe-Blackburn-Grigg Soil Complex.

The river deposits accumulated chiefly by vertical accretion. Strata, some darkened by organic matter and some light colored, may vary in texture. These strata suggest periodic flooding during freshets of the Fraser. The thickness of strata increase with distance from the river. Surface soil textures, and those of the strata in the vertical section of the profile, vary from place to place. The most common surface texture is silty clay loam; this is associated with minor inclusions of silty clay.

The Blackburn soils are poorly drained. Porosity is limited and permeability is slow to very slow. There is considerable swelling and shrinkage in the wet and dry seasons. Drying off is the cause of shrinkage and vertical cracking into coarse prismatic structure. As the wet season advances the soil swells, the cracks close and a very compact horizon forms just below the depth of cultivation. A barrier to the downward movement of water is thus produced, through which seepage is very slow, so the water table remains near the surface during most of the winter.

The Blackburn series was assigned to the Orthic sub-group of Dark Gray Gleysolic soils, which developed under swamp forest. Uncleared areas have a vegetative cover composed chiefly of hemlock, maple, cottonwood, thimbleberry, blackberry, herbs and grasses. A profile was located about 300 yards northeast of the Chadsey and Keith-Wilson Road crossing. It was described as follows:

Horizon	Depth	Description
Aha	0 - 7"	Very dark gray (10YR 3/1 moist) silty clay loam. Some admixture with Bg-1 material. Weak fine to medium granular structure, friable, porous, many roots. pH 5.4 Abrupt change to:

Continued:

Horizon	Depth	Description
Bg-1	7 - 18"	Alternate layers 3 to 4" thick of dark and light colored silty clay loam. The dark strata are very dark grayish-brown (10YR 3/2 moist) with a few faint mottles. The light strata are grayish-brown (2.5Y 5/2 moist) with many distinct yellowish-brown (10YR 5/8 moist) mottles. Moderately strong very coarse prismatic structure, compact, very firm, common visible pores on horizontal plane, good root penetration between prisms. pH 5.7 Gradual change to:
Bg-2	18 - 28"	Alternate layers 2 to 3" thick of dark and light colored silty clay loam. The dark strata are very dark grayish-brown (10YR 3/2 moist) with common faint mottles. The light strata are grayish-brown (2.5Y 5/2 moist) with many prominent mottles. Moderate to moderately strong prismatic structure, common visible pores on horizontal plane. Good root penetration between prisms, the number of roots decreasing with depth. pH 5.9 Gradual change to:
Cg-1	28 - 41"	Olive gray (5Y 5/2 moist) silty clay loam. Common distinct yellowish-brown (10YR 5/8 moist) mottles confined to old root channels. Massive, firm, few roots. pH 6.0
IICg	41" +	Gleyed very fine sand.

Land Utilization:

All of the Blackburn series is cultivated and used for dairying and some specialized crops. Like the Grigg soils, the Blackburn soils have a fairly level topography, and should be well suited to crops which require a uniform maturity.

The Blackburn soils are poorly drained. This is due to the low elevation and the low gradient for run-off water. In the wet season, gravity drainage is sluggish, and there is much ponding and flooding, a situation that cannot be prevented. Regardless of this limitation, soil productivity on individual farms could be increased by tile drainage where suitable outlets are available. When adequately drained, the prismatic structure of the sub-soil gradually would convert to subangular blocky structure, thus improving macro-porosity and root penetration.

The fine soil texture accounts for the fairly high cation exchange and moisture holding capacities. Thus, lime, fertilizers and irrigation could increase crop production. In addition, the high content of organic matter, narrow carbon-nitrogen ratio and medium soil reaction all encourage bacterial activity that makes nutrients available to plants. The Blackburn soils have been included in Class II to III, but the rating would improve with better drainage.

ARNOLD SERIES

Description:

The Arnold soils are derived from Fraser River floodplain deposits. Their distinguishing feature consists of buried horizons high in organic matter. The comparable Blackburn series also has such buried horizons, but it has the further feature of prismatic structure, which is absent in the Arnold series. Areas of the Arnold soils are located in the vicinity of the Fraser River, in the western part of Chilliwack Municipality.

In areas near the Fraser River the topography varies from level to gently undulating; the Arnold soils occupy both the ridges and depressions. In other areas of undulating relief the Arnold soils are associated with others, such as the Grigg and Henderson series. The elevations of the Arnold soils are from 15 to 30 feet above sea level. The classified area of the Arnold series occupies 899 acres. In addition, there is an Arnold-Henderson Soil Complex, 150 acres, and an Arnold-Grigg Soil Complex, 641 acres.

The parent materials were deposited as strata during freshets of the Fraser River. The soils are characterized by buried pAh horizons. At depths these take the form of dark colored strata, separated by strata of lighter color. The thickness of the dark and light strata increases with distance from the river. In undulating topography the dark and light strata are thicker on the ridges and more numerous in the depressions. The textures at the surface and of the dark and light strata in the profile vary. The average surface and profile texture is silty clay loam, with minor inclusions of silt loam and silty clay. In places the Ah horizon has been covered by recent alluvium brought in by floods before the dykes were built, or in some places, when the dykes were breached during flood stages of the river.

This is a poorly drained group of soils. However, porosity is fair and permeability moderate to moderately slow. Internal drainage is slow. Water saturation occurs in winter, owing to poor external drainage. The elevations of this series are several feet lower than those of lands in the eastern part of the map-area, gravity drainage to the Fraser is sluggish, and flooding occurs in winter.

The Arnold series was assigned to the Orthic sub-group of Dark Gray Gleysolic soils. Soil development was associated with a swamp forest of hemlock, maple, cottonwood, and other trees, and shrubs and grasses. A representative soil profile was examined about 200 yards northeast of Yale and Chadsey road crossing. It was given the following description:

Horizon	Depth	Description
Aha	0 - 8"	Very dark grayish-brown (10YR 3/2 moist) silty clay loam. Moderate coarse crumb structure, friable, porous, many roots, admixture with recent alluvium. pH 5.8 Abrupt change to:
pAh-1	8 - 13"	Very dark brown (10YR 2/2 moist) silty clay loam. Coarse subangular blocky structure. Friable, porous, many roots. pH 5.8 Abrupt change to:
Cg-1	13 - 15"	Dark grayish-brown (2.5Y 4/2 moist) silty clay loam. Common distinct medium yellowish-brown (10YR 5/8 moist) mottles. Massive, friable, roots common. pH 5.9 Abrupt change to:
pAh-2	15 - 25"	Black (10YR 2/1 moist) silt loam high in organic matter. Massive, friable, roots common. pH 5.9
Cg-2	25 - 42"	Gray (2.5Y 5/1 moist) silty clay. Common to many distinct medium mottles. Massive, very firm, plastic, sticky. Roots rare, few visible pores, least permeable horizon. pH 5.9

Land Utilization:

The Arnold soils are farmed for dairying and crops such as corn and peas. Oats are grown in rotation with hay and pasture. These are poorly drained soils, with a drainage problem similar to that of the Blackburn series. The Arnold soils are at low elevations, and the drainage creeks and sloughs also are low-lying; there is flooding at times of heavy rains. Although overall drainage is difficult, tile drainage of individual farms is feasible and worthwhile.

The Arnold soils have a high cation exchange capacity. Chemical analyses of composite samples show a wide range in the amounts of almost all nutrients. The soils tend to be strongly acid, and thus would benefit from liming. In the dry months of summer the soils would benefit from irrigation. Water for this purpose is available in sloughs and from an unconfined groundwater aquifer. The Arnold soils were assigned to Class III for dry farming and Class II under irrigation.

ELK SERIES

Description:

Elk series is derived from the finer textured fan materials usually found at the lower parts of the larger fan aprons. The upper, coarser textured parts of the same fans were differentiated and named Isar series. The Elk soils occur in the eastern sections of Chilliwack Municipality.

The topography is from gently to very gently sloping. Elevations vary from 45 to 100 feet above sea level. The classified area totals 675 acres, all of which is arable.

The soils developed on dark colored parent material high in ferro-magnesium minerals which break down easily. The soil consists of a capping of fine material from 18 to 36 inches thick, which overlies sands and gravels. The surface textures include loam, silt loam and silty clay loam. The roughly stratified underlying strata carry seepage water, and average drainage is poor.

The Elk series is composed of Orthic Dark Gray Gleysolic soils, which developed under swamp forest. A cultivated profile was examined on a fan near Elk Creek, on the north side of Chilliwack Central Road. It was described as follows:

Horizon	Depth	Description
Aha	0 - 8"	Very dark brown (10YR 2/2 moist) silt loam to silty clay loam. Weak medium to coarse subangular blocky breaking to granular structure. Friable, many roots. pH 5.8 Gradual boundary to:
Ah	8 - 14"	Very dark grayish-brown (10YR 3/2 moist) silt loam. Faint mottling in the lower part. Weak to moderate medium blocky structure. Friable, many roots. pH 5.6 Gradual boundary to:
Cg	14 - 22"	Very dark gray (10YR 3/1 moist) loam to fine sandy loam. Common faint mottles, massive, friable, common roots. pH 5.7 Clear change to:
IICg	22" +	Alternating strata consisting of gravelly sand, fine sandy loam to loam and gravelly layers. The porous layers act as seepage channels. No roots.

Land Utilization:

Elk soils are used for dairy farming, but their productivity is limited by poor drainage. Chemical analyses of a representative profile indicates a fairly high cation exchange capacity. The organic matter is high and the carbon-nitrogen ratio is optimum. The soil reaction is medium acid and available phosphorus is high. It was concluded from laboratory results that inherent soil fertility is high, except for low exchangeable potassium.

The Elk soils were assigned to Land Capability Class III for dry farming. Under supplemental irrigation these soils would be rated in Class II.

10. ORTHIC GLEYSOL SOILS

In Chilliwack Municipality the Orthic sub-group of the Gleysol soils has poor drainage. These soils developed under swamp forest in the presence of a high water table, which in most places recedes in the dry season. Characteristic features in cultivated land are an Aa horizon from five to seven inches thick which may be low in organic matter. This is underlaid by a strongly gleyed, non-calcareous mineral horizon or horizons. Under virgin conditions an Ah horizon not more than two inches thick may be present.

The gleyed horizons are dull and grayish, and generally mottled. The number and brightness in color of the mottles is dependent upon water table fluctuations from a high at or near the surface to depths of several feet. The mottling is caused by oxidation of iron while the soil is damp and aerated, as the water table recedes.

Soil profiles so situated as to maintain moisture at field capacity, but which at times are free of non-capillary water, may permit air to enter old root channels and oxidize their walls. In such cases the only mottling present consists of rings around the root channels.

The Gleysol soils do not have observable eluvial or illuvial horizons. Under natural vegetation the Orthic Gleysol may have a surface layer of organic litter not more than one inch thick. A generalized cultivated profile is as follows:

Horizon	Description
Aa	Cultivated horizon. Brown to grayish-brown from five to seven inches thick. Massive to subangular blocky structure.
Cg	Gray or olive gray, with brown, yellowish-brown or yellow mottles. Weak subangular blocky to massive structure. This horizon can be sub-divided on the basis of intensity of gleying and mottling, texture and stratification.

In Chilliwack Municipality the Orthic Gleysol is represented by the Prest, McElvee, Vedder, Chadsey, and Sumas series.

PREST SERIES

Description:

This series is derived from Fraser River floodplain deposits. Most areas of these soils are located in the northern parts of Chilliwack Municipality.

The topography generally is undulating. In the undulating areas the Prest soils are associated with the Fairfield series; Prest series is in the low spots and the Fairfield soils are on the higher ground. The elevations are from 30 to 45 feet, and the total area mapped was 920 acres, most of which is non-arable. An additional 459 acres were classified as a Fairfield-Prest Soil Complex.

The profile textures vary from silt loam to silty clay. In places there is a few inches of peat on the surface. Drainage is very poor; in the lowest spots water is at the surface in the growing season, and in most places the water table is near the surface.

The Prest series was assigned to the sub-group of Orthic Gleysol soils. The Prest soils support sedges, water cress, skunk cabbage, and similar plants. A description of the profile follows:

Horizon	Depth	Description
Cg-1	0 - 10"	Dark gray (5Y 4/1 moist), gray (5Y 6/1 dry) silty clay loam. Many semi-decomposed roots. pH 5.2
Cg-2	10" +	Gray (2.5Y 5/1 moist) silt loam to silty clay loam. Massive, firm. Dispersed semi-decomposed plant remains. pH 5.0

Land Utilization:

Under the drainage conditions observed at the time of the survey (1961), the Prest soils were non-arable. They would be productive if adequately drained, but at present, such drainage would not be economic.

These soils were placed in Class V, and are regarded as of doubtful value for agriculture until the drainage has been improved.

McELVEE SERIES

Description:

The McElvee series is derived chiefly from deposits of the Chilliwack and Vedder rivers. The sediments were eroded from the Chilliwack River basin in the Cascade mountains. Upon reaching the lowland, the materials fanned in northeast, north and northwest directions. Most areas of McElvee soils are in the vicinity of Sardis and Yarrow. Distinguishing features are the absence of an Ah horizon, poor drainage and silt loam to loam texture.

The topography is from nearly level to gently undulating. In gently undulating areas the McElvee soils are associated with the Lickman series and the Sardis Complex. In some areas of very poor drainage, they are in association with the Peaty Gleysol named Annis series. Elevations range from 80 feet where the rivers enter the lowland, to about 30 feet northeast of Sardis, and from 10 to 15 feet on the western fringe of the soil series. The soils classified as McElvee series total 647 acres. In addition, there are a number of other groupings as follows:

McElvee Series, Shallow Phase	420	acres
McElvee Series, Deep and Shallow Phase Soil Complex	4,037	"
McElvee-Lickman Soil Complex	367	"
McElvee, Deep & Shallow Phase-Lickman Shallow Phase Soil Complex	272	"
McElvee Shallow Phase-Sardis-Lickman Shallow Phase Soil Complex	459	"
Grigg-McElvee Deep & Shallow Phase Soil Complex	93	"

The parent material accumulated by lateral and vertical accretion, due to the overflow of natural levees during flood stages of the rivers. Although the average profile textures are from silt loam to loam, an occasional lens of sandy loam or sand may be observed. In the southern part, underlying material at depths of 20 to 50 inches often consists of gravels. In the northern part, where McElvee soils meet deposits of the Fraser River, underlying materials at depths of 20 inches or more may be derived from the Fraser River.

The poor drainage of the McElvee soils is due to restricted external drainage. The soil has adequate macro-porosity, and is regarded as moderately permeable. The undulating areas are poorly drained in the low places and at the low elevations in the western section. In the area of McElvee soils in the Eastern Prairie section of the Sumas Drainage District, gravity drainage to the Fraser River is restricted, and flooding is frequent in winter.

The McElvee series is an Orthic Gleysol. In uncleared areas the native vegetation consists of cottonwood, cedar, hemlock, maple, and a strong growth of shrubs, herbs and grasses. A profile was examined about 200 yards southwest of the Keith-Wilson and Sumas Prairie road crossing. The description is as follows:

Horizon	Depth	Description
L	1 - 0"	Mat of fibrous roots.
Aa	0 - 6"	Dark grayish-brown (2.5Y 4/2 moist), grayish-brown (2.5Y 5/2 dry) silt loam. A few faint to distinct yellowish-brown (10YR 5/8 moist) mottles. Massive, friable, many fibrous roots. pH 5.6 Clear change to:
Cg-1	6 - 16"	Olive gray (5Y 4/2 moist) silt loam. Common to many faint to distinct yellowish-brown (10YR 5/8 moist) mottles. Massive, friable to firm, common to many roots, many visible pores. pH 6.3 Diffuse lower boundary to:
Cg-2	16 - 25"	Olive gray (5Y 4/2 moist) silt loam. Many distinct yellowish-red (5YR 4/8 moist) mottles. Massive, friable to firm, common to many roots, many visible pores. pH 6.6 Abrupt change to:
Cg-3	25 - 32"	Olive gray (5Y 4/2 moist) silt loam to silty clay loam. Possibly Fraser River deposit. Many faint to distinct yellowish-brown (10YR 5/8 moist) mottles. Massive, firm, common roots and visible pores. Least permeable horizon. pH 6.7 Abrupt change to:
IICg	32" +	Interstratified sands of various textures. pH 6.8

Land Utilization:

The major uses of the McElvee soils are dairying, small fruit and vegetable production. Most of the small farms around Yarrow and Sardis are devoted to small fruits and vegetables.

Productivity is limited by poor drainage. The poorly drained McElvee soils lie in the Chilliwack Drainage District and in the Eastern Prairie section of the Sumas Drainage District. In the Chilliwack Drainage District the McElvee soils could be improved by tile drainage, but in the Eastern Prairie section the problem is more difficult, owing to the low elevation. In this area there is flooding in winter, which damages perennial crops. Because of the rapid permeability of the McElvee soils and their complexes, they rapidly accept large quantities of water from adjoining areas. This would make drainage of individual farms difficult and costly.

McElvee soils have moderate cation exchange and moisture holding capacities. Analyses of composite surface samples from different locations show a wide range of nutrient levels. The soil reaction is from medium to strongly acid. The percent base saturation is from 25 to 80. Available phosphorus and exchangeable potassium have a similar range. These variations are probably due to a range of farm management practices.

An investigation of soil management indicated that the McElvee soils give a great response to supplemental irrigation. Applications of lime and fertilizers also give the best results with irrigation.

The McElvee series, deep phase, was assigned to Land Capability Class III for dry farming, and Class II when irrigated.

VEDDER SERIES

Description:

The Vedder series is derived from lacustrine deposits. The soils occur on the west fringe of Chilliwack Municipality. The topography is level and the elevations lie between 10 and 20 feet. Only 62 acres of the series occur in the Chilliwack map-area.

The lacustrine parent material is stratified. The profile texture varies from silt loam to heavy clay. Where they come in contact with the coarse textured Sumas soils, the Vedder soils overlie sand at depths of from 12 to 18 inches. Drainage is poor to very poor.

The Vedder series was classified as an Orthic Gleysol. A cultivated profile description of the deep phase is as follows:

Horizon	Depth	Description
Aa	0 - 9"	Very dark grayish-brown (10YR 3/2 moist), grayish-brown (10YR 5/2 dry) silty clay loam. Weak medium subangular blocky structure. Friable, porous, many roots and earthworms. pH 5.7
Cg-1	9 - 23"	Olive gray (5Y 4/2 moist) silty clay loam. Many medium strong brown (7.5YR 5/8 moist) mottles. Massive, deep cracks, tendency to break on horizontal cleavages. Friable to firm, many visible pores and roots. pH 6.2
Cg-2	23 - 33"	Olive gray (5Y 4/2 moist) heavy clay. Common faint to distinct yellowish-brown (10YR 5/8 moist) mottles. Massive, firm, few visible pores or roots. Visible stratification; the least permeable horizon. pH 6.4
Cg-3	33 - 45"	Olive gray (5Y 4/2 moist) clay. Many distinct yellowish-red (5Y 4/8 moist) mottles. Massive, friable, porous, occasional root. pH 6.5

Land Utilization:

The small area of Vedder soils in the Chilliwack map-area is used for dairy farming. The drainage is poor. In part, this is due to seepage from Vedder Canal. Soil productivity will be low until the drainage is improved.

The 62 acres of Vedder series in the Chilliwack map-area is the shallow phase, and as such was assigned to Land Capability Class IV.

CHADSEY SERIES

Description:

This series, derived from lacustrine materials, occurs on the western fringe of the map-area. The topography is level to slightly undulating, and the range of elevation is from 10 to 15 feet. The area mapped was 263 acres, most of which is so poorly drained as to be non-arable.

The textural range of the lacustrine parent material is from silt loam to clay. The poor drainage is due chiefly, to seepage from Vedder Canal. The Chadsey soils are Orthic Gleysols. They support sedges, water-cress, skunk cabbage, and similar water loving plants. A description of the soil profile follows:

Horizon	Depth	Description
Cg-1	0 - 12"	Dark gray (5Y 4/1 moist), gray (5Y 6/1 dry) clay. Common faint yellowish-brown (10YR 4/8 moist) mottles. Many semi-decomposed roots. pH 5.3
Cg-2	12 - 25"	Gray (2.5Y 5/1 moist) clay. Massive, very firm, plastic, sticky. pH 5.0
Cg-3	25" +	Dark gray (2.5Y 4/1 moist) clay. Massive, very firm, sticky, plastic, semi-decomposed plant remains in the matrix. pH 4.6

Land Utilization:

The Chadsey soils have doubtful value for production of field crops until drainage is improved. These soils were assigned to Land Capability Class V.

SUMAS SERIES

Description:

The Sumas series is derived from coarse textured lacustrine deposits. The soils occur on the western side of the Chilliwack map-area. The topography is level, at elevations between 10 and 15 feet. A total of 291 acres was assigned to the Sumas series. In addition, there are 37 acres of Sumas Sandy Loam and 13 acres of Sumas Loamy Sand, all acreages being arable.

The parent material consists of coarse sand, with a range of surface texture from loamy sand to loam. Drainage is poor to very poor. The soils are Orthic Gleysol, and their cultivated profile is as follows:

Horizon	Depth	Description
Aa	0 - 5"	Very dark grayish-brown (10YR 3/2 moist), grayish-brown (10YR 5/2 dry) loamy sand. Incipant mottling, massive, very friable. Many roots, all confined to this horizon. pH 5.4
Cg-1	5 - 9"	Loamy sand, mottled, massive, very friable, no roots. pH 6.4
Cg-2	9 - 18"	Olive gray (5Y 5/2 moist) loamy sand. A few faint mottles confined to old root channels. Massive, very friable. pH 6.7
Cg-3	18" +	Coarse, single-grained sand. pH 6.7

Land Utilization:

Sumas Lake was drained in the 1920s; Sumas series was part of the lake bottom. The Sumas Drainage Canal was built in 1926, and the area became suitable for agriculture.

At the time of the survey (1961) farming included dairying, small fruit and vegetable growing. In winter the internal drainage of the Sumas soils is slow because of low elevations and almost flat grades. There is prolonged flooding in the wet season, which is hard on perennial crops. However, good yields of annual crops are possible with fertilization and some form of irrigation. Sub-irrigation is practiced here, owing to level land and a coarse textured soil profile.

The Sumas soils were assigned to Land Capability Classes V and VI for dry farming, and Classes III and IV under irrigation.

11. PEATY GLEYSOL SOILS

The Peaty sub-group of Gleysol soils occupies very poorly drained areas in Chilliwack Municipality. These soils developed under the influence of a high water table, which favored the accumulation of a surface layer of organic matter.

When cultivated there is from six to twelve inches of dark gray to reddish-black muck as a surface layer, abruptly underlaid by gleyed and mottled sub-soil that does not have eluvial or illuvial horizons. In places there is a variant having an Ah horizon below the organic layer, which is not more than two inches thick. The soil reaction varies from strongly to slightly acid. In generalized form, the cultivated profile is as follows:

Horizon	Description
Ha	Dark gray to reddish-black organic matter, from six to twelve inches thick. Granular structure; some mixing with underlying mineral soil.
Cg	Gray to dark gray mineral soil, with brown, yellowish-brown and strong brown mottles. Massive structure. This horizon may be sub-divided by intensity of gleying or mottling, or by changes of texture.

The only representative of the Peaty Gleysol in Chilliwack Municipality is Annis Muck.

ANNIS MUCK

Description:

This soil type occurs in scattered depressions on the floodplain of the Fraser, Chilliwack, and Vedder rivers. Such depressions are located chiefly in the southern part of Chilliwack Municipality.

The topography is from near level to gently undulating. The Annis Muck occupies depressions within areas of better drained soils, and also it occurs on low ridges in organic soil areas. The range of elevation is from 30 to 45 feet. The area classified as Annis Muck amounts to 747 acres. In addition a Pelley-Annis Soil Complex occupies 578 acres, a Annis-Grigg-Pelley Soil Complex covers 213 acres, and there are 53 acres of a Henderson-Annis Soil Complex.

The parent material consists of six to twelve inches of well decomposed muck, which overlies silty clay loam to silty clay floodplain sediments. The drainage is very poor and the mineral soil beneath the layer of muck is strongly gleyed.

This soil type was mapped as a Peaty Gleysol. The organic surface horizon is derived from swamp forest vegetation. A cultivated soil profile having the typical features of Annis Muck was examined about 200 yards west of Prairie-Central-Banford road crossing. It was described as follows:

Horizon	Depth	Description
Ha	9 - 0"	Well decomposed reddish black (10YR 2/1 moist) muck. Weak granular structure. Many fine roots and a few earthworms. pH 5.2 Abrupt change to:

Continued:

Horizon	Depth	Description
Cg-1	0 - 7"	Dark gray (10YR 4/1 moist) silty clay loam. Few to common distinct brownish-yellow (10YR 6/6 moist) mottles. Massive, firm, few to common visible pores, a few roots. pH 6.3 Clear change to:
Cg-2	7 - 36"	Gray (2.5Y 5/0 moist) silty clay loam. A few to common distinct yellowish-red (5YR 5/6 moist) mottles. Massive, firm, a few cracks. pH 6.3 Abrupt change to:
Cg-3	36" +	Bluish-gray silty clay. Massive, very firm, sticky and plastic. pH 7.0

Land Utilization:

Although most of the acreage of Annis Muck has been brought into use for farming, satisfactory crop production is dependent on adequate drainage. For this soil type, management is medial as between mineral and organic soils. When associated with mineral soils in a complex (e.g. Grigg- Annis Soil Complex), the management is in line with that for mineral soils, but when Annis Muck is in association with organic soils, the remarks in regard to the management of the Gibson and Banford mucks apply also to Annis Muck.

In the Chilliwack map-area the Annis Muck is from strongly to very strongly acid. Liming is recommended, the amount to apply to depend on the crop, and the acidity of the different profile horizons. A ton of limestone per acre will raise the reaction about pH 0.2, when mixed to a depth of about seven inches. Over-liming should be avoided to prevent a reduction in the availability of phosphorus, manganese and boron.

Although total nitrogen is high in Annis Muck, the carbon-nitrogen ratio is wide; this indicates low availability of soil nitrogen to plants. Thus, crops are likely to respond to application of nitrogen fertilizers. The same is true of total phosphorus, most of which is in organic form. However, phosphorus should be applied to Annis Muck in combination with potassium, which is the most deficient of the major nutrients in this soil. Lower yields than those from unfertilized ground could result from an application of phosphorus alone.

Minor elements that may be deficient in the surface soil of Annis Muck are manganese, boron, copper, iron, zinc and molydenum. Inasmuch as the soil reaction is a governing factor which determines the availability of minor elements, the pH may be used as an indicator of minor element status. This procedure is explained in the section on chemical analyses.

Irrigation may be necessary on Annis Muck at times in the dry season, but at the rate of only an inch or two per application as required. The Annis Muck was assigned to Class III for dry farming and irrigation.

12. ORTHIC REGOSOL SOILS

The Orthic Regosol is characterized by the lack of horizon development, but a weak non-chernosemic Ah horizon is permitted. This must be less than five inches thick and only one Munsell color unit darker than the underlying parent material. There should be no visible evidence of salts or gley. The Orthic Regosol occurs under forest, and it is moderately well to well drained. The following is a generalized soil profile in cultivated land:

Horizon	Description
Aa	Olive brown to dark grayish-brown horizon, from six to eight inches thick. Massive to weak subangular blocky or weak granular structure.

Continued:

Horizon	Description
C	Olive brown to brown. Often divisible into sub-horizons using variation of texture or weak mottling as the basis of distinction.

The Orthic Regosol soils in the Chilliwack map-area are Grevell series, Sardis Soil Complex and Isar series.

GREVELL SERIES

Description:

These soils are derived from Fraser River floodplain deposits. Most of the classified acreage is in the northern part of the map-area.

The topography is gently undulating. In this kind of relief the Grevell soils are in association with the Monroe and Fairfield series. The Grevell soils occupy areas near the bends of meandering sloughs, at slough junctions and on isolated ridges. These soils have higher elevations than those associated with them. Their range of elevations are from 30 to 45 feet. A total of 314 acres was mapped as Grevell series. In addition there is a Grevell-Fairfield (Shallow Phase) Soil Complex, 768 acres, and a Grevell-Monroe (Shallow Phase) Soil Complex, 258 acres.

The parent materials accumulated as lateral accretions which were deposited outward from the Fraser River and the chain of associated sloughs during freshets. The surface textures vary from sandy loam to loamy sand. The subsoil consists of sand interstratified with materials of finer texture. These soils occupy well drained to moderately well drained positions, excepting one small, undyked area subject to flooding, which has been included as poorly drained phase.

The Grevell series is an Orthic Regosol. The vegetation of areas in the native state consists of a thin stand of cottonwood and shrubs such as red-osier dogwood, twinberry, thimbleberry, and waxberry. A model profile in cultivated soil was examined about one-quarter mile west of McSween and Ballam road crossing, about 100 yards south of a dyke. This was described as follows:

Horizon	Depth	Description
Aa	0 - 10"	Dark grayish-brown (10YR 4/2 moist) sandy loam. Weak fine to medium subangular blocky structure. Friable, many fine roots. pH 5.7
C1	10 - 19"	Dark grayish-brown (10YR 4/2 moist) loamy sand. Few to common faint mottles. Single-grained, loose, common roots. pH 6.1
C2	19 - 24"	Dark grayish-brown (10YR 4/2 moist) very fine sandy loam. Few to common faint mottles, which are confined to root channels. Weak medium to coarse subangular blocky structure. Slightly hard, dry, friable moist, few roots. pH 6.1
C3	24" +	Dark grayish-brown (10YR 4/2 moist) interstratified sand and silt loam. A few faint mottles. pH 6.2

Land Utilization:

Soil areas mapped as Grevell series and its soil complexes occur in small, scattered areas; their utilization and management are necessarily the same as those of the associated soils.

The coarse texture of the Grevell soils is responsible for low cation exchange and moisture holding capacities. The organic matter content of the surface horizon also is low, and these soils have low nutrient holding power.

Under dry farming the Grevell soils were included in Land Capability Class V, but they would gain to Class IV when irrigated. These soils require adequate fertilization and frequent irrigation for optimum yields, but the size of each area is too small to warrant special treatment. In some of the undulating areas the ground has been levelled, thus exposing the underlying sand. This procedure lowers the value of the levelled areas, and also it lowers the value of areas of associated soils which were covered with the surplus of sandy material.

SARDIS SOIL COMPLEX

Description:

The Sardis Soil Complex consists of a group of soils derived from deposits of the Chilliwack and Vedder rivers. These soils are in the southern parts of the Chilliwack Municipality lowland, and also in the Chilliwack River valley.

The topography is level to gently undulating. In undulating relief the soils are associated with the Lickman and McElvee series. Lowland elevations vary from 80 feet at the efflux of the rivers into the lowland to about 30 feet northeast of Sardis, and 15 feet on the west side of the municipality. Upland elevations of these soils are from 80 to over 1,000 feet above sea level.

A total of 1,960 acres in the lowland and 1,902 acres in the upland were mapped as Sardis Soil Complex. These soils were so-named because of their unusual variability. In addition to them, associated soils were grouped with the Sardis type as follows:

Sardis-McElvee (Shallow Phase) Soil Complex	1,100 Acres
Sardis-Lickman Soil Complex	542 "
McElvee (Shallow Phase)-Sardis-Lickman (Shallow Phase) Soil Complex	459 "

The parent material is composed of coarse sands and gravels, deposited during flood stages of the streams. The Sardis soils are very variable as to texture of the profile and drainage. The average surface texture is sandy loam, but large areas are surfaced with loamy sand, and some areas of sand are included. The substratum consists of sand and gravelly sand. Although the greater part of the Sardis soils are moderately well drained, there are extremes which vary from excessive to poor drainage.

The classified Sardis soils range from Orthic Regosol to Orthic Gleysol, but the Orthic Regosol occupies the bulk of the acreage. The following is a description of a Sardis Orthic Regosol in cultivated land:

Horizon	Depth	Description
Aa	0 - 6"	Brown to dark brown (10YR 3/3 moist) sandy loam. Weak medium subangular blocky breaking to granular structure. Very friable, many roots. pH 5.7 Abrupt change to:
C-1	6 - 25"	Dark yellowish-brown (10YR 3/4 moist) strata which varies from coarse sand to sandy loam. Single-grained to weak subangular blocky structure. Roots common. pH 6.2 Clear change to:
C-2	25" +	Gravelly medium sand, variegated colors, single-grained, scattered roots. pH 6.2

Land Utilization:

There are areas of Sardis soils still in the native state, but on the whole, these are poor for agriculture. A large part of the area of Sardis soils and their complexes are dairy farmed, and in the Sardis and Yarrow localities, several farms on these soils specialize in poultry, sheep and hogs.

Coarse texture is responsible for low moisture and nutrient holding capacities. Sardis soils having loamy sand and sandy loam textures were assigned to Class IV under irrigation. For dry farming these soils have doubtful value for agriculture, and were given a Class V Land Capability Rating.

Areas of Sardis soils along the Vedder and Chilliwack rivers are subject to flooding at high water. The dykes reduce the flood hazard, but they do not remove it completely. This is due to seepage under the dykes, through the coarse textured materials. The Sardis soils in these localities also are subject to saturation in winter, owing to poor external drainage.

ISAR SERIES

Description:

Isar series is composed of coarse textured materials on alluvial-colluvial fans eroded from the Cascade Mountains. Most areas are located in the eastern section of the Chilliwack Municipality lowland, and in the Chilliwack River valley, which is included in the upland of the map-area.

The topography is typical of fans. There is a main downward slope toward the valley centre, with lateral slopes at right angles, the most gentle one being in the vicinity of the fan apron. At the apex of the fan, the main slope may be up to 30 to 40%, but it is only 2 to 3% at the fan margin. Elevations vary widely from lowland to upland. In the lowland 135 acres were mapped as Isar series, and 427 acres as Isar Gravelly Loam. In the upland 1,381 acres were differentiated as Isar series.

The parent materials consist of coarse alluvial-colluvial debris surfaced with finer textured materials having a range of depth from none at all around the fan apex to 24 inches or more near the margin of the fan apron. Surface and sub-surface textures vary from gravelly loamy sand and sandy loam in the higher parts of fans to gravelly loam and loam in the lower parts. Parent rocks are high in ferro-magnesium minerals, which also contain veins of quartz and calcite. The soils are from well to excessively drained.

The Isar soils were mapped as Orthic Regosols. A profile was examined on a small fan about two miles west of Slesse Creek. The topography was a 5% slope to the north. The area was logged and growth was alder and willow about six feet high, with thimbleberry, weeds, grasses and moss. A part of this fan was veneered by a recent, roughly sorted outwash. The soil profile was described as follows:

Horizon	Depth	Description
Chj	0 - 4"	Very dark grayish-brown (10YR 3/2 moist) loam. Weak medium subangular breaking to granular structure. Very friable, occasional angular gravel, many fine roots. Horizon covers a buried surface. pH 6.0 Abrupt change to:
C-1	4 - 9"	Dark grayish-brown (10YR 4/2 moist) loam. Weak medium blocky structure. Friable moist, localized sand pockets, scattered angular gravels, moderate root content. pH 6.2 Terminated by a buried surface:

Continued:

Horizon	Depth	Description
C-2	9 - 21"	Dark brown (10YR 4/3 moist) sandy loam with loam pockets. A few lenses of coarse sand and gravelly sand. Moderate medium blocky structure. Friable, moist, scattered roots. pH 5.8 Abrupt change to:
C-3	21" +	Gravelly sand, angular gravels, dark colored, occasional bits of calcite. Loose, occasional root in the upper part. Alternate lenses and strata having finer texture up to loam. pH 7.2

Land Utilization:

Most of the acreage in the lowland, and a large part of the acreage classified in the Chilliwack River valley, which is included in the upland, are dairy farmed. However, a considerable part of the Isar soils in the upland is still in the native state.

These well to excessively drained soils have low moisture holding capacity. But they are fairly productive when fertilized and irrigated. Under irrigation the Isar soils were given a Land Capability Rating of Class IV. But when dry farmed, in different locations the rating varies from Class IV to Class V, or from marginal to doubtful for farming.

13. MULL REGOSOL SOILS

Characteristic features of the Mull Regosols consist of a non-chernosemic Ah horizon, little or no L-H horizon, and no visible salt accumulations or gley. This sub-group of Regosolic soils developed under forest with moderately good to good drainage. A generalized profile which describes the main features of a cultivated Mull Regosol is as follows:

Horizon	Description
Aha	Dark grayish-brown to very dark grayish-brown horizon, from six to eight inches thick. Weak granular to weak subangular blocky structure.
C	A dark brown to dark grayish-brown horizon. Often divisible into sub-horizons on the basis of different textures or weak mottling.

Representatives in the Chilliwack Municipality of the Mull Regosol soils are the Monroe and Lickman series.

MONROE SERIES

Description:

The Monroe soils are derived from floodplain deposits of the Fraser River. Most of the classified areas occur in northern parts of Chilliwack Municipality.

Although some areas are nearly level, the average topography is gently undulating. The undulations are ridge- and - swale - like, with bars and sloughs and meander scrolls. Elevations are from 30 to 45 feet above sea level. The areas mapped as Monroe soils consist of Monroe series, 623 acres, Monroe Silty Clay Loam 146 acres, and Monroe series (Shallow Phase), 786 acres. In addition, the following complexes were mapped:

Monroe (Deep and Shallow Phase)-Fairfield Soil Complex	3,517 Acres
Monroe (Shallow Phase)-Fairfield Soil Complex	1,944 "
Monroe-Fairfield Soil Complex	2,983 "
Monroe (Deep and Shallow Phase) Soil Complex	490 "
Monroe (Shallow Phase)-Fairfield (Shallow Phase) Soil Complex	213 "
Monroe-Blackburn-Grigg Soil Complex	474 "
Gravell-Monroe (Shallow Phase) Soil Complex	258 "

The parent material was deposited chiefly by lateral accretions from the Fraser River and from numerous meandering channels, which at flood time acted as arms of the river, and at other times as sloughs. The general profile textures are silt loam to very fine sandy loam, with minor variation to silty clay loam. Below 20 inches depth, the strata often have coarser textures than those mentioned above. The soils are moderately well to well drained. There is adequate macro-porosity, moderate permeability and good root penetration.

The Monroe series is a Mull Regosol. The few areas that survive in the native state indicate that this series supported a forest of Douglas fir, cedar, hemlock, cottonwood, maple, alder, and birch, along with a lush understory of shrubs, herbs and grasses. A cultivated soil profile was examined about 400 yards northeast of the Chapman and Castleman road crossing. The description is as follows:

Horizon	Depth	Description
Aha	0 - 8"	Very dark grayish-brown (10YR 3/2 moist) silt loam. Weak medium granular to weak medium subangular blocky structure. Friable, porous, many roots. pH 6.1 Abrupt change to:
C-1	8 - 14"	Dark grayish-brown (10YR 4/2 moist) loam. Weak fine to medium subangular blocky breaking easily to granular structure. Friable, porous, common to many roots. pH 6.3 Abrupt change to:
C-2	14 - 25"	Brown to dark brown (10YR 4/3 moist) very fine sandy loam. Weak medium subangular blocky to massive structure. Friable, few roots, faint incipient mottling. pH 6.6 Gradual boundary to:
C-3	25 - 35"	Brown to dark brown (10YR 4/3 moist) very fine sandy loam. Massive, very friable, no roots, faint incipient mottling. pH 6.6 Gradual boundary to:
C-4	35 - 41"	Brown to dark brown (10YR 4/3 moist) silt loam. Massive, friable, incipient mottling. pH 6.5

Land Utilization:

Most of the area occupied by Monroe soils and their complexes is devoted to hay and pasture, with oats, corn and peas in rotation. Inasmuch as the relief is undulating, these soils are not well suited to crops that must have uniform maturity. Some areas have been levelled, but this practice cannot be recommended unless the profile is sufficiently deep.

Drainage is no problem, except in a few low lying areas near sloughs that may be flooded for brief periods at high water. Chemical analyses indicate a moderate cation exchange capacity at the surface, which becomes moderate to low in the subsoil. At the surface these soils are medium acid, becoming only slightly acid at depths. Such reactions are excellent for micro-biological activity, and for availability of plant nutrients. The percent base saturation is moderately high, indicating a good supply of calcium. Analyses of composite surface samples indicate a low magnesium content in places.

The surface horizon has a moderate content of organic matter, and the carbon-nitrogen ratio is optimum. The levels of available phosphorus and exchangeable potassium vary from low to moderately high, but on the whole, the Monroe soils are deficient in these elements. This suggests that the Monroe soils should respond to fertilizer applications. Based on the physical and chemical characters of the soil, the Monroe series (Deep Phase) was assigned to Class II for dry farming and Class I when irrigated.

A survey of soil management showed that the Monroe soils attain optimum production when irrigated. They require a comparatively short irrigation interval, because moisture holding capacity is not high.

LICKMAN SERIES

Description:

The Lickman soils are derived chiefly from deposits of the Chilliwack and Vedder rivers, which eroded materials from the Cascade Mountains. These materials fanned out in north, northeast and northwest directions from the rivers as they crossed the lowland. Most areas of the series are located around Sardis and Yarrow.

The surface is nearly level to gently undulating. In gently undulating areas the Lickman soils are associated with the McElvee series and Sardis Soil Complex; the Lickman soils are in the better drained locations. Elevations are from 80 feet where the rivers enter the lowland, to about 30 feet northwest of Sardis and 10 to 15 feet on the western fringe of areas mapped as Lickman series. The Lickman series occupies 814 acres. In addition the following groupings were made:

Lickman Shallow and Deep Phase Soil Complex	918 Acres
McElvee-Lickman Soil Complex	367 "
McElvee Deep and Shallow Phase-Lickman Shallow Phase Soil Complex	272 "
McElvee Shallow Phase-Sardis-Lickman Shallow Phase Soil Complex	499 "
Sardis-Lickman Soil Complex	542 "

The parent material accumulated by lateral accretion; by overflowing of the natural levees during flood stages of the rivers. Although the average surface and profile texture is silt loam to loam, an occasional lens of sand or sandy loam may occur. In the southern part of the soil areas, underlying materials at 20 to 50 inches depth may be gravels. In the northern areas the Lickman soils overlie deposits of the Fraser River, which may be found below a depth of 20 inches or more. The moderately well drained soil has adequate macro-porosity, moderate permeability and good root penetration. Restricted drainage in the soil profile is generally confined to depths below 20 inches.

This series is a Mull Regosol. The vegetation on uncleared areas consists of cottonwood, cedar, hemlock, maple, and a lush growth of shrubs, herbs and grasses. A representative cultivated soil profile was examined about 200 yards west-southwest of the Keith-Wilson and Sumas Prairie road crossing. It was described as follows:

Horizon	Depth	Description
Aha	0 - 6"	Dark grayish-brown (10YR 4/2 moist) loam. Weak medium subangular blocky structure. Friable, porous, many roots and a few earthworms. pH 5.7 Clear change to:
C	6 - 16"	Olive brown (2.5Y 4/3 moist) loam. Massive, friable, many visible pores, common to many roots. pH 5.8

Continued:

Horizon	Depth	Description
Cgj	16 - 26"	Olive brown (2.5Y 4/3 moist) loam. Many faint to distinct dark yellowish-brown (10YR 4/4 moist) mottles which increase in number with depth. Massive, friable, many visible pores, common roots. pH 5.8 Gradual change to:
Cg-1	26 - 32"	Olive (5Y 5/3 moist) loam to sandy loam. Many faint to distinct dark yellowish-brown (10YR 4/4 moist) mottles. Massive, friable, porous, common roots. pH 5.8 Abrupt change to:
Cg-2	32 - 42"	Olive (5Y 5/3 moist) sandy loam. Many faint to distinct dark yellowish-brown (10YR 4/4 moist) mottles. Massive, friable, porous, a few roots. pH 5.4

Land Utilization:

In the Sardis and Yarrow localities a large part of the land has been subdivided into small holdings and used for the production of vegetables and small fruits. The larger farms are devoted to dairying. The Lickman soils have no drainage problem.

The soil reaction at the surface varies from strongly to medium acid, and in general, the soils are unsaturated. Thus, a satisfactory response to liming may be expected.

The organic matter content of the surface horizon is moderate, and the carbon-nitrogen ratio is optimum for the availability of nitrogen to the higher plants. The levels of available phosphorus and exchangeable potassium vary from low to medium. Since the cation exchange capacity also is moderately low, the soils should benefit from light but frequent applications of complete fertilizers. Irrigation is required throughout the dry season, owing to low moisture holding capacity of these soils. For dry farming the Lickman soils were assigned to Class II, and they gain a grade to Class I when irrigated.

14. GLEYED MULL REGOSOL SOILS

Imperfect drainage is the governing factor which converts the Orthic to a Gleyed Regosol. Such soils have forest cover. The chief characteristics are the presence of a distinct, non-chernosemic Ah horizon, which is underlaid by mottled subsoil having some gley at depths. A generalized profile of main features in a cultivated example of the Gleyed Mull Regosol is as follows:

Horizon	Description
Aha	Dark grayish-brown to very dark grayish-brown horizon, six to eight inches thick. Weak granular to subangular blocky structure.
Cgj	Dark grayish-brown to grayish-brown horizon or horizons with common, distinct yellowish-brown mottles. Often divisible into sub-horizons on the basis of the intensity of mottling or strata having different textures.

The only representative of the Gleyed Mull Regosol in Chilliwack Municipality is the Fairfield series.

FAIRFIELD SERIES

Description:

These soils were derived from deposits of the Fraser River. Most of the classified areas lie in the northern part of Chilliwack Municipality.

Although some areas are nearly level, the average topography is gently undulating. The undulations are ridge-and-swale-like, including bars, sloughs and meander scrolls. Associated with the Fairfield soils in the gently undulating relief are the Monroe, Grevell and Prest series. The Fairfield soils occupy drainage positions about one degree poorer than the Monroe series. The elevations are from 30 to 45 feet. The area mapped as Fairfield series totals 1,924 acres, and there is a shallow phase amounting to 142 acres. In addition, associated soil groupings are as follows:

Fairfield Deep and Shallow Phase Soil Complex	877 Acres
Fairfield-Prest Soil Complex	459 "
Monroe Deep and Shallow Phase-Fairfield Soil Complex	3,517 "
Monroe Shallow Phase-Fairfield Soil Complex	1,944 "
Monroe-Fairfield Soil Complex	2,983 "
Monroe Shallow Phase-Fairfield Shallow Phase Soil Complex	213 "

The parent materials accumulated by lateral accretions from numerous meandering channels which carried Fraser River freshets. During major flood stages the materials were laid down as cover deposits or vertical accretions. The most common soil textures are silt loam and silty clay loam. Areas mapped as silt loam have minor inclusions of silty clay loam and vice versa. Below a depth of 20 inches, strata are often of coarser texture. Where sandy material is within 18 inches of the surface, the soil was mapped as a shallow phase.

The soils are imperfectly drained, the water being removed so slowly in winter as to wet them for long periods. There are adequate marco-porosity, moderate permeability and good root penetration.

The Fairfield series is a Gleyed Mull Regosol. The vegetation of areas in the native state is composed chiefly of Douglas fir, cedar, hemlock, cottonwood, maple, alder, birch, and a strong undergrowth of shrubs, herbs and grasses. A cultivated soil profile was examined about 200 yards southeast of the Chapman-Castleman road crossing. It was given the following description:

Horizon	Depth	Description
Aha	0 - 7"	Very dark grayish-brown (10YR 3/2 moist) silty clay loam. Moderate medium subangular blocky to crumb structure. Friable, porous, many roots. pH 5.5 Abrupt change to:
Cgj-1	7 - 14"	Dark grayish-brown to grayish-brown (10YR 4/2 - 5/2 moist) silty clay loam. Common distinct yellowish-brown (10YR 5/8 moist) mottles. Massive to weak subangular blocky structure. Friable to firm, common fine roots. pH 5.5 Gradual change to:
Cgj-2	14 - 26"	Brown (10YR 5/3 moist) very fine sandy loam. Many distinct yellowish-brown (10YR 5/8 moist) mottles. Massive structure, friable to firm, occasional root. pH 5.8 Clear change to:
IICgj	26" 66cm	Brown (10YR 5/3 moist) loamy sand in stratified layers of medium to fine sand. Many distinct yellowish-brown (10YR 5/8 moist) mottles. Massive to single-grained structure, very friable. pH 6.0

Land Utilization:

Most of the area occupied by the Fairfield soils and associated complexes is used for hay and pasture, with oats, corn and peas in rotation. The soil management is concerned with an undulating topography, in which moisture relations vary from ridges to hollows. On ridges the crops tend to mature earlier than in the low areas, hence these soils are unsuitable if an evenly maturing crop is desired.

Although the Fairfield soils are imperfectly drained, tile drainage is not warranted. When the Fraser is high, the lands adjacent to Hope Slough and tributary ones are flooded in their lower sections, and drainage of lands but slightly above the flood level is retarded. The extent of such flooding depends on the height attained by the Fraser during a freshet. Since the hazard is not serious, no move has been made to remedy the situation.

The soils potentially are productive. They are medium acid at the surface and grade to slightly acid at depths. Such reactions are excellent for pasture plants, micro-biological activity, nitrogen fixation and availability of phosphorus. The percent base saturation is moderately high, indicating a fair supply of calcium, but the magnesium level may be low in places.

The surface horizon contains a fair amount of organic matter, and the carbon-nitrogen ratio is optimum for nitrogen availability. The levels of available phosphorus and exchangeable potassium range from low to high, probably due to variation of applications on different farms. These soils would respond to a good fertilizer regime. The Fairfield soils respond also to irrigation, although their drought resistance is greater than that of the associated Monroe soils. The Fairfield soils were placed in Class II for dry farming; they attain Class I when irrigated.

15. MUCK SOILS

The Muck soils occupy a large acreage in the south and southeast sections of Chilliwack Municipality. They occur in depressed areas which serve as catchments of seepage water. Under natural conditions the water table is at or near the surface during most of the year. The wet conditions retard decomposition of plant remains, so that accumulation is slightly faster than the rate of decay. In places the organic deposit may be up to three feet or more deep.

The organic material is composed chiefly of the remains of reeds, sedges, wood and moss. The surface consists of well decomposed muck, with less decomposition beneath. The organic deposits overlie strongly gleyed floodplain sediments of fine texture. The reaction of the muck profile is from medium to extremely acid.

These soils were differentiated according to the thickness of the organic deposit. Areas having 12 to 24 inches of organic material over mineral soil were classed Shallow Muck; areas deeper than 24 inches were mapped as Deep Muck. A generalized cultivated profile of the Shallow Muck phase is as follows:

Horizon	Description
Ha	Dark gray to black, six to ten inches thick. Granular to weak subangular blocky structure.
F	Brown to dark brown, six to ten inches thick. Semi-decomposed peat, compact, hard when dry. May be underlaid by semi-decomposed friable peat.
IICg	Gray to olive gray silt loam to silty clay. Strongly gleyed but generally no mottles unless artifically drained. Massive, may have widely spaced cracks when dry.

The Deep Muck phase in the form of a generalized cultivated profile was given the following description:

Horizon	Description
Ha	Dark gray to black, six to ten inches thick. Granular structure.
F	Brown to dark brown, six to ten inches thick. Semi-decomposed peat, hard and compact when dry.
L - F	Reddish-brown to dark brown semi-decomposed peat. Variable thickness, fibrous, recognizeable plant remains.
IICg	Strongly gleyed silt loam to silty clay with no mottling.

In Chilliwack Municipality the representative of the Shallow Muck is the Banford Muck. The Gibson Muck is the example of the Deep Muck phase.

BANFORD MUCK

Description:

In Chilliwack Municipality the deposits of Banford Muck occur on Fraser River floodplain sediments. Most of the classified acreage is located in the south and southeast parts of the map-area.

The average topography is level; minor areas are gently undulating. In undulating areas the Banford Muck is associated with Annis Muck. The Banford and Gibson mucks are intermixed without topographic or other surface evidence to distinguish them, owing to differentiation on the thickness of the organic layer. The elevations are from 35 to 40 feet above sea level. The classified area of Banford Muck is 178 acres. In addition there is a Banford-Annis Soil Complex, 690 acres, and a Banford-Gibson Soil Complex, 577 acres.

Soil development took place under very poor drainage, which favored the accumulation of organic materials derived from swamp forest vegetation. The underlying mineral soil is strongly gleyed. The Banford Muck is classed as Shallow Muck.

The organic material of the cultivated layer has humified to muck, beneath which it changes to semi-decomposed peat. The organic layer has a thickness of from 12 to 24 inches. The underlying mineral soil varies in texture from silt loam to silty clay. A profile was examined east of Banford Road, and described as follows:

Horizon	Depth	Description
Ha	0 - 9"	Reddish-black (10R 2/1 moist) muck. Very friable, many fine roots. pH 4.3 Clear change to:
F	9 - 22"	Dark reddish-brown (5YR 3/3 - 3/4 moist) semi-decomposed peat. Friable, a few roots. pH 4.3
IICg	22" +	Gray (2.5Y 5/0 moist) silty clay loam. A few faint to distinct yellowish-red (5YR 5/6 moist) mottles. Massive structure. pH 4.8

Land Utilization:

See the Land Utilization section under Gibson Muck.

GIBSON MUCK

Description:

The Gibson Muck overlies Fraser River floodplain sediments. Most of the mapped areas are located in the south and southeast of Chilliwack Municipality.

The average topography is level to nearly level. In places this soil type is associated with Banford Muck without visible evidence as to its location, inasmuch as it is a deeper phase of the same type of deposit. The range of elevation is from 35 to 40 feet, and the area mapped was 360 acres, a large part of which has been reclaimed for agriculture.

The Gibson Muck developed under the influence of a water table at or near the surface during most of the year. Such drainage conditions slow up the decomposition of organic matter, so that accumulation can occur. This soil type is classed as Deep Muck, the deposits being up to three feet or more thick. The reaction varies from slightly to strongly acid.

A representative cultivated soil profile, located about one-quarter mile east of the McGuire-Gibson road crossing, was given the following description:

Horizon	Depth	Description
Ha	0 - 10"	Black (5YR 2/1 moist) muck. Weak medium granular structure. Very friable, many fine roots. pH 4.8 Abrupt change to:
F	10 - 20"	Very dusky red (2.5YR 2/2 moist) semi-decomposed organic matter containing a few recognizable stems of plants and bits of wood. Friable, moist, no roots. pH 4.7 Gradual change to:
L	20 - 42"	Dark reddish-brown (2.5YR 2/4 moist) fibrous, woody peat in which most plant remains can be recognized. The material is bound by a mass of dead roots which lie vertically. pH 4.8
IICg	42" +	Gray (2.5Y 5/0 moist) silty clay loam. Massive structure. pH 4.8

Land Utilization:

Organic soils are formed under conditions of poor drainage. Two opposing forces (a) the provision of adequate drainage for optimum crop yields, and (b) the maintenance of a high water table to prolong the life of the soil, operate in the agricultural utilization of these soils. The plan should, therefore, include provision for necessary drainage requirements, and practical means of water level control.

Since providing adequate drainage in organic soils poses problems perculiar to them, expert guidance should be sought before embarking upon a reclamation program. In tile drainage, the quality of tile is an important consideration. Clay tiles, glazed or unglazed, meeting the ASTM standard of extra quality are the best in peat soils; concrete tile would deteriorate under strongly acid conditions.

Wet conditions caused by seepage from the uplands can often be corrected by installing intercepting tile lines. A diversion ditch located at the base of the mineral soil area next to the organic soil should take care of seepage water orginating from the mineral soil.

The height of the ground water level influences crop production and seriously affects the rate of subsidence. Therefore, a normal water level at the height required for optimum crop yields, and which will still allow for the least amount of subsidence compatible with high yields, should be maintained. Maintenance of a static water level in an area is affected by a number of factors -- the amount of available water, type of farming, permeability, crop tolerance, etc. In grassland farming higher water tables are tolerated than by intensive farming enterprises. In permeable soils a higher level could be permitted than in less permeable soils because of difference in time required to remove excess water. In general, a water table of 30 inches is satisfactory for most vegetable crops. Hay and pasture crops, corn, and celery tolerate somewhat higher levels. The ideal situation is a water control system that permits a progressive lowering and maintenance of the water table as the growing season progresses.

During the soil survey, it was observed that little care was taken in controlling the water table level in the Chilliwack map-area; severe subsidence of peat soils was observed. The belief that the organic soils are extremely poor soils, and should be got rid of by burning should be dispelled. These soils are productive if properly managed; for some specialized cropping, e.g. vegetable production, the organic soils are much more productive than the better rated mineral soils.

The organic soils in Chilliwack map-area are in general strongly to very strongly acid Limestone or marl at the rate of two to ten tons per acre is usually recommended depending on the prevailing soil reaction, the crop to be grown, the degree of acidity, and the change in the acidity of the various horizons of the profile.

On an average, one ton of limestone per acre will raise the soil pH about 0.2 units when mixed to a depth of seven inches. Overliming should be avoided because of the reduction in the availability of manganese, boron, and phosphorus.

Though the total nitrogen in organic soils is high, the carbon-nitrogen ratio is generally wide. This indicates low availability of soil nitrogen to higher plants. Therefore, crops would respond to nitrogen applications. Similarly, the total phosphorus, most of which is in organic form, may be high but the forms of phosphorus which plants can utilize is generally low. Crops growing on most organic soils usually respond to phosphate fertilizer, provided an adequate amount of potassium is included in the mixture. Lower yields than those obtained from unfertilized areas may result from an application of phosphorus alone. Potassium is often the most limiting major plant nutrient affecting crops grown on organic soils.

Minor elements deficient in organic soils are manganese, boron, copper, iron, zinc, and molybdenum. Because soil reaction is an important factor in determining both the available and total content of minor elements, it may be used as an indirect measure of determining the minor element status, as discussed in the section on Chemical Analysis.

On Gibson and Banford soils, irrigation may be necessary during some part of the year. One or two inches of irrigation at a time is recommended. Unnecessary application of irrigation water, however, can result in reduced yields. For both irrigation and dry farming the Gibson and Banford Mucks have been rated a Class III to IV soils. Although there are no large areas of peat lands in the Chilliwack area which require complete reclamation, there are some unorganized areas south and east of the map-area which may be considered for development at some future date. For this purpose, a few pertinent points for their reclamation are briefly outlined:

1. Burning of peat or the forest debris should not be practiced.
2. Forested land should be bulldozed and trees allowed to rot for a year before they are cleared. Shrubs and small trees should be plowed in.
3. It is usually not advisable to plow for two or three years after the first breaking in order to give the plants that were turned under a chance to decompose. During this period the water table should be kept low. At this stage lime applications to improve soil reaction may not be economical.
4. On raw decomposed organic soils the use of a heavy roller that weighs from 600 to 700 pounds per linear foot is sometimes desirable to compact

the soil, and thus improve the capillary rise of water.

5. Newly developed fields are generally infested with insects; adequate measures should be taken against such pests.
6. In subsequent years, adequate liming and fertilization will improve the productivity of the organic soil. Rapid subsidence of peat soil is not a desirable characteristic. This can be reduced by keeping the water table as high as feasible for crop production.

MISCELLANEOUS LAND TYPES

DUMP:

To the north of Vedder Crossing about three acres are used as a garbage and refuse dump.

DYKES AND DITCHES:

A total of 151 acres are occupied by dykes and ditches in the Chilliwack Municipality lowland. However, this acreage includes only the ditches adjacent to the dykes.

GRAVEL PITS:

There are many gravel pits scattered in the upland of the map-area, which occupy about 55 acres. This acreage does not include undeveloped areas of gravel in outwash deposits, or in the Sardis Soil Complex.

MARL:

In the eastern part of the map-area, 204 acres of marl were differentiated. A large part of the marl underlies strongly acid, semi-decomposed peat.

NIVEN LAND TYPE:

This land type, which occupies 532 acres, is included as a miscellaneous area because it does not fit into the standard soil classification procedure. The profile is characterized by from six to twelve inches of mineral soil over-lying peat. This land type occurs in scattered spots in the southern and eastern sections of the map-area.

In different places the over-lying mineral soil is derived from the following sources:

Fraser River floodplain deposits.
Chilliwack River deposits.
Alluvial-colluvial fan deposits.
Made-land. Areas artificially filled.

These soils are poorly to very poorly drained, and in different places they could be recognized as Rego-Gleysol, Orthic Gleysol and Dark Gray Gleysolic soils. Most of the acreage is used for dairying, the individual areas mostly are too small to have their own management practices. Exceptions are in the eastern part of Chilliwack Municipality, where, in a few of the larger areas, the management should be similar to that of the muck soils.

PONDS:

Ponds occupy about 34 acres in small depressions of the lowland map-area. The depth of water is too great for the growth of sedges and reeds, except around the pond margins.

ROCK OUTCROPS:

The area of differentiated rock outcroppings amounts to 346 acres, but in the upland many rock outcrops were not separated.

SLOUGHS:

The area occupied by sloughs is 1,734 acres. This indicates the extent of the slough network in the northern part of the map-area lowland. The sloughs serve as arms and tributaries of the Fraser. Since they carry water all year they are a source of water for irrigation.

SWAMPS:

Areas of actual swamps are very small, only three acres being differentiated. The swamps occur in depressions which receive seepage from higher ground, and they may contain water for all or most of the year. They are characterized by swamp vegetation.

Table 2: APPROXIMATE ACREAGES OF DIFFERENT SOILS

Soils	Map Symbol	Acreage
Annis Muck	AN	747
Annis-Grigg-Pelley Soil Complex	AN-GG-PY	213
Arnold Series	AR	899
Arnold-Henderson Soil Complex	AR-H	151
Arnold-Grigg Soil Complex	AR-GG	641
Banford Muck	BD	178
Banford-Annis Soil Complex	BD-AN	690
Banford-Gibson Soil Complex	BD-GN	577
Blackburn Series	BB	920
Calkins Series	CN	803
Chadsey Series	CH	263
Cheam Series	CM	146
Cheam Series, Stony Phase	CM:n	1,134
Cheam-Popkum Soil Complex	CM-PO	241
Columbia Sandy Loam	CL	2,717
Columbia Sandy Loam, Stony Phase	CL:n	356
Cultus Series	C	1,195
Elk Series	EK	675
Fairfield Series	F	1,924
Fairfield-Prest Soil Complex	F-PR	459
*Fairfield-Fairfield S. P. Soil Complex	F-F:sp	877
Fairfield Series, S. P.	F:sp	142
Gibson M[illegible]	GN	360
Grevell Series	G	314
Grevell-Fairfield S.P. Soil Complex	G-F:sp	768
Grevell-Monroe S.P. Soil Complex	G-M:sp	258
Grigg Series	GG	2,030
Grigg Silt Loam	GGsil	453
Grigg-Annis Soil Complex	GG-A	648
Grigg-Grigg S.P. Soil Complex	GG-GG:sp	128
Grigg-Grigg S.P.-Annis Soil Complex	GG-GG:sp-AN	118
Grigg-McElvee-McElvee S.P. Soil Complex	GG-ME-ME:sp	93
Grigg-Pelley Soil Complex	GG-PY	781
Henderson Series	H	203
Henderson-Annis Soil Complex	H-AN	53
Isar Series	IS	1,516
Isar Gravelly Loam	ISgl	427
Lickman Series	LK	811
Lickman S.P.-Lickman Soil Complex	LK:sp-LK	918
Liumchen Sandy Loam	LN	531
Marble Hill Series	MH	464
Marble Hill S.P.-Marble Hill Soil Complex	MH:sp-MH	1,586
Marble Hill Series, S.P.	MH:sp	3,798
Marble Hill-Ryder Soil Complex	MH-RD	1,013
Marble Hill S.P.-Rock Outcrop Soil Complex	MH:sp-R.O.	116
McElvee Series	ME	647
McElvee Series, S.P.	ME:sp	420
McElvee S.P.-McElvee Soil Complex	ME:sp-ME	4,037

Table 2 Continued:

Soils	Map Symbol	Acreage
McElvee-Lickman Soil Complex	ME-LK	367
McElvee-McElvee S.P.-Lickman S.P. Soil Complex	ME-ME:sp-LK:sp	272
McElvee S.P.-Sardis-Lickman S.P. Soil Complex	ME:sp-SD-LK:sp	459
Monroe Series	M	623
Monroe Series, S.P.	M:sp	786
Monroe Silty Clay Loam	Msicl	146
Monroe-Fairfield Soil Complex	MF	2,983
Monroe S.P.-Monroe Soil Complex	M:sp-M	490
Monroe S.P.-Fairfield Soil Complex	M:sp-F	1,944
Monroe-Monroe S.P.-Fairfield Soil Complex	M-M:sp-F	3,517
Monroe S.P.-Fairfield S.P. Soil Complex	M:sp-F:sp	213
Monroe-Blackburn-Grigg Soil Complex	M-BB-GG	474
Pelley Series	PY	474
Pelley-Annis	PY-AN	578
Pelley S.P.-Annis Soil Complex	PY:sp-AN	72
Pelley-Pelley S.P. Soil Complex	PY-PY:sp	213
Popkum Sandy Loam	PO	525
Prest Series	PR	920
Ryder Series	RD	2,338
Ryder-Ryder S.P. Soil Complex	RD-RD:sp	2,895
Ryder Series, S.P.	RD:sp	1,262
Ryder S.P.-Ryder-Rock Outcrop Soil Complex	RD:sp-RD-R.O.	4,448
Ryder S.P.-Rock Outcrop Soil Complex	RD:sp-R.O.	15,195
Sardis Soil Complex	SD	3,861
Sardis-Lickman Soil Complex	SD-LK	542
Sardis-McElvee S.P.-McElvee Soil Complex	SD-ME:sp-ME	1,100
Slesse Series	SL	383
Sumas Series	SM	341
Sweltzer Series	SW	271
Tamihi Sand	T	107
Vedder Series, S.P.	VD	62
Miscellaneous Land Types:		
Dump	-	3
Dykes and Ditches	-	151
Gravel Pits	G.P.	55
Marl	-	204
Niven Land Type	NN	532
Ponds	-	34
Rock Outcrops	R.O.	346
Sloughs	-	1,734
Swamps	-	3
Total Acreage		89,362

*S.P.: Shallow Phase

LAND CAPABILITY CLASSIFICATION

A classification of the soils in the Chilliwack map-area into land capability classes is summarized in Table 3. Soil ratings under dry farming and irrigation follow the Land Capability Classification scheme outlined in Appendix II.

The soil ratings in Table 3 are complete and final for soils such as Columbia Sandy Loam, which has no associates in the form of soil complexes. But in the case of soils such as the Monroe and Fairfield series, which for the most part were mapped as soil complexes, the ratings are based on the physical and chemical characteristics of the soil profile. Such ratings should be modified to take local features (topography, stoniness, depth of solum, etc.) into account. The final rating of a soil complex at any particular location can be estimated according to examples in Appendix II.

Land evaluation in any locality should be undertaken with the help of field sheets which carry complete information. The Soil Map of the Chilliwack Area would not serve the purpose. On the map, soil boundaries were broadened, and it does not carry complete survey information. For special purposes, copies of field sheets for particular locations may be obtained from the Soil Survey Branch, Department of Agriculture, Kelowna, B. C.

Table 3: INDEX RATING OF SOIL PROPERTIES AND LAND CAPABILITY CLASSES FOR DRY FARMING AND IRRIGATION

Soils	For Dry Farming		For Irrigation	
	Index	Class	Index	Class
Upland Soils:				
Calkins Series	29	V	-	-
Columbia Sandy Loam	26	V	34	IV
Columbia S.L., Stony Phase	18	VI	-	-
Cultus Series	10	VI-VII	-	-
Luimchen Sandy Loam	28	V	39	IV
Marble Hill Series	45*	III	60**	II
Ryder Series	49*	III	66**	II
Slesse Series	62	II	62	II
Sweltzer Series	51	III	70	II
Tamihi Sand	16	VI	30	IV
Lowland Soils:				
Annis Muck	47	III	47	III
Arnold Series	59	II	54	III
Banford Muck	40	III-IV	40	III-IV
Blackburn Series	56	II-III	48	III
Chadsey Series	29	V	-	-
Cheam Series	24	V	30	IV
Elk Series	54	III	63	II
Fairfield Series	69	II	76	I
Gibson Muck	40	III-IV	40	III-IV
Grevell Series	24	V	30	IV
Grigg Series	66	II	61	II
Henderson Series	75	I	75	I
Henderson Series, Poorly Drained	51	III	46	III
Isar Series	27	V	37	IV
Lickman Series	58	II	77	I
McElvee Series	53	III	62	II
Monroe Series	58	II	77	II
Pelley Series	45	III	42	III
Popkum Sandy Loam	34	IV	47	III
Prest Series	29	V	-	-
Sardis Soil Complex	22	V	34	IV
#Sumas Series (L.S.-S.L.)	22	V	36	IV
Sumas Sandy Loam	26	V	40	III-IV
Sumas Loamy Sand	18	VI	33	IV
@Vedder Series, S.P.	31	IV	31	IV

* Wide range of soil rating.
** No easily available source of irrigation water.
\# L.S.: Loamy Sand. S.L.: Sandy Loam.
@ S.P.: Shallow Phase.

CHEMICAL ANALYSES

Land use interpretation of individual soils has been based on field and laboratory characterization of the soils.

Soil chemical analyses are presented in Tables 4 to 9 for the majority of soils found in the Chilliwack map-area. The analyses provide information with regard to the classification of these soils, and serve as a general guide to their fertility and management. It is pointed out, however, that the results are not intended as a specific fertilizer recommendation for any soil on individual farms. The remarks made are generalizations, intended to indicate general trends and to serve as a basis for further investigational work. The following brief discussion of various soil properties is given as an aid to the interpretation of the chemical data.

Soil Reaction:

The acidity or alkalinity, i.e. pH, of soil is determined by its content of hydrogen ions and hydroxyl ions. When there are more hydrogen than hydroxyl ions (pH below 7.0) the soil is said to be acid. If there are more hydroxyl ions than hydrogen ions (pH above 7.0), the soil is alkaline. The pH scale goes from 0 to 14. At pH 7.0 there are equal number of hydrogen and hydroxyl ions, and the soil is neutral.

Perhaps no other single test gives more indirect information about the overall soil condition than a pH determination. As an aid to management, soil pH values are important as they give some indication of lime requirement. However, since different soils have different degrees of buffer capacity, pH values are not reliable for the purpose of estimating the frequency or amount of lime required. For example, pH 5.0 may signify a soil extremely low in available calcium whereas pH 7.0 indicates one with a large supply of calcium and magnesium. A sandy soil that has a pH of 7.0, however, may contain only 1,000 lbs. of calcium per acre, whereas a silty clay loam at pH 7.0 may have 10,000 lbs. Thus along with pH, it is highly desirable to know the cation exchange capacity and percent base saturation.

The pH value also gives an indication of the probable availability of certain plant nutrients in the soil because the availability of some elements is closely associated with this value. The more important interrelations between pH and nutrient availability are:

(a) Exchangeable Calcium and Magnesium:

As the exchangeable calcium and magnesium supplies are depleted, the soil acidity gradually increases. Consequently, a pH determination gives some indication of the content of these minerals. Such information is important because these elements not only serve as plant nutrients, but also influence the availability of nitrogen, phosphorus, potassium, and boron.

(b) Solubility of Iron, Aluminum, Manganese, Copper, and Zinc:

In acid soils, appreciable amounts of these constituents become soluble, so much so that in some cases they may become toxic to certain plants. As the soil is neutralized, these ions form inert oxides and hydroxides, and the amounts in solution become less and less. As the pH of the soil is increased above neutrality, the solubility of these ions becomes so low that certain plants may suffer from a deficiency of iron, manganese, copper or zinc.

(c) Availability of Phosphorus:

The availability to plants of soil phosphorus changes with changes of soil acidity. Phosphate availability in many soils is highest when the soil is neutral or slightly acid, and it declines as the soil becomes either strongly acid or alkaline.

(d) Micro-biological Activity:

Bacteria and other micro-organisms living in the soil convert nitrogen, sulphur, and phosphorus from organic compounds in which these nutrients are unavailable to plants, to simpler inorganic forms that plants can utilize. Neutralizing an acid soil usually makes the soil conditions more favorable to the growth of bacteria and may thus indirectly speed up processes by which important nutrients become available to plants. The bacteria that live in association with the roots of legumes are less effective in their role of nitrogen fixation in acid soils than in neutral or alkaline soils.

In any discussion of the relationship between pH and nutrient availability in soils it should be emphasized that these relationships differ in different soils. In peat and muck soils, the relationships between pH and nutrient availability are not the same as in mineral soils. Copper, for example, may be deficient in acid organic soils but is rarely so in acid mineral soils. Again, many alkaline soils have an adequate supply of available boron, whereas over-liming a naturally acid soil usually brings about boron deficiency. The optimum range of soil reaction for most plants lies between pH values of 5.6 and 7.8.

The corresponding terms used for ranges in pH are as follows:

	pH
Extremely acid	Below 4.5
Very strongly acid	4.5 - 5.0
Strongly acid	5.1 - 5.5
Medium acid	5.6 - 6.0
Slightly acid	6.1 - 6.5
Neutral	6.6 - 7.3

Organic Matter:

The content of organic matter in the soil may vary from less than one percent in mineral soils to as high as 100 percent in organic soils. The proper amount of organic matter is one of the most important requirements in soil fertility and management. Most, if not all, of the nitrogen and some of the phosphorus and sulphur is held in organic combination. The organic form of these nutrients must be mineralized before higher plants can utilize them, and this is accomplished by the micro-biological population of the soil.

Another way organic matter functions as a source of plant nutrients is through release of the adsorbed cations of calcium, magnesium, and potassium (discussed in Cation Exchange section). On the basis of unit weight, the rententive capacity of organic matter is greater than that of most clays.

Nutrient elements, such as iron, which form highly insoluble inorganic compounds under natural soil conditions, may not be present in the soil solution in sufficient concentration to permit optimum plant growth. The formation of iron-organic complexes of iron-humates, however, makes the iron more available. Greater solubility of these compounds accounts in part for their effectiveness as nutrient suppliers. The formation of metal-organic complexes sometimes stabilizes a soil nutrient (e.g. boron) that otherwise might not be retained in sufficient quantities for good plant growth.

One of the greatest contributions of organic matter to soil fertility is its effect on soil structure. As organic matter decomposes, organic colloids and acids are formed which have a beneficial influence upon soil structure. Aggregation, and the formation of granular structure is facilitated by the presence of organic colloids in the soils. Aggregation improves and increases the movement of air, gases and water through the soil which is beneficial to the micro-biological population. In short, the presence of adequate amounts of organic matter in the soil improves the structure of both light and heavy soils and increases a favorable carbon dioxide-oxygen tension in the soil which is beneficial to plant root development and growth. Since there is a tendency for organic matter contents in the soil to decrease with cultivation, any good soil management program should include measures necessary to maintain organic matter at an adequate level.

The following levels (average of 0 - 10" depth) are used to characterize the organic matter content of a soil:

Low	0 - 1.5%
Moderate	1.5 - 3.0%
Moderately high	3.0 - 4.5%
High	4.5 +

Soil Phosphorus:

Phosphorus is one of the major elements essential for plant growth. Most of the total phosphorus supply is tied up in a form that is not immediately available to the growing plant. Available soil phosphorus originates from the breakdown of soil minerals, from soil organic matter, or from a previous addition of phosphate fertilizer. Only inorganic phosphatus can be utilized by the growing plants. Soil micro-organisms change the organic phosphorus to the inorganic form; the rate of this conversion increases with an increase in soil reaction up to about pH 8.0.

Phosphorus applied to soil as fertilizer is changed into less soluble forms similar to native compounds. The characteristic feature of soil phosphorus is its low solubility, the solubility being very sensitive to pH (see section on Soil Reaction). The process of changing soluble phosphates into less soluble phosphates in soils is called fixation. The nature of fixation may affect the efficiency of added phosphorus differently in different soils. Hydrated iron and aluminum oxides in acid soils are known to absorb soluble phosphorus to form iron and aluminum phosphate. In slightly acid, neutral, and alkaline soils the available phosphorus is converted into hydroxyapatite and its intermediate forms. Acid soils will fix phosphate to a greater extent than alkaline soils of similar texture. Within a group of acid or alkaline soils, the fixed phosphorus is less available in heavy textured than in light textured soils.

A problem of major concern in soil management involves more efficient use of the native, fixed and applied forms of phosphorus. Of foremost consideration is the control of soil reaction and the time of fertilizer application. Secondly, the addition of organic matter from manure and crop residues increases the availability of both native and fixed phosphorus as the decomposition products make soil phosphorus soluble and prevent its fixation.

If the level of available phosphorus is low, a large application of phosphate fertilizer is needed to bring the available phosphorus level within a suitable range. In high-fixing acid soils, the residual or carry-over effects of phosphorus for a second crop usually are small unless the soil has been fertilized for many years. At the start, therefore, the rate of application may have to be high, with annual applications necessary. As the residual phosphorus gradually accumulates in the soil, the rate and frequency of application may be reduced.

The data on phosphorus levels given in Table 4 are on the basis of adsorbed phosphorus values. The following levels may be used as a general guide:

Very low	5	p.p.m.
Low	5 - 10	"
Moderate	10 - 20	"
Moderately high	20 - 30	"
High	30 +	"

Soil Nitrogen:

Nitrogen is a major element of special importance because plants need it in rather large amounts. It is fairly expensive to supply, and is easily lost from the soil. A major factor in successful farming is the farmer's ability to maintain an adequate nitrogen supply.

The atmosphere is the ultimate source of soil nitrogen. Green plants cannot utilize gaseous nitrogen directly, and it must first be combined with other elements. Such combinations, called nitrogen-fixation, are brought about in several ways. One of the chief methods of this transfer is through the agency of micro-organisms inhabiting the soil. The nitrogen fixing aerobic bacteria known as Azotobacter and the anaerobic bacteria called Clostridia are responsible for fixing large quantities of atmospheric nitrogen. The bacteria, Rhizobia, living in symbiotic relationship with legumes also makes a contribution to the total nitrogen content of soils. Aside from the nitrogen attributable to micro-biological activity some is washed into the soil each year as a result of electrical storms.

All but a small part of the soil nitrogen is present in organic forms. The nature of the organic compounds is inexact because widely varying types of nitrogenous compounds gain entrance to the soil and start decomposing. Most of the soil nitrogen is believed to be in the form of proteins. Other compounds are heterocyclic nitrogen, chitin, lignin, amino acids, and nucliec acids.

Despite the large amounts of nitrogen released in the soil each year, the reserve of available nitrogen is never very great. This in conjunction with the very large amounts removed by leaching and crop production makes it necessary for an adequate fertilizer program to be undertaken. The addition of green cover crops and crop residues enhances the nitrogen content of the soil. In a general way it can be said that 75 to 100 pounds of nitrogen per acre should be available for crop growth. Management practices should be such that a moderate level of available nitrogen is always present in the soil for crop use. Such a condition requires adequate drainage, a satisfactory pH level and a good rotation practice which includes several types of legumes; the use of legumes facilitates the maintenance of a narrow carbon-nitrogen ratio. It must be stated that organic sources of nitrogen will never completely satisfy the crop requirements and thus the proper use of commercial inorganic fertilizers is imperative in any soil management program.

Under conditions favorable for nitrogen availability, the following levels may be used as a general guide:

Very low	.10%
Low	.10% - 25%
Moderate	.25% - 40%
High	.40%

Soil Potassium:

Plants need large amounts of potassium, one of the three major fertilizer elements. Exchangeable potassium is the important reservoir of readily available potassium. It may be derived from potassium-bearing minerals or from fertilizers, other soil additives, or crop residues.

When soluble potassium is applied to soils that contain expandable lattice clay minerals, a substantial part of it may be converted into a form which is not readily available. Drying appears to be necessary for this fixation by montmorillonite but not by illite. Fixed potassium should not be considered as a total loss but as an addition to the total reserve supply, which helps to reduce leaching and luxury consumption of the soluble and the exchangeable forms. Its availability generally is intermediate between that of the exchangeable and natural non-exchangeable forms. In the case of illites, the fixation may be regarded as the restoration of potassium previously lost from the crystal lattice by weathering, leaching and cropping. Ammonium ions and hydrogen ions (actually hydronium ions, H_3O) are of about the same size as potassium ions and therefore interfere and compete with potassium in fixation and release reactions involving the interlayers of expandable lattice minerals. Ammonia added to a soil containing vermiculite, montmorillinite, or degrading illite thus may become fixed and thereby decrease the fixation of subsequently added potassium. The converse would occur where the potassium was applied first.

Apart from its importance in general plant physiology, potassium assists different plants in a number of specialized ways. It increases the resistance of some plants to particular diseases. Potassium improves the rigidity of straw and stalks, so there is less lodging. It helps overcome influences of adverse weather, such as low soil moisture and low temperature, and of poor physical soil conditions, such as compaction and inadequate aeration.

If legumes, such as clover and alfalfa, and grasses are growing together, a shortage of potassium may lead to the reduction or disappearance of the legume without the occurance of any severe deficiency symptoms. Grasses and weeds can thrive at levels of available soil potassium that are inadequate for forage legumes.

The supply of potassium to plants often affects and is affected by the level of other nutrients. In soils containing expandable lattice clay minerals, like montmorillonite, in acid to neutral soil conditions, an increase in exchangeable calcium sometimes causes the release of non-exchangeable potassium, provided of course that the level of total potassium is not too low. But normally within a wide range of saturation of the cation exchange capacity, the calcium has only a minor effect on the uptake of exchangeable potassium. Actually an increase in the exchangeable potassium level may reduce the uptake of calcium or magnesium and cause the luxury consumption of potassium, even though the absolute potassium level is very low relative to the level of the other two cations, as is customary. Such an affect has been observed in alfalfa and clover amongst other crops.

The usual effects of nitrogen and phosphorus, the other two major fertilizer nutrients, are associated with the nutrient balance in the plant. If the supply of nitrogen and phosphorous is high relative to that of potassium, growth may be rapid at first, but the potassium concentration in the plant may become reduced to a deficiency level. Thus, even though the total potassium uptake by the plant may be increased by the high nitrogen and phosphorous levels, addition of potassium to the soil would be necessary to maintain the nutrient balance required for rapid and continued growth. In situations of high available potassium levels and low nitrogen and phosphorous supply, luxury consumption of potassium is to be expected.

The efficient management of soil with respect to potassium must be based on a number of soil management factors. These are the kind of crop, the rotation system, the livestock-management system, the nature of the soil, the liming and fertilizer practices, and the weather.

Satisfying the potassium requirement of a cropping system should be based first on the natural potassium-supplying power of the soil. In this regard, soils range from organic and acid sandy soils (which cannot be depended on for any natural reserve supply) to clay soils that contain large amounts of relatively unweathered potassium minerals, and which do not have to be supplemented by potash fertilizer. Soils having little or no reserve potassium supply and low cation exchange capacity require frequent additions of small or moderate amounts of potassium. Large single applications to such soils may result in higher losses through leaching and unbalanced nutrient relations in the crop through luxury consumption. Leaching losses from the rain can be serious in winter. The continual removal of hay crops severely depletes the soil potassium. Similar is the case with the leguminous crops. Liming acid soils improves various growth conditions and thereby increases the potassium requirements of the legumes, but it also reduces the leaching of potassium.

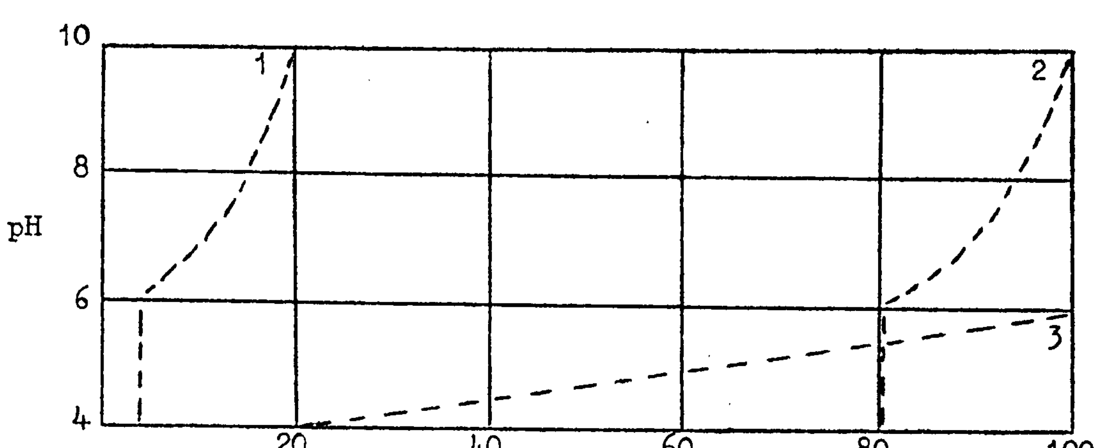
The following levels of exchangeable potassium have been used as an approximate guide to characterize the soils for hay, pasture and legumes:

Very low	Less than 30 p.p.m.*
Low	30 - 60 p.p.m.
Moderate	61 - 90 "
Moderately high	91 - 120 "
High	121 p.p.m. +

<u>Cation Exchange Capacity and Exchangeable Cations:</u>

The mineral and organic particles of soils exhibit cation exchange properties. The particle surfaces are negatively charged, and positively charged cations are adsorbed on the particle surface to counteract their negative charge. The soil is a heterogeneous system of solid, liquid, and gaseous components in various proportions. The solid component of the soil is made up of primary minerals, clay minerals, and hydrous oxides, together with organic matter and living organisms. In this heterogeneous system the soil solution acts as the medium by which the exchange of ions between members of the different phases is made possible, even when the reactants are not in direct contact.

This ability of the soil to hold exchangeable cations is termed the cation exchange capacity, and is expressed as milli-equivalents of cations required to neutralize the negative charge of 100 grams of soil at pH 7. Depending upon the content of organic matter and the type and content of clay minerals present, the cation exchange capacities range from practically nil to over 100 milli-equivalents per 100 grams of soil. In addition, changes are also caused by changes in pH. A pH of 7 is arbitrarily chosen for the purposes of comparison. The cation exchange capacity of organic soils varies considerably more than in mineral soils. As a rough approximation it is about 20 m.e./100 gms. at pH 4, 100 at pH 6 and 150 - 200 at pH 7. Thus an acid peat soil might show a low percent base saturation as determined at pH 7 but in fact the soil might have an optimum balance of nutrients at the pH level which prevails under field conditions. Another obvious conclusion is that it takes much more lime to raise the pH of organic soil because the cation exchange capacity of organic soils is not only large but also increases rapidly with increases in pH. The changes in cation exchange capacities in relation to changes in pH is shown below:



The negative charge, or effective cation exchange capacity, of clays and organic matter varies with pH. Those of kaolinite (curve 1) and montmorillonite (curve 2) are constant below pH 6 but increase at more alkaline reactions. The negative charge of humus (curve 3) increases linearly with pH.

One milli-equivalent of calcium per 100 grams of mineral soil is roughly equivalent to 400 pounds of calcium per acre to plow depth or the amount of calcium in 1,000 pounds of pure limestone.

The cation exchange properties of soils influence plant nutrition. Nutrient cations held as exchangeable bases are in an available state, but not easily leached from soils. Since the cation exchange capacity of a soil depends on the content of organic matter and clay, there is

*Note: The results of exchangeable potassium are presented in milli-equivalents per 100 grams which can be converted into parts per million by multiplying by factor 390.

variation in behavior between soil types, and between soil horizons of the same profile.

Hydrogen, aluminum, calcium, magnesium, potassium, and sodium are the most abundant exchangeable cations. Their proportions vary from soil to soil, depending on inherited characteristics and past management practices. Hydrogen and aluminum are the predominant exchangeable cations in most acid soils. Calcium and magnesium are most common in nearly neutral soils, while strongly alkaline soils contain large proportions of exchangeable sodium in addition to calcium and magnesium. The strength with which the ions are bound on the particle surface depends on the nature of the ions and of the particle charge.

A knowledge of the nature of exchangeable cations and cation exchange capacity is essential for lime and fertilizer recommendations and for soil management. Although the nature of exchangeable cations may vary tremendously within a soil type, its cation exchange capacity and potassium supplying power is generally uniform.

Exchangeable calcium and magnesium are removed by crops and lost by leaching during the wet season. A gradual development of soil acidity is caused by increasing deficiency of these elements. Benefit from liming is greater than mere reduction of acidity, inasmuch as these two elements are also plant nutrients and essential to plant growth.

To bring about changes in soil reaction, soils high in clay and organic matter require more lime than sandy soils having the same pH. In general, where average crops are produced it is suggested that at least 60% base saturation is required for mineral soils, and at least 40% for organic soils. Calcium is more readily available at lower base saturation in peat and muck than in mineral soils.

The availability of any exchangeable cation nutrient to plants depends on several factors, such as aeration, the level of other cations, the nature of the plant, depth of rooting and the ability of soil minerals and organic matter to supply nutrients. Assuming the base saturation levels suggested above, the ideal ratio of calcium to magnesium to potassium should be 13:2:1.

Exchangeable sodium is an important constituent that can profoundly affect the physical properties of a soil. If the exchange complex contains appreciable amounts of sodium, dispersion of soil particles will occur. Such a condition causes the soil to puddle, promotes poor aeration and water availability; puddling is most detrimental in fine textured soils. If the exchange complex becomes more than 10 to 15% saturated with sodium, nutritional disorders are likely to occur.

The following levels of cation exchange capacity are used to characterize the nutrient holding power of soils:

Very low	0 - 5	m.e./100 gms.
Low	5 - 10	"
Moderately low	10 - 15	"
Moderate	15 - 20	"
Moderately high	20 - 25	"
High	25 +	"

METHODS OF ANALYSES

Determination of cation exchange capacity was by a method described by Peach (9). Exchangeable potassium and sodium were obtained by use of a Beckman B flame spectrophotometer. Versenate titration with Erichrome Black T indicator was used to determine exchangeable calcium plus magnesium. Galcon indicator was employed to obtain calcium alone. The percent organic matter of soil samples was obtained by the wet combustion method, also described by Peach (9).

Total nitrogen was determined by the procedure described by Atkinson (2), with the modification that selenium was used as the catalyst, as suggested by Bremner (3). The carbon-nitrogen ratio was obtained by calculating the content of carbon in organic matter (% organic matter/ 1.724). Available phosphorus was estimated by the Bray No. 1 procedure as described by Laverty (7).

The results of the chemical analyses of soil samples from the Chilliwack map-area are presented in Tables 4 to 9 inclusive.

Table 4: ORGANIC MATTER, NITROGEN AND PHOSPHORUS ANALYSES OF SELECTED UPLAND SOIL PROFILES IN THE CHILLIWACK MAP-AREA

Soils						
Horizon	Depth	pH	% O.M.	% Total Nitrogen	C-N* Ratio	P.P.M. Available Phosphorus
TAMIHI SAND - Orthic Podzol						
Ae	0- 2"	3.9	-	0.046	-	-
Bfh-1	2- 8	5.7	1.15	0.021	31.8	99
Bfh-2	8-17	6.0	0.70	0.014	29.0	17
Bf-1	17-24	5.9	0.21	0.013	9.4	9
Bf-2	24-34	6.2	0.08	-	-	19
C	34 +	5.8	-	-	-	51
LIUMCHEN SANDY LOAM - Orthic Concretionary Podzol						
Ae	0- 2"	4.9	1.35	0.086	7.8	24
Bfhcc-1	2- 8	5.6	3.16	0.083	22.0	145
Bfhcc-2	8-15	5.5	3.19	0.077	24.0	79
Cg-1	15-35	5.7	0.25	0.016	9.1	31
Cg-2	35-42	5.4	0.41	0.019	12.5	12
Cc	42 +	5.4	0.30	0.017	10.2	23
SLESSE SERIES - Minimal Concretionary Podzol Soils						
Aecc	0- 1"	6.0	4.21	0.152	16.1	74
Bfhcc-1	1- 6	5.5	2.85	0.109	10.9	71
Bfhcc-2	6-12	5.8	2.69	0.115	13.6	83
C-1	12-24	5.0	0.69	0.061	6.6	9
C-2	24 +	4.7	0.59	0.092	3.7	2
SWELTZER SERIES - Orthic Concretionary Brown Soils						
Bfhcc	0- 7"	5.4	3.92	0.124	18.3	43
Bfc-1	7-20	5.8	2.07	0.106	11.3	23
Bfc-2	20-29	5.9	0.94	0.056	9.8	13
C	29-36	6.1	0.55	0.053	6.0	-
IIC	36 +	5.9	0.63	-	-	-
RYDER SERIES - Orthic Acid Brown Wooded Soils						
Bf-1	0-12"	6.2	1.62	0.112	8.4	118
Bf-2	12-20	5.8	1.77	0.095	10.8	106
B-IIC	20-33	6.0	0.69	0.056	7.2	28
IIC	33 +	5.8	0.30	0.035	4.9	6
MARBLE HILL SERIES - Orthic Acid Brown Wooded Soils						
Bfh	0- 6"	5.8	4.77	0.127	21.8	19
Bf	6-20	5.6	2.42	0.066	21.2	19
B-IIC	20-26	5.6	1.48	0.054	15.9	36
IIC	26 +	5.6	0.41	0.048	5.0	66

* The quantity of carbon was calculated by dividing the organic matter content by 1.724.

Table 4: (Continued)

Soils						P.P.M.
Horizon	Depth	pH	% O.M.	% Total Nitrogen	C-N* Ratio	Available Phosphorus
COLUMBIA SANDY LOAM - Orthic Acid Brown Wooded Soil						
Bfh-1	0- 7"	5.5	4.73	0.194	14.1	42
Bfh-2	7-17	5.8	3.15	0.126	14.5	13
IIC	17 +	5.6	1.77	0.076	13.5	57
CALKINS SERIES - Orthic Dark Gray Gleysolic Soils						
Ah	0- 8"	4.7	16.54	0.718	13.3	260
A-C	8-13	5.1	6.68	0.820	4.7	51
Cg-1	13-22	5.4	4.44	0.161	12.4	57
Cg-2	22 +	5.5	1.78	0.078	13.3	37

The results in Table 4 show that total nitrogen is proportional to the content of organic matter in the different soil horizons. However, in several of the upland soil horizons there is a wide carbon-nitrogen ratio, which is an indication of low nitrogen availability to the higher plants.

In most of the soils the content of available phosphorus in the surface 10 - 15 inches is high, and in some of them the level is high in the deeper horizons. On the whole, there is no correlation between phosphorus availability and soil reaction, but then, none of the soils having high available phosphorus has a pH low enough to limit such availability.

Table 5: ORGANIC MATTER, NITROGEN AND PHOSPHORUS ANALYSES OF SELECTED LOWLAND SOIL PROFILES IN THE CHILLIWACK MAP-AREA

Soils						P.P.M.
Horizon	Depth	pH	% O.M.	% Total Nitrogen	C-N Ratio	Available Phosphorus
CHEAM SERIES - Orthic Acid Brown Wooded Soils						
Bf	0- 7"	5.7	2.35	0.095	14.7	15
B-C	7-19	5.8	1.57	0.078	11.7	18
C-1	19-37	5.9	1.77	0.059	17.4	32
C-2	37 +	5.9	0.84	0.042	11.6	21
POPKUM SANDY LOAM - Orthic Acid Brown Wooded Soil						
Ah	0- 2"	5.4	11.52	0.344	19.8	88
Bf	2-13	5.5	2.54	0.108	13.6	91
Cgj	13-23	5.7	0.76	0.039	11.3	150
C	23 +	5.8	0.28	0.017	9.6	68
HENDERSON SERIES - Orthic Meadow Soils						
Aha	0- 7"	6.2	12.28	0.624	11.4	4
Ah	7-17	6.0	3.51	0.185	11.0	5
Cg	17-30	5.5	1.98	0.069	16.7	6
IICg	30 +	5.8	0.07	0.034	1.2	18

* The quantity of carbon was calculated by dividing the organic matter content by 1.724.

Table 5: (Continued)

Soils: Horizon	Depth	pH	% O.M.	% Total Nitrogen	C-N Ratio	P.P.M. Available Phosphorus
PELLEY SERIES - Orthic Dark Gray Gleysolic Soils						
Aha	0- 8"	5.7	12.68	0.601	12.2	49
Cg-1	8-16	5.9	1.13	0.069	9.5	23
Cg-2	16-19	6.1	0.76	0.065	6.8	16
Cg-3	19-30	6.1	0.70	0.074	5.5	18
Cg-4	30 +	5.9	0.55	0.055	5.8	18
GRIGG SERIES - Orthic Dark Gray Gleysolic Soils						
Aha	0- 7"	5.5	6.24	0.328	11.0	48
Bg	7-12	6.1	1.24	0.079	9.1	16
Cg-1	12-22	6.2	0.80	0.060	7.7	9
Cg-2	22-33	6.1	0.61	0.058	6.1	10
Cg-3	33-43	6.0	0.67	0.055	7.1	9
Cg-4	43-52	6.0	1.74	0.095	10.6	5
BLACKBURN SERIES - Orthic Dark Gray Gleysolic Soils						
Aha	0- 7"	5.4	10.35	0.542	11.1	27
Bg-1	7-18	5.7	2.90	0.052	32.4	10
Bg-2	18-28	5.9	2.34	0.119	11.4	7
Cg	28-41	6.0	1.77	0.098	10.5	3
IICg	41 +	5.7	0.14	0.024	3.4	41
ARNOLD SERIES - Orthic Dark Gray Gleysolic Soils						
Aha	0- 8"	5.8	4.84	0.276	10.1	4
pAh-1	8-13	5.8	8.51	0.362	13.1	8
Cg-1	13-15	5.9	3.15	0.171	10.7	5
pAh-2	15-25	5.9	9.85	0.356	16.0	12
Cg-2	25-42	5.9	2.18	0.099	12.8	4
ELK SERIES - Orthic Dark Gray Gleysolic Soils						
Aha	0- 8"	5.8	7.48	0.338	13.0	78
Ah	8-14	5.6	7.67	0.356	12.5	50
Cg	14-22	5.7	1.88	0.110	9.9	21
IICg	22 +	5.7	1.41	0.077	10.6	24
McELVEE SERIES - Orthic Gleysol Soils						
Aa	0- 6"	5.6	8.18	0.360	13.2	23
Cg-1	6-16	6.3	0.76	0.080	5.5	8
Cg-2	16-25	6.6	0.63	0.116	3.2	9
Cg-3	25-32	6.7	0.78	0.089	5.1	8
IICg	32 +	6.8	0.49	0.044	6.5	7
VEDDER SERIES - Orthic Gleysol Soils						
Aa	0- 9"	5.7	3.75	0.231	9.4	6
Bg	9-23	6.2	1.77	0.068	15.1	6
Cg-1	23-33	6.4	0.63	0.051	7.2	4
Cg-2	33-45	6.5	0.78	0.046	9.8	6
SUMAS SERIES - Orthic Gleysol Soils						
Aa	0- 5"	5.4	1.62	0.094	10.0	17
Cg-1	5- 9	6.4	0.67	0.061	6.4	8
Cg-2	9-18	6.7	0.70	0.058	7.0	10
Cg-3	18 +	6.7	0.61	0.011	32.2	7

Table 5: (Continued)

Soils Horizon	Depth	pH	% O.M.	% Total Nitrogen	C-N Ratio	P.P.M. Available Phosphorus
ANNIS MUCK - Peaty Gleysol Soil						
Ha	9- 0"	5.2	-	2.062	-	16
Cg-1	0- 7	6.3	3.45	0.191	10.5	30
Cg-2	7-36	6.3	0.45	0.044	5.9	20
Cg-3	36 +	7.0	1.50	0.079	11.0	19
GREVELL SERIES - Orthic Regosol Soils						
Aa	0-10"	5.7	1.84	0.120	8.9	5
IIC	10-19	6.1	0.50	0.104	2.9	5
IIIC	19-24	6.1	0.55	0.052	6.2	2
II-IIIC	24 +	6.2	0.33	0.018	10.6	5
SARDIS SOIL COMPLEX - Orthic Regosol Soils						
Aa	0- 6"	5.7	2.60	0.151	10.0	11
C-1	6-25	6.2	0.75	0.037	11.7	10
C-2	25 +	6.2	0.62	0.031	11.6	11
MONROE SERIES - Mull Regosol Soils						
Aha	0- 8"	6.1	4.78	0.245	11.3	23
C-1	8-14	6.3	1.31	0.082	9.3	7
C-2	14-25	6.6	0.76	0.045	9.8	16
C-3	25-35	6.6	0.61	0.046	7.7	16
C-4	35-41	6.5	0.50	0.045	6.5	10
LICKMAN SERIES - Mull Regosol Soils						
Aa	0- 6"	5.7	4.19	0.258	9.4	8
C	6-16	5.8	0.77	0.064	7.0	13
Cgj	16-26	5.8	1.05	0.050	12.2	12
Cg-1	26-32	5.8	0.80	0.045	10.3	10
Cg-2	32-42	5.4	0.56	0.046	7.1	11
FAIRFIELD SERIES - Gleyed Mull Regosol Soils						
Aha	0- 7"	5.5	5.82	0.330	10.2	2
Cgj-1	7-14	5.5	0.61	0 076	4.7	5
Cgj-2	14-26	5.8	0.66	0.053	7.2	7
IICgj	26 +	6.0	0.61	0.044	8.05	7
GIBSON MUCK - Deep Muck Soil						
Ha	0-10"	4.8	81.3	2.583	18.2	20
F	10-20	4.7	91.6	2.482	21.4	14
L	20-42	4.8	98.8	2.800	20.4	8
IICg	42 +	4.8	0.99	0.037	15.5	3
BANFORD MUCK - Shallow Muck Soil						
Ha	0- 9"	4.3	82.90	2.394	20.1	8
F	9-22	4.3	71.50	1.964	21.1	8
IICg	22 +	4.8	0.99	0.037	15.5	3

The lowland soils in Table 5 have total nitrogen in their surface horizons which is proportional to the content of organic matter. The carbon-nitrogen ratios at the surface of the mineral soils averages in the range 10 to 13. This is optimum for nitrogen availability.

Some of the poorly drained soils (Pelley, Grigg, McElvee series) have carbon-nitrogen ratios from four to six, which is almost equivalent to the ratios in proteins. Such close ratios should not be mistaken for high nitrogen availability. These conditions indicate a lack of normal nitrogen fixation and a poor supply for higher plants.

The availability of phosphorus is not limited by the pH of any of the mineral soils in Table 5. In the cultivated areas of the lowland, the levels of available phosphorus vary with the farm management practices. Such variation should not be mistaken for significant differences of inherent soil fertility.

Table 6: CATION EXCHANGE CAPACITY AND EXCHANGEABLE CATIONS OF SELECTED UPLAND SOIL PROFILES IN THE CHILLIWACK MAP-AREA

Soils			Cation Exchange Capacity	Exchangeable Cations m.e./100 gms.					Percent Base Satura-tion
Horizon	Depth	pH	m.e./100 gms.	Ca	Mg	K	Na	Total	
TAMIHI SAND - Orthic Podzol									
Ae	0- 2"	3.9	7.20	1.03	0.82	0.29	0.19	2.33	32.4
Bfh-1	2- 8	5.7	7.70	0.78	0.52	0.39	-	1.69	21.9
Bfh-2	8-17	6.0	4.50	0.48	0.35	0.16	-	0.99	22.0
Bf-1	17-24	5.9	1.65	0.39	0.23	0.35	-	0.97	58.8
Bf-2	24-34	6.2	2.70	0.37	0.18	0.30	0.36	1.21	44.8
C	34 +	5.8	2.44	0.36	0.07	0.29	0.31	1.03	42.2
LIUMCHEN SANDY LOAM - Orthic Concretionary Podzol									
Ae	0- 2"	4.9	11.09	1.79	2.00	0.14	-	3.93	35.4
Bfhcc-1	2- 8	5.6	23.40	0.58	0.88	0.14	-	1.60	6.8
Bfhcc-2	8-15	5.5	21.54	0.41	-	0.11	-	0.52	2.4
Cg-1	15-35	5.7	6.49	0.29	-	0.10	-	0.39	6.0
Cg-2	35-42	5.4	10.06	0.38	-	0.14	-	0.52	5.2
Cc	42 +	5.4	8.81	0.38	-	0.07	-	0.45	5.1
SLESSE SERIES - Minimal Concretionary Podzol Soils									
Aecc	0- 1"	6.0	-	-	-	-	-	-	-
Bfhcc-1	1- 6	5.5	27.30	1.93	0.77	0.59	0.46	3.75	13.7
Bfhcc-2	6-12	5.8	23.52	1.51	0.97	0.43	0.06	2.97	12.2
C-1	12-24	5.0	26.49	9.38	5.10	0.31	0.21	15.00	56.6
C-2	24 +	4.7	29.35	7.50	3.98	-	0.21	11.69	39.8
SWELTZER SERIES - Orthic Concretionary Brown Soils									
Bfhcc	0- 7"	5.4	24.82	1.02	1.19	0.54	-	2.75	11.1
Bfc-1	7-20	5.8	18.97	0.81	0.24	0.38	-	1.43	7.5
Bfc-2	20-29	5.9	10.85	0.79	0.14	0.30	-	1.23	11.3
C	29-36	6.1	8.70	0.70	0.11	0.20	-	1.01	11.6
IIC	36 +	5.9	28.87	13.07	4.48	0.48	-	18.03	62.5
RYDER SERIES - Orthic Acid Brown Wooded Soils									
Bf-1	0-12"	6.2	11.67	1.88	0.93	0.61	0.08	3.50	30.0
Bf-2	12-20	5.8	11.90	0.71	0.51	0.39	0.07	1.68	14.1
B-IIC	20-33	6.0	9.19	2.11	1.08	0.51	0.05	3.75	40.8
IIC	33 +	5.8	8.57	2.50	1.65	0.46	0.06	4.67	54.5
MARBLE HILL SERIES - Orthic Acid Brown Wooded Soils									
Bfh	0- 6"	5.8	16.00	1.53	0.37	0.97	0.07	2.94	18.4
Bf	6-20	5.6	11.69	0.66	0.22	0.32	0.14	1.34	11.4
B-IIC	20-26	5.6	9.32	0.43	0.15	0.08	0.15	0.81	8.7
IIC	26 +	5.6	4.72	0.65	0.42	0.04	0.09	1.20	25.4

Table 6: (Continued)

Soils: Horizon	Depth	pH	Cation Exchange Capacity m.e./100 gms.	Exchangeable Cations m.e./100 gms.: Ca	Mg	K	Na	Total	Percent Base Saturation
COLUMBIA SANDY LOAM - Orthic Acid Brown Wooded Soils									
Bfh-1	0- 7"	5.5	21.08	0.32	0.07	0.09	0.05	0.51	2.4
Bfh-2	7-17	5.8	21.42	0.10	0.07	0.04	0.05	0.26	1.2
IIC	17 +	5.6	13.91	0.27	0.08	0.04	0.05	0.44	4.0
CALKINS SERIES - Orthic Dark Gray Gleysolic Soils									
Ah	0- 8"	4.7	50.14	8.39	2.29	2.92	0.60	14.20	27.7
A-C	8-13	5.1	36.35	1.44	0.53	0.36	0.21	2.54	7.0
Cg-1	13-22	5.4	26.85	1.11	0.51	0.29	0.21	2.12	13.8
Cg-2	22 +	5.5	12.48	1.67	1.38	0.24	0.18	3.47	27.8

The soil analyses in Table 6 indicates that the upper part of the solums of most upland soils are severely leached, inasmuch as the percent of base saturation increases with depth. These soils also are low in exchangeable calcium and magnesium, but high in exchangeable potassium.

Taken as a whole, the upland soils have a much lower base saturation percentage than those of the lowland which have similar pH values. In part, this may be due to the impeded drainage of the lowland soils, and also to their more recent origin.

Table 7: CATION EXCHANGE CAPACITY AND EXCHANGEABLE CATIONS OF SELECTED LOWLAND SOIL PROFILES IN THE CHILLIWACK MAP-AREA

Soils: Horizon	Depth	pH	Cation Exchange Capacity m.e./100 gms.	Exchangeable Cations m.e./100 gms.: Ca	Mg	K	Na	Total	Percent Base Saturation
CHEAM SERIES - Orthic Acid Brown Wooded Soils									
Bf	0- 7"	5.7	13.90	1.50	0.97	0.57	0.09	3.13	22.5
B-C	7-19	5.8	9.57	1.09	0.60	0.55	-	2.24	23.4
C-1	19-37	5.9	8.82	1.50	1.23	0.23	0.10	3.06	34.7
C-2	37 +	5.9	11.72	3.07	0.51	0.50	-	4.08	34.8
POPKUM SANDY LOAM - Orthic Acid Brown Wooded Soil									
Ah	0- 2"	5.4	34.66	8.19	2.75	0.32	0.19	11.45	33.00
Bf	2-13	5.5	20.16	1.04	1.09	0.06	0.15	2.34	11.61
Cgj	13-23	5.7	9.97	0.38	-	0.08	0.12	0.58	5.92
C	23 +	5.8	4.64	0.51	-	0.13	0.15	0.79	17.00
HENDERSON SERIES - Orthic Meadow Soils									
Aha	0- 7"	6.2	40.46	18.88	2.12	0.71	0.25	21.94	54.2
Ah	7-17	6.0	32.63	10.06	4.18	0.15	0.18	14.57	44.7
Cg	17-30	5.5	19.90	5.36	2.68	0.09	0.19	8.32	41.8
IICg	30 +	5.8	11.25	4.94	1.65	0.04	0.16	6.79	60.4
PELLEY SERIES - Orthic Dark Gray Gleysolic Soils									
Aha	0- 8"	5.7	37.72	13.13	1.46	0.33	0.18	15.10	40.03
Cg-1	8-16	5.9	18.80	9.87	3.04	0.18	0.20	13.29	70.69
Cg-2	16-19	6.1	27.95	15.81	8.67	0.18	0.26	24.92	89.16
Cg-3	19-30	6.1	18.40	9.19	5.23	0.18	0.25	14.85	80.71
Cg-4	30 +	5.9	23.45	9.69	5.01	0.18	0.25	15.13	64.52

Table 7: (Continued)

Soils: Horizon	Soils: Depth	pH	Cation Exchange Capacity m.e./100 gms.	Exchangeable Cations m.e./100 gms.: Ca	Mg	K	Na	Total	Percent Base Saturation
GRIGG SERIES - Orthic Dark Gray Gleysolic Soils									
Aha	0- 7"	5.5	33.53	9.12	3.97	0.20	-	13.29	39.6
Bg	7-12	6.1	24.91	9.00	5.21	0.14	-	14.35	57.6
Cg-1	12-22	6.2	26.76	9.56	6.68	0.14	-	16.38	61.2
Cg-2	22-33	6.1	27.84	9.25	7.10	0.23	0.29	16.87	60.6
Cg-3	33-43	6.0	25.93	9.75	7.45	0.25	0.34	17.79	68.6
Cg-4	43-52	6.0	38.83	13.27	7.05	0.18	0.25	20.75	53.4
BLACKBURN SERIES - Orthic Dark Gray Gleysolic Soils									
Aha	0- 7"	5.4	35.28	7.88	1.83	0.24	0.20	10.15	32.6
Bg-1	7-18	5.7	25.33	7.10	2.76	0.06	0.18	10.10	43.8
Bg-2	18-28	5.9	30.59	10.88	5.26	0.10	0.20	16.44	53.8
Cg-1	28-41	6.0	19.87	8.02	2.81	0.08	0.18	11.09	55.8
IICg	41 +	5.7	3.31	1.00	0.67	0.01	0.09	1.77	53-5
ARNOLD SERIES - Orthic Dark Gray Gleysolic Soils									
Aha	0- 8"	5.8	25.72	10.92	4.08	0.15	0.27	15.42	60.0
pAh-1	8-13	5.8	40.94	11.77	4.18	0.11	0.26	16.32	40.0
Cg-1	13-15	5.9	26.11	9.98	3.88	0.11	0.23	14.20	54.5
pAh-2	15-25	5.9	52.22	15.91	7.73	0.20	0.19	24.03	46.0
Cg-2	25-42	5.9	37.94	18.03	4.55	0.14	0.27	22.99	60.5
ELK SERIES - Orthic Dark Gray Gleysolic Soils									
Aha	0- 8"	5.8	30.89	13.50	1.52	0.14	0.18	15.34	49.66
Ah	8-14	5.6	34.91	13.22	0.91	0.14	0.21	14.38	41.91
Cg	14-22	5.7	14.61	6.69	0.60	0.05	0.18	7.52	51.47
IICg	22 +	5.7	18.63	4.63	1.09	0.05	0.16	5.93	31.83
McELVEE SERIES - Orthic Gleysol Soils									
Aa	0- 6"	5.6	25.80	9.17	1.31	0.19	0.22	10.89	42.2
Cg-1	6-16	6.3	15.79	7.85	2.16	0.09	0.21	10.31	65.2
Cg-2	16-25	6.6	15.41	7.13	3.74	0.04	0.33	11.24	73.0
Cg-3	25-32	6.7	18.93	8.58	5.74	0.07	0.38	14.77	78.0
IICg	32 +	6.8	9.05	4.07	2.78	0.04	0.28	7.17	79.4
VEDDER SERIES - Orthic Gleysol Soils									
Aa	0- 9"	5.7	21.16	8.61	1.89	0.18	0.11	10.79	51.0
Bg	9-23	6.2	16.05	8.51	3.69	0.14	0.13	12.47	78.0
Cg-1	23-33	6.4	19.08	7.36	4.48	0.14	0.18	12.16	63.8
Cg-2	33-45	6.5	14.06	6.35	4.17	0.11	0.17	10.80	76.8
SUMAS SERIES - Orthic Gleysol Soils									
Aa	0- 5"	5.4	6.66	2.91	0.05	0.06	0.06	3.08	46.3
Cg-1	5- 9	6.4	5.24	1.93	1.14	0.04	0.08	3.19	60.9
Cg-2	9-18	6.7	5.60	2.25	0.81	0.04	0.10	3.20	57.2
Cg-3	18 +	6.7	3.29	1.07	1.28	0.03	0.06	2.44	74.2
ANNIS MUCK - Peaty Gleysol Soil									
Ha	9- 0"	5.2	84.42	28.70	3.26	0.25	0.16	32.37	38.3
Cg-1	0- 7	6.3	27.96	18.44	3.16	0.15	0.29	22.04	79.2
Cg-2	7-36	6.3	24.16	14.39	6.82	0.15	0.25	21.61	89.5
Cg-3	36 +	7.0	25.44	19.50	5.09	0.16	0.30	25.05	98.5

Table 7: (Continued)

Soils			Cation Exchange Capacity	Exchangeable Cations m.e./100 gms.					Percent Base Satura-
Horizon	Depth	pH	m.e./100 gms.	Ca	Mg	K	Na	Total	tion
GREVELL SERIES - Orthic Regosol Soils									
Aa	0-10"	5.7	15.92	5.34	3.06	0.23	0.13	8.76	55.03
C-1	10-19	6.1	4.40	2.90	2.15	0.20	0.13	5.38	57.23
C-2	19-24	6.1	13.87	6.26	2.15	0.20	0.15	8.76	63.16
C-3	24 +	6.2	9.82	3.34	1.91	0.13	0.10	5.48	55.80
SARDIS SOIL COMPLEX - Orthic Regosol Soils									
Aa	0- 6"	5.7	11.71	5.44	1.34	0.11	0.20	7.09	60.55
C-1	6-25	6.2	8.81	4.75	1.59	0.08	0.18	6.60	74.91
C-2	25 +	6.2	7.63	3.72	1.51	0.08	0.15	5.46	71.56
MONROE SERIES - Mull Regosol Soils									
Aa	0- 8"	6.1	24.02	12.58	2.65	0.39	0.19	15.81	65.8
C-1	8-14	6.3	15.85	8.81	1.29	0.16	0.13	10.39	65.5
C-2	14-25	6.6	11.87	6.44	1.80	0.16	0.11	8.51	71.7
C-3	25-35	6.6	11.22	5.75	1.96	0.25	0.11	8.07	71.9
C-4	35-41	6.5	15.02	8.31	3.22	0.25	0.14	11.92	79.4
LICKMAN SERIES - Mull Regosol Soils									
Aa	0- 6"	5.7	20.74	4.65	3.85	0.09	0.17	8.76	42.2
C	6-16	5.8	9.78	2.88	0.77	0.04	0.18	3.87	39.6
Cgj	16-26	5.8	11.36	4.44	1.08	0.04	0.17	5.73	50.4
Cg-1	26-32	5.8	9.46	3.18	0.90	0.04	0.16	4.28	45.5
Cg-2	32-42	5.4	8.94	2.71	0.86	0.04	0.21	3.82	42.8
FAIRFIELD SERIES - Gleyed Mull Regosol Soils									
Aha	0- 7"	5.5	26.35	7.19	3.86	0.28	0.18	11.51	43.7
Cgj-1	7-14	5.5	18.65	8.85	3.77	0.35	0.18	13.15	70.5
Cgj-2	14-26	5.8	12.12	4.12	3.29	0.20	0.18	7.79	64.2
IICgj	26 +	6.0	6.45	1.91	2.30	-	0.21	4.42	68.5
BANFORD MUCK - Shallow Muck									
Ha	0- 9"	4.3	124.07	30.03	4.35	0.23	0.23	34.84	28.0
F	9-22	4.3	114.17	16.26	3.23	0.07	0.28	19.84	17.4
IICg	22 +	4.8	22.64	7.86	2.95	0.11	0.10	11.02	48.8
GIBSON MUCK - Deep Muck									
Ha	0-10"	4.8	122.23	53.99	5.64	0.31	0.18	60.12	50.0
F	10-20	4.7	131.78	47.68	5.32	0.09	0.27	53.36	40.4
L	20-42	4.8	137.52	53.68	4.06	0.09	0.42	58.25	42.4
IICg	42 +	4.8	22.64	7.86	2.95	0.11	0.10	11.02	48.8

In Table 7 the pH and percent base saturation of the soil profiles increase with depth. Variations in the levels of exchangeable cations from one soil series to another are probably due to differences of management from farm to farm.

The analyses show close correlation between cation exchange capacity and soil texture. When textures are the same in different soils, the cation exchange capacity increases as the organic matter in the soil is increased.

Table 8: ORGANIC MATTER, NITROGEN AND PHOSPHORUS ANALYSES OF COMPOSITE SURFACE SAMPLES OF SELECTED LOWLAND SOILS IN THE CHILLIWACK MAP-AREA

Soils Sample No.	pH	% O.M.	% Total Nitrogen	C-N Ratio	P.P.M. Available Phosphorus
GRIGG SERIES - Orthic Dark Gray Gleysolic Soils					
1	5.7	6.69	0.366	10.6	18
2	5.6	6.41	0.346	10.7	18
3	6.6	6.66	0.330	11.7	153
4	6.5	6.17	0.340	10.5	39
5	5.8	7.24	0.414	10.1	36
ARNOLD SERIES - Orthic Dark Gray Gleysolic Soils					
1	5.3	9.57	0.510	10.8	24
2	5.1	12.62	0.617	11.9	34
3	5.0	10.64	0.588	10.5	31
4	5.6	9.79	0.482	11.8	17
5	5.2	13.77	0.695	11.5	7
McELVEE SERIES - Orthic Gleysol Soils					
1	5.4	6.61	0.417	9.2	25
2	5.0	4.82	0.333	8.5	8
3	5.7	6.81	0.313	11.9	18
4	5.6	6.65	0.270	14.3	7
5	5.9	6.50	0.294	12.8	10
ANNIS MUCK - Peaty Gleysol Soil					
1	5.5	30.04	1.029	16.9	26
2	5.4	27.83	0.817	19.8	6
3	5.7	33.67	1.078	19.2	9
4	5.0	66.03	1.894	20.2	9
5	5.1	71.84	1.949	21.4	9
MONROE SERIES - Mull Regosol Soils					
1	5.5	4.01	0.270	8.6	12
2	5.6	3.66	0.220	9.6	9
3	5.9	4.18	0.234	10.4	18
4	5.9	3.85	0.194	11.5	5
5	5.9	3.61	0.220	9.5	10
LICKMAN SERIES - Mull Regosol Soils					
1	5.4	4.94	0.278	10.3	14
2	5.5	5.28	0.354	8.7	15
3	5.7	7.53	0.263	16.6	19
4	5.3	4.50	0.331	7.9	18
5	5.7	4.19	0.258	9.4	10
FAIRFIELD SERIES - Gleyed Mull Regosol Soils					
1	5.9	4.56	0.273	9.7	5
2	6.0	4.57	0.278	9.5	32
3	5.9	4.77	0.278	9.9	53
4	6.0	4.10	0.255	9.4	3
5	6.4	4.52	0.258	10.2	5

Table 9: CATION EXCHANGE CAPACITY AND EXCHANGEABLE CATIONS OF COMPOSITE SURFACE SAMPLES OF SELECTED LOWLAND SOILS IN CHILLIWACK MAP-AREA

Soils / Sample No.	pH	Cation Exchange Capacity	Exchangeable Cations: Ca	Mg	K	Na	Total	Percent Base saturation
GRIGG SERIES - Orthic Dark Gray Gleysolic Soils								
1	5.7	30.26	12.00	3.50	0.48	0.20	16.18	49.0
2	5.6	31.78	13.90	5.42	0.22	0.27	19.81	62.5
3	6.6	23.96	16.97	1.46	0.12	0.12	18.67	78.0
4	6.5	30.57	18.29	2.43	0.16	0.15	21.03	69.0
5	5.8	31.27	14.49	2.85	0.55	0.25	18.14	58.0
ARNOLD SERIES - Orthic Dark Gray Gleysolic Soils								
1	5.3	31.66	6.18	0.45	0.20	0.16	6.99	22.0
2	5.1	36.90	5.11	1.51	0.38	0.12	7.22	19.5
3	5.0	37.86	8.51	2.76	0.25	0.25	11.77	31.2
4	5.6	37.40	12.22	2.37	0.27	0.23	15.09	40.4
5	5.2	42.26	6.82	1.92	0.23	0.20	9.27	21.8
McELVEE SERIES - Orthic Gleysol Soils								
1	5.4	29.74	6.45	0.78	0.12	0.12	7.47	25.1
2	5.0	27.83	7.40	0.97	0.11	0.19	8.67	31.2
3	5.7	24.07	8.97	8.06	0.11	0.16	17.30	72.0
4	5.6	20.48	10.70	1.75	0.11	0.19	12.75	62.2
5	5.9	19.61	8.39	7.98	0.08	0.12	16.57	84.5
ANNIS MUCK - Peaty Gleysol Soil								
1	5.5	54.62	20.06	1.06	0.16	0.38	21.66	38.5
2	5.4	49.43	14.44	2.11	0.30	0.39	17.24	35.0
3	5.7	68.56	32.87	4.23	0.36	0.37	37.73	55.0
4	5.0	87.86	38.66	2.55	0.23	0.34	41.78	47.6
5	5.1	108.39	14.98	3.51	0.16	0.28	18.93	17.5
MONROE SERIES - Mull Regosol Soils								
1	5.5	22.26	10.48	1.75	0.27	0.15	12.65	57.0
2	5.6	18.18	6.98	2.47	0.13	0.11	9.69	53.4
3	5.9	17.76	9.80	1.75	0.13	0.14	11.82	66.5
4	5.9	16.18	8.56	2.11	0.19	0.09	10.95	68.0
5	5.9	19.54	10.53	1.75	0.21	0.09	12.58	64.5
LICKMAN SERIES - Mull Regosol Soils								
1	5.4	19.26	6.33	1.55	0.18	0.14	8.20	42.6
2	5.5	20.85	4.10	1.49	0.11	0.16	5.86	28.1
3	5.7	22.15	6.33	1.02	0.10	0.13	7.58	34.2
4	5.3	25.88	5.46	1.49	0.12	0.13	7.20	27.8
5	5.7	20.74	4.65	3.85	0.09	0.17	8.76	42.2
FAIRFIELD SERIES - Gleyed Mull Regosol Soils								
1	5.9	20.26	9.68	0.58	0.20	0.13	10.59	52.0
2	6.0	21.03	9.56	1.90	0.21	0.08	11.75	56.0
3	5.9	22.67	12.33	0.87	0.25	0.05	13.50	59.5
4	6.0	20.26	9.87	2.33	0.21	0.11	12.52	61.0
5	6.4	19.74	12.28	2.03	0.25	0.10	14.66	74.5

The analyses of composite soil samples in Tables 8 and 9 consist of surface samples from the major soils in the lowland of the Chilliwack map-area. They show a wide range of pH, levels of exchangeable cations and available phosphorus. To a large extent, this is attributed to a range of farm management procedures. However, the narrow range in the content of organic matter in individual soils is noteworthy, excepting Annis Muck, in which a wide range of organic matter content is to be expected.

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APPENDIX I CLIMATIC TABLES

Table A: AVERAGE MONTHLY MEAN TEMPERATURES

Station	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual	Years
Chilliwack (Sardis)	34	39	41	49	56	60	64	63	60	51	43	39	50	10
Agassiz	34	38	43	49	56	60	64	64	59	51	42	37	50	64
Abbotsford (Airport)	33	38	41	47	54	58	61	62	58	49	42	38	49	11
Abbotsford (Upper Sumas)	37	40	45	50	55	60	64	63	59	52	43	40	51	9
Cultus Lake	32	37	41	48	55	59	63	63	59	50	42	37	49	12

Table E: FROST DATA

Station	Elevation Feet	No. of Years	Average Frost-Free Period Days	Last Frost (Spring) Average	Last Frost (Spring) Earliest	Last Frost (Spring) Latest	First Frost (Fall) Average	First Frost (Fall) Earliest	First Frost (Fall) Latest
Chilliwack	21	32	184	Apr. 20	Mar. 13	May 24	Oct. 21	Sept. 24	Dec. 8
Agassiz	52	49	198	Apr. 14	Feb. 25	May 24	Oct. 29	Sept. 8	Dec.24
Abbotsford (Matsqui)	30	24	178	Apr. 25	Mar. 22	May 31	Oct. 20	Sept. 11	Nov.19

Table F: AVERAGE MONTHLY AND ANNUAL SNOWFALL IN INCHES

Station	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual	Years
Chilliwack (Sardis)	13.8	6.1	3.4	0.3	Tr.	0.0	0.0	0.0	0.0	0.1	3.7	6.4	33.8	56
Agassiz	13.5	9.9	4.0	0.3	0.1	0.0	0.0	0.0	0.0	0.0	3.1	7.6	38.5	66
Abbotsford (Airport)	11.8	5.1	5.0	0.3	0.0	0.0	0.0	0.0	0.0	Tr.	2.1	5.7	30.0	11
Abbotsford (Upper Sumas)	5.9	6.1	2.2	Tr.	0.0	0.0	0.0	0.0	0.0	0.0	2.3	4.8	21.3	25
Cultus Lake	12.4	7.3	1.7	0.1	0.0	0.0	0.0	0.0	0.0	Tr.	2.3	5.2	29.0	24
Sardis (Vedder Crossing)	4.9	16.1	10.9	1.5	0.0	0.0	0.0	0.0	0.0	Tr.	5.2	3.9	42.5	3

APPENDIX I

Table B: PRECIPITATION AT CHILLIWACK (SARDIS) FOR 38 YEARS

Elevation 26'

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
1916	4.85	7.95	11.35	4.35	3.78	1.79	4.43	0.58	1.56	1.76	7.21	6.09	55.70
17	9.10	7.08	5.08	5.51	1.40	5.41	0.80	1.14	2.51	5.35	7.63	19.49	70.50
18	9.61	8.33	7.62	1.17	3.09	0.73	1.99	3.70	0.33	10.18	6.64	12.05	65.44
19	8.63	5.75	6.37	5.45	5.29	1.17	0.40	0.57	2.43	3.64	11.60	10.59	61.89
20	12.99	2.12	7.15	3.21	3.30	4.60	0.64	1.50	10.52	9.88	5.72	8.70	70.33
21	10.05	8.87	4.95	3.94	2.18	5.15	0.57	2.62	8.24	11.38	9.69	8.66	76.30
22	3.81	3.29	4.88	4.55	3.41	1.20	0.03	3.27	5.29	8.68	3.36	13.09	54.86
23	12.02	5.41	5.34	2.06	4.80	1.99	1.25	0.34	4.22	3.67	6.48	12.03	59.61
24	8.36	5.93	4.97	3.60	3.57	2.80	1.54	1.99	4.13	6.44	9.34	8.84	61.56
25	11.70	5.92	5.34	2.44	3.46	0.62	0.69	1.86	0.70	3.21	5.25	8.77	49.96
26	6.60	5.44	1.55	3.54	6.27	0.73	0.25	3.08	3.28	6.69	7.05	9.16	53.64
27	7.45	5.16	7.25	2.84	3.05	0.70	0.71	3.21	5.27	9.10	9.57	5.54	59.85
28	8.39	5.98	4.92	3.55	3.21	2.71	1.42	1.91	4.00	6.52	8.87	8.82	60.30
29	2.66	2.23	4.94	2.74	4.48	2.99	0.56	0.68	1.85	4.11	2.69	7.10	37.03
30	3.82	10.60	4.68	3.86	4.67	2.92	0.09	0.01	4.23	6.80	4.49	4.43	50.60
31	9.88	6.55	8.88	4.31	3.11	4.74	0.56	0.06	7.32	3.61	10.17	7.17	66.34
32	7.49	12.18	9.08	4.39	1.24	3.17	3.54	0.85	2.17	8.76	14.06	7.16	74.09
33	8.43	4.86	6.40	1.36	4.07	1.93	2.15	0.57	9.46	12.41	5.60	16.27	73.55
34	10.46	3.34	8.41	2.81	6.05	0.60	2.39	1.08	2.58	7.41	7.06	8.17	60.36
40	3.90	8.55	7.54	3.99	3.51	0.90	1.81	1.83	2.03	7.81	4.95	7.54	54.36
41	6.44	3.56	2.63	2.44	4.55	2.79	0.68	3.93	9.18	7.73	7.67	8.41	60.01
42	2.32	2.56	5.17	2.93	2.57	4.76	1.72	0.37	1.55	4.10	7.94	10.28	46.29
43	6.04	5.25	7.36	5.18	3.90	2.20	2.86	2.37	2.93	5.82	3.02	6.90	53.83
44	6.72	3.56	3.55	2.43	2.75	1.95	2.10	2.26	4.35	5.38	6.64	3.44	45.13
45	10.02	5.34	9.08	4.78	2.92	1.13	0.66	1.27	5.05	13.80	10.24	7.08	71.37
46	8.47	7.26	7.22	5.54	0.58	4.68	1.40	0.95	1.47	5.12	5.77	9.84	58.30
47	10.61	5.54	4.40	3.96	0.87	3.63	1.66	0.38	2.21	12.48	4.68	13.31	63.73
48	5.79	9.49	3.81	3.05	4.25	1.65	3.11	4.80	3.16	5.31	11.50	7.54	63.46
51	11.43	16.13	5.83	1.21	3.70	1.23	0.10	1.14	3.07	9.15	5.62	7.12	65.73
52	7.22	4.19	6.22	3.63	3.78	3.62	0.99	1.19	1.26	2.49	1.99	7.06	43.64
53	21.67	4.93	5.78	5.15	3.76	4.60	1.52	1.55	7.78	10.04	12.07	15.54	94.39

APPENDIX I

Table B: (Continued)
PRECIPITATION AT CHILLIWACK (SARDIS) FOR 38 YEARS

Elevation 26'

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
1954	16.27	6.16	3.39	6.80	2.47	4.04	1.12	4.29	3.97	5.12	18.00	9.73	83.36
55	6.37	8.53	6.19	6.87	8.59	4.28	3.06	0.28	2.73	12.63	13.64	10.81	83.98
56	8.02	7.78	8.25	1.36	4.54	6.88	0.51	1.97	8.52	13.01	4.78	16.63	82.25
57	5.32	6.81	7.67	2.44	1.59	2.89	3.16	5.58	1.10	3.49	5.87	7.86	53.78
58	12.43	7.96	3.40	6.28	1.32	0.67	0.42	1.93	4.30	10.04	12.44	13.39	74.58
59	12.67	6.42	10.68	11.12	3.85	4.07	2.34	3.05	8.97	8.14	11.04	9.72	92.07
60	8.13	5.76	7.04	5.92	7.99	2.43	Tr.	4.08	2.95	8.54	8.51	7.61	68.96
High	21.67	16.13	11.35	11.12	8.59	6.88	4.43	5.58	10.52	13.80	18.00	19.49	94.39
Low	2.66	2.12	1.55	1.21	0.58	0.62	Tr.	0.01	0.33	1.76	1.99	3.44	37.03

Table C: PRECIPITATION FOR ABBOTSFORD (UPPER SUMAS) 1935-45

Elevation 30'

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
1935	6.30	5.01	5.43	4.75	4.24	3.93	1.57	1.47	4.19	5.08	9.10	8.46	59.53
36	7.17	5.40	4.93	3.94	3.75	2.98	3.26	2.95	4.10	1.46	1.27	8.41	49.52
37	2.65	6.38	3.09	4.90	2.41	7.20	0.33	3.08	1.40	4.45	9.92	7.68	53.49
38	3.53	1.78	2.84	4.41	2.03	0.18	1.15	1.60	1.81	4.45	3.82	9.79	37.39
39	6.64	3.53	2.70	2.63	2.82	3.51	3.35	0.53	0.78	6.03	6.03	7.97	46.42
40	2.75	7.20	6.23	4.06	3.25	0.87	1.85	1.23	1.99	5.77	3.89	5.93	45.02
41	4.35	3.35	2.28	1.92	3.56	2.34	0.54	4.16	6.29	5.48	5.76	6.11	46.14
42	1.64	1.77	3.80	3.04	2.70	6.01	2.05	0.45	1.03	3.31	6.34	7.09	39.23
43	3.67	4.14	4.90	3.99	3.71	2.37	2.34	2.87	2.17	5.43	1.95	4.57	42.11
44	3.65	3.45	2.29	2.33	2.42	1.76	1.03	1.34	2.99	5.41	6.21	2.64	33.52
45	7.37	4.96	6.09	3.84	2.49	0.80	0.66	1.23	4.02	8.95	7.32	5.62	53.35
High	7.37	7.20	6.23	4.90	4.24	7.20	3.35	4.16	6.29	8.95	9.92	9.79	59.53
Low	1.64	1.77	2.28	1.92	2.03	0.18	0.33	0.45	0.78	1.46	1.27	2.64	33.52

APPENDIX I

Table D: PRECIPITATION AT CULTUS LAKE 1932-1957

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug..	Sept.	Oct.	Nov.	Dec.	Year
1932	8.06	10.37	9.22	4.59	1.41	3.50	3.02	0.68	3.65	6.83	12.22	7.81	71.86
33	8.98	4.85	6.24	1.64	5.14	1.90	1.97	0.63	8.41	11.67	5.66	17.69	74.78
34	9.92	2.90	8.79	2.34	7.25	1.63	2.95	0.94	3.02	7.29	7.04	8.11	62.18
35	15.76	3.56	5.21	2.26	0.80	4.34	1.80	0.65	5.19	6.89	3.93	3.80	54.21
36	9.00	6.21	7.59	5.32	5.61	2.15	4.08	3.04	2.85	1.91	1.86	11.43	61.05
37	3.31	7.81	4.52	7.00	3.77	6.73	0.80	3.52	1.24	5.46	13.09	8.90	66.15
38	4.58	1.69	4.87	5.26	1.88	0.52	0.71	0.94	1.71	5.47	6.33	13.01	46.97
39	7.78	5.07	3.57	3.28	3.17	3.83	3.38	0.69	1.37	6.69	7.92	12.40	59.15
40	3.21	8.55	6.80	4.55	3.93	0.99	2.24	1.86	2.44	7.03	4.15	7.54	53.29
41	4.82	3.11	2.82	2.87	4.75	2.40	0.64	3.04	7.39	7.05	7.13	7.68	53.70
42	2.39	1.73	3.78	4.81	2.19	4.77	1.98	0.61	1.08	3.89	8.06	8.67	43.96
43	6.56	5.59	8.23	5.63	4.63	2.19	3.48	2.13	2.34	5.64	2.18	7.16	55.96
44	5.40	3.30	3.76	2.58	3.09	2.39	1.80	1.46	4.04	5.15	7.56	2.71	43.24
45	8.38	4.67	8.20	3.91	2.73	1.28	0.59	1.51	4.29	12.97	7.47	6.83	62.83
46	9.46	7.04	5.74	5.38	0.59	3.69	1.22	1.07	2.12	5.45	4.53	9.56	55.85
47	9.93	5.25	5.07	3.53	3.03	3.70	1.90	0.46	1.91	11.01	4.07	10.76	60.62
48	5.30	9.89	3.94	2.69	3.94	2.04	2.44	4.95	3.58	4.39	9.38	5.68	58.22
49	2.35	9.11	3.26	4.52	1.21	2.43	1.73	1.61	2.64	5.85	9.51	10.14	54.36
50	4.24	9.23	9.52	5.31	3.85	0.76	1.39	3.06	1.82	7.93	9.12	11.69	67.92
51	8.13	14.10	3.90	1.14	3.62	0.98	0.18	1.17	2.37	7.90	6.09	5.88	55.46
52	4.66	3.25	4.61	3.13	1.95	3.06	0.89	1.91	1.02	2.34	1.72	4.82	33.36
53	15.09	4.00	3.95	4.04	2.27	3.51	1.78	2.96	7.08	9.36	8.54	10.19	72.77
54	11.56	6.66	2.48	4.25	1.58	3.19	0.73	4.32	3.16	3.62	15.26	6.60	63.41
55	2.62	5.04	4.46	4.83	6.21	2.41	2.57	0.45	1.55	8.61	12.99	8.61	60.35
56	6.24	4.14	4.48	0.81	0.81	6.09	0.36	2.29	5.91	11.33	3.22	11.13	56.81
57	4.02	5.83	5.16	1.57	1.33	2.86	2.21	2.28	0.76	3.66	3.16	5.96	38.80
High	15.76	14.10	9.52	7.00	7.25	6.73	4.08	4.95	8.41	12.97	15.26	17.69	74.78
Low	2.35	1.69	2.48	0.81	0.80	0.52	0.18	0.45	0.76	1.91	1.72	2.71	33.36

APPENDIX II

LAND CAPABILITY CLASSIFICATION

PROCEDURE

This classification is based on the physical, chemical and land-form characteristics of the soil types. In the Chilliwack map-area eight land capability classes were used. These and their index ratings under irrigation and dry farming, are as follows:

Class	Description	Index Rating
I	Very good to excellent arable land	71 - 100%
II	Good arable land	55 - 70
III	Fair arable land	40 - 54
IV	Fair to poor arable land	30 - 39
V	Doubtful for agriculture, but very good range and/or forest land	20 - 29
VI	Fair to good range and/or forest land	10 - 19
VII	Poor to very poor range and/or forest land	5 - 10
VIII	Very poor range and/or forest land	0 - 5

An index rating of a soil type is obtained by rating physical factors such as texture, drainage, topography, stoniness and erosion and chemical ones including reaction, cation exchange capacity and organic matter. In evaluating for irrigation and dry farming the only variable is texture, all other factors remaining the same. A soil type assigned to Class V or VI (non-arable) for dry farming could be moved to Class III or IV when irrigated, and thus a moderately coarse textured soil would be arable under irrigation. An explanation of significant factors follows:

(1) Texture of the Whole Soil Profile:

Soil texture refers to the relative proportions of sand, silt and clay a soil may have. The texture governs moisture holding capacity, permeability and ease of cultivation. Thus, drought resistance and the need of supplemental irrigation varies with the texture. Medium textured soils, with good moisture holding capacity and permeability and which are easy to work, rate highest for irrigation.

But soils of medium texture are less drought resistant than clays, and for dry farming the more moisture retentive clay soils may be the most productive. Although the clays have the highest moisture holding capacity, they generally have the disadvantages of slow permeability and difficult workability. Clay soils rate comparatively high for dry farming, and lower when irrigated. Ratings for the various soil textures are as follows:

Textural Class	Rating for Dry Farming	Rating for Irrigation
Silt Loam	75 - 85%	95 - 100%
Loam	75 - 85	95 - 100
Silty Clay Loam	95	95
Clay Loam	95	95
Sandy Clay Loam	85	95
Very Fine Sandy Loam	70	95
Silty Clay	100	85
Sandy Clay	90	85
Fine Sandy Loam	65	80 - 85
Sandy Loam	50 - 60	70 - 80
Clay	100	65 - 70
Loamy Very Fine Sand	45	65 - 70
Loamy Fine Sand	40	60 - 65
Heavy Clay	90	50 - 65
Loamy Sand	35	55 - 60
Sand	25	40 - 50
Gravel	20	30

The previous ratings are for nearly uniform textures thoughout the profile. In cases in which subsoil textures change abruptly, the rating will be an average of the surface and subsoil textures. For example, a soil with a loam surface underlain immediately by heavy clay would be given a rating of:

$$\frac{100 + 65}{2} = 82 \text{ (under irrigation)}$$

For soils with a gravelly substratum, the deduction given will depend on the depth to gravel. If the depth to gravel is less than 18 inches, the rating should be:

$$\frac{\text{Texture of the surface soil plus 30}}{2}$$

In the above formula, 30 is the gravel factor. If the depth to gravel is greater than 18 inches, a lesser deduction should be made, depending upon the depth.

A further deduction of up to 20 points is made for those soil structures which restrict permeability and the rooting depth of plants.

(2) Topography:

The importance of topography is self-evident. It affects the operation of farm machinery, it largely determines the drainage pattern, the rate of run-off, and the erodability of the soil. All these factors affect the productivity and costs of operation. For example, in the Lower Fraser Valley growing canning peas constitutes an important cash crop. In order to use mechanical harvesters it is important that the crop matures uniformly, and only level areas with uniform soil and drainage are suitable.

The limits and designations for the topographic ratings are as follows:

Uniform Slope	Irregular Slope	% Slope		% Rating
A_{1-2}	B_{1-2}	0 - 2	Level to smooth very gently sloping or very gently undulating, well drained. All irrigable.	95 - 100
A_3	B_3	2 - 5	(a) Gently sloping to gently undulating with good drainage.	85 - 95
			(b) Short broken slopes generally found on river bottoms and former stream channels.	70 - 90
A_4	B_4	6 - 9	Moderately sloping, undulating to gently rolling.	75 - 85
A_5	B_5	10 - 15	Steeply sloping and rolling.	60 - 75
A_6	B_6	15 - 30	Very steeply sloping and strongly rolling.	30 - 60
A_7	B_7	30 +	Hilly land, eroded land and extremely steeply sloping land. All unsuitable for irrigation regardless of soil features.	30 minus

(3) Stoniness:

Stoniness requires little definition, least of all to the farmer. The presence of stones, while diluting the soil mass and thereby directly affecting productivity, is chiefly an economic factor. They interfere with the use of machinery, they damage machinery and they are costly and time consuming to remove. Consequently, the degree of stoniness is a factor to consider in the utilization of a soil, and is rated as follows:

Symbol	Description	% Rating
S_0	Stones absent or so few in number that there is no interference with cultivation.	100
S_2	Sufficient stones present to interfere with tillage, but not enough to prevent clean cultivation. Slight stone removal necessary.	95 - 99
S_3	Moderately stony soil in which clean cultivation is difficult or impractical. Moderate stone removal necessary.	85 - 95
S_4	Very stony and a severe handicap to cultivation, heavy cleaning required. Includes gravelly terraces with 12 inches or less of fine material over gravel.	30 - 85
S_5	Excessively stony land which is uneconomic to clear and unsuitable for irrigation.	30 minus

(4) Erosion:

Soil erosion as referred to in these ratings is restricted to accelerated erosion resulting from the disturbance of the soil landscape by man's activities in burning, over-grazing, logging and cultivation. Such erosion may be caused by either water or wind action.

The ratings are based on the amount of surface soil removed. However, consideration should be given to the nature of the subsoil and modifications made where necessary. If the subsoil is of good texture, friable and free of alkali salts, the soil may still be fairly productive. If the subsoil is of poor structure and heavy texture, or contains alkali salts, or is gravelly and sandy, the removal of the topsoil is far more serious. The ratings are as follows:

Symbol	Description	% Rating
E_0	Slight or no erosion, most of the original surface horizon is present (up to 25% of Aa removed).	90 - 100
E_1	Moderate erosion of the surface horizon and some damage to soil productivity (up to 50% of Aa removed).	80 - 90
E_2	Severe erosion with a considerable percentage or all of the surface horizon removed, may contain shallow gullies.	65 - 80
E_3	Very severe erosion of the profile; the C horizon is exposed in many places. May contain occasional deep gullies.	50 - 65
E_4	Erosion has removed the solum and exposed unproductive subsoil; badly gullied; not suitable for irrigation.	50 minus

(5) Drainage:

Soil drainage refers to the rapidity and extent of the removal of water by surface run-off and by flow through the soil. It also includes the frequency and duration of periods when the soil is rid of free-water. Poor drainage restricts soil productivity by reducing aeration, reducing the rooting zone and by restricting the range of crops which can be grown. The following ratings are based on the height and duration of a water table:

Symbol	Description	% Rating
D_0	Normal well drained profile.	95 - 100
D_1	Restricted drainage in the lower part of the solum or in the C horizon; no restricted drainage to a depth of 4 feet during most of the growing season. A high water table is present for only a short time in the winter or spring.	85 - 95
D_2	Restricted drainage for some crops with anaerobic conditions at 3 feet. High water table is present several months of the year. Some artificial drainage is required.	70 - 85
D_3	Soils that require drainage under natural conditions; groundwater soils and organic soils. A high water table exists for a major part of the year. Also includes soils which may be flooded or will develope seepage when surrounding land is irrigated. These soils require drainage and may be capable of upward revision when drained if crop response warrants.	50 - 70
D_4	Depressional areas which are uneconomic or unfeasible to drain; natural seepages containing excessive amounts of alkali salts, marl, etc. Unsuitable for development except possibly as rough pasture.	50 minus

(6) Chemical Characteristics:

In assessing the overall productivity of a soil, consideration must be given to the chemical characteristics. There are many chemical characteristics which influence plant growth, but in this rating only the more permanent features which have an important direct and indirect affect on the fertility status of the soil are considered. The constituents considered in this rating are organic matter content, soil reaction and cation exchange capacity. A basic rating is made for these three factors for each soil type by averaging the analytical data derived from profile and composite surface samples.

a. Organic Matter Content

Organic matter affects not only the chemical characteristics of a soil, but also the physical characteristics as well. It has a beneficial effect on the structure and tilth of a soil, and increases the moisture holding capacity. It also increases the cation exchange capacity, and is itself a source of many plant food elements. When rating for organic matter content, consideration is given to the carbon to nitrogen ratio; a small deduction is made for wide ratios.

% O.M. Content; 0 to 10" Depth	% Rating
Low: 0 - 1.5	5 - 10
Moderate: 1.5 - 3.0	10 - 15
Moderately High: 3.0 - 4.5	15 - 20
High: 4.5 +	20 - 25

b. Soil Reaction

Perhaps no other single test gives more indirect information about the overall soil condition than a pH determination. A pH value gives some indication of lime requirements and also indicates the probable availability of certain nutrients as the availability of numerous elements is closely associated with pH. However, pH alone is not an absolute indicator of calcium availability and it is desirable to know the per cent base saturation. When rating for reaction, consideration is therefore given to per cent base saturation and modifications made where necessary.

pH; Average to 20" Depth	% Rating
Extremely acid: pH 4.5 or less	12 minus
Very strongly to strongly acid: pH 4.5 - 5.5	12 - 18
Medium to slightly acid: pH 5.6 - 6.5	19 - 24
Neutral: pH 6.6 - 7.3	25
Mildly to moderately alkaline: pH 7.4 - 8.4	24 - 15
Strongly to very strongly alkaline: pH 8.5 +	15 minus

c. Cation Exchange Capacity

The ability of a soil to hold certain plant nutrients in a readily available state is termed the cation exchange capacity. This characteristic is dependent partly on the type and content of clay minerals present, and partly on the content of organic matter.

C.E.C. in Milliequivalents per 100 gm. soil - Average to 20" Depth	% Rating
Very low to low: 0 - 10	20 - 30
Moderately low to moderate: 10 - 20	30 - 40
Moderately high to high: 20 +	40 - 50

The rating of a., b., and c. above are added together to obtain a total rating for chemical characteristics.

SOIL INDEX RATING

The index rating of a soil is determined by taking the ratings for texture, drainage, topography and others into account, and combining the results as follows:

Example No. 1:

Silt Loam Texture:	(a) Dry Farmed	75%
	(b) Irrigated	100
	Undulating (B_4)	80
	Imperfect Drainage (D_1)	90
	Chemical Factors	72
	No Erosion	100
	No Stoniness	100

The index rating is determined by multiplying the above factors as follows:

(a) Index Rating for Dry Farming:

$$\frac{75}{100} \times \frac{80}{100} \times \frac{90}{100} \times \frac{72}{100} \times \frac{100}{100} \times \frac{100}{100} = \frac{39}{100} \text{ or } 39\%$$

Therefore, in the above case, the soil is included in Class IV for dry farming.

(b) When irrigated the index rating is as follows:

$$\frac{100}{100} \times \frac{80}{100} \times \frac{90}{100} \times \frac{72}{100} \times \frac{100}{100} \times \frac{100}{100} = \frac{52}{100} \text{ or } 52\%$$

Therefore, under irrigation, the soil is rated as in Class III.

Example No. 2:

If the soil described in Example No. 1 was mapped as a shallow phase (map symbol x:sp) because sand occurred within 12 to 14 inches of the surface, the rating of all factors except texture would be the same. The difference caused by silt loam topsoil - subsoil sand would be determined as follows:

(a) Soil texture rating for dry farming:

$\frac{75 + 25}{2}$ = 50% (instead of 75% as in the case of deep phase)

(b) Soil texture rating when irrigated:

$\frac{100 + 50}{2}$ = 75% (instead of 100% as in the case of deep phase)

The numbers 25 and 50 are the ratings of sand for dry farming and irrigation respectively. So a shallow phase as above would be assigned to Class V for dry farming (Index Rating 26) and to Class IV when irrigated (Index Rating 39).

In the above examples the figures are hypothetical. In the lowland of the Chilliwack map-area, lands having B_3 and B_3 topography were mapped as a complex of two or more soil types and/or phases. Information from the field sheets (which may be borrowed by government agencies) should be used to evaluate soil complexes, because some of the factors (topography, stoniness, etc.) vary from place to place. The name of the soil complex is derived from the names of the soil series of which it is composed. Such names are hyphenated (Grigg-Pelly Soil Complex). The name of the series occupying the major acreage comes first, with the others in the same order.

Although the proportions of two soil series occurring in a complex vary from place to place, the proportions in general are 3:2 for a complex of two series and 3:2:1 for three soil series. In land evaluation these ratios may be used without serious loss of accuracy. The exact proportions of different soil series in a mapped area of a complex were not differentiated, because this would have made the soil survey too time consuming and costly. However, should this information be necessary for any purpose, a visit to the site and an estimation of such acreages may be made by the interested person. The method to use to evaluate a soil complex is outlined in following Examples Nos. 3 and 4:

Example No. 3:

Suppose from a field sheet it is noted that the Monroe-Fairfield Soil Complex has undulating topography (B_4) and no stoniness at a particular location. The soil complex can be evaluated by assuming that the Monroe and Fairfield soils are in the 3:2 ratio. For dry farming the index rating of Monroe and Fairfield soils is 58 and 69, based on the profile characteristics. Therefore the rating of the soil complex is:

$$\frac{58 \times 3}{5} + \frac{69 \times 2}{5} = 63\% \quad (5 = \text{the ratio } 3:2 \ (3 + 2)$$

If the rating of topography B_4 is 75% and stoniness S_0 is 100%, the rating of the above complex is:

$$\frac{63}{100} \times \frac{75}{100} \times \frac{100}{100} = 47\% = \text{Class III land.}$$

Certain upland soils (Ryder, Marble Hill series) have variable topography and stoniness. Although such soils are included in Class III for dry farming, the ratings vary from Class III to VIII at different locations. The land rating of the Ryder and Marble Hill series and their complexes could be determined as in Example No. 3, except in the case of areas of rock outcroppings for which the rating is zero. This feature is taken care of in Example No. 4.

Example No. 4:

Suppose that, on a field sheet, particular locations mapped as Ryder Deep and Shallow Phase-Rock Outcrop Soil Complex has B_5/A_5 topography and

S_3 stoniness. For land evaluation it will be assumed that the proportions of the three is 3:2:1. Now, the index rating of Ryder series is 49 for dry farming, and in arriving at this index the average soil texture was 75%. Therefore the texture rating of Ryder Shallow Phase is:

$\frac{75 + 20}{2} = 48$ (approximately) and the index rating of the Ryder Shallow Phase profile is: $\frac{48}{75} \times \frac{49}{100} = 31$.

The index rating of rock outcrop is zero. Thus, the index rating of the Ryder Deep and Shallow Phase-Rock Outcrop Soil Complex is:

$(49 \times \frac{1}{2} + 31 \times 1/3 + 0 \times 1/6) \times \frac{65}{100}$ (rating for topography) $\times \frac{85}{100}$ (rating for stoniness) = 19 - 20. The land is therefore Class V - VI, which is good forest land.

Thus, by using the soil profile descriptions and chemical analyses in this report, and additional information on the field sheets, the classified soils can be evaluated at any location in the map-area.

APPENDIX III

GLOSSARY

Alluvium - Materials moved and redeposited by water. There are two groups of alluvium based on origin: (1) Local alluvium accumulated at the base of slopes by small streams draining small basins of nearly homogeneous rock and soil material, (2) General alluvium along main river courses. Soils derived from alluvium are called alluvial soils.

Anthropic - A general term meaning man-made. It refers to soil altered by man.

Colluvium - Poorly sorted material accumulated at the base of steep slopes, moved by gravity, frost action, creep and wash. Soils derived from colluvium are called colluvial soils.

Concretion - An aggregate formed by precipitation of a mineral. Iron concretions or "shot" occur in some Fraser Valley soils.

Dry-land Farming - Farming without irrigation, particularly in areas where rainfall in the growing season is not adequate for optimum crop production.

Eluvial Horizon - A light colored mineral horizon caused by the leaching and bleaching action of percolating water in the soil profile. Most noticeable in podzolic soils.

Friable - Easily crushed by the fingers; non-plastic.

Glacial Drift - All material transported and deposited by glacial action and by melt-water from glaciers.

Glacial Outwash - All material eroded from glaciers by melt-water which is sorted and deposited beyond the ice-front.

Glacial Till - Unsorted drift deposited directly as glacier ice melts.

Gley - A soil in which the material has been modified by saturation with water in the presence of organic matter for a long period.

Horizon - A layer in the soil profile approximately parallel to the land surface, with more or less well-defined characteristics that have been produced by the operation of soil building processes. The horizon boundaries are described as abrupt if less than an inch wide; clear if 1 to 2½ inches wide; gradual if 2½ to 5 inches wide; and diffuse if more than 5 inches wide.

Horizon Nomenclature - Definition of capital and lower case letters used to describe horizons in this report follows:

L — An organic layer characterized by accumulation of organic matter in which the original structures are definable.

H - An organic layer characterized by accumulation of decomposed organic matter in which the original structures are undefinable.

F - An organic layer characterized by the accumulation of partly decomposed organic matter. The original structures are descernable with difficulty. Fungi mycelia are often present.

A - The surface horizon of a mineral soil having maximum in-situ accumulation of organic matter.

B - A soil horizon, usually beneath an A horizon, in which clay, iron, or aluminum, with necessary organic matter, have accumulated by receiving suspended material from the A horizon, or by clay development in place, or by an in-situ concentration of weathering products. Horizon B has blocky or prismatic structure, or a combination of these features.

C - A soil horizon comparatively unaffected by the pedogenic processes operative in the A and B horizons, excepting the process of gleying and the accumulation of carbonates and soluble salts. Lithologic changes are indicated by Roman Numeral prefixes.

a - A layer disturbed by man's activities such as cultivation or pasturing; used only with reference to horizon A.

c - A cemented (irreversible) pedogenic horizon.

cc - Cemented (irreversible) pedogenic concretions.

e - A horizon characterized by removal of clay, iron, aluminum or organic matter. Eluviated; usually lighter in color than the layer below.

f - A horizon enriched with hydrated iron, with chroma of three or more and redder than horizons above or below.

g - A horizon characterized by reduction and gray colors; gley, often mottled.

h - A dark mineral horizon characterized by the presence of humus. An example is the Chernozemic A, written Ah.

j - A horizon whose characteristics are weakly expressed (juvenile).

p - An old buried surface horizon.

II - Parent material changes in the B and C horizons are indicated by prefix Roman Numerals II, III, etc.

Illuvial Horizon - A horizon of accumulation in the soil profile, particularly of iron and aluminum compounds. Prominent in podzols as a reddish-brown horizon.

Impervious Material - Materials resistant to penetration by water, air and roots.

Lacustrine Deposits - Materials carried by streams and deposited in lakes.

Leaching - Removal of soluble constituents from the soil by percolating water.

Loess - More or less fine textured material moved and deposited by wind.

Mottled - Irregularly marked with spots of different colors. Mottling in soils indicates lack of good drainage and poor aeration.

Muck - Fairly well decomposed organic soil, often containing a relatively high proportion of mineral material.

Organic Soil - Soil composed chiefly of organic matter.

Orthic - A term used in reference to the normal or regional soil profile.

Parent Material - The unconsolidated geological material from which the soil profile develops.

Peat - Undecomposed or slightly decomposed organic matter accumulated under wet conditions.

Plastic - Capable of being molded without rupture; not friable.

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

Soil Groups - Soils with similar characteristics which reflect the influence of environment. They are categories of the soil classification system. Soil groups may be divided into sub-groups as in this report.

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

Strath - The more or less flat bottomland in a river valley.

Stratified - Composed or arranged in strata or layers.

Structure - The morphological aggregates in which the individual soil particles are arranged. The following structures are mentioned in this report:

Prismatic - Large aggregates with vertical axis longer than the horizontal and with fairly well defined edges and surfaces, with tops usually flat.

Blocky - Blocky-like aggregates with vertical and horizontal axis of about the same length, and usually with sharp edges.

Subangular Blocky - Block-like aggregates with vertical and horizontal axis of about the same length, usually with sub-rounded edges.

Granular - More or less rounded aggregates with absence of smooth faces and edges.

Massive - Large cohesive masses, almost amorphous or structureless, with irregular cleavage faces.

Single Grained - Loose, incoherent mass of individual particles, as in sand.

Texture - Soil texture is based on the percentage of sand, silt and clay that a soil may have.

Water Holding Capacity - The amount of water held in a soil after the excess gravity water has drained away.

Water Table - The upper limit of that part of the soil or underlying material wholly saturated with water.