Soil Survey

of the

ASHCROFT-SAVONA AREA THOMPSON RIVER VALLEY BRITISH COLUMBIA

by

P. N. SPROUT AND C. C. KELLEY

Interim Report

Map Reference:
SOIL MAP OF THE ASHCROFT-SAVONA AREA
Scale 2" = 1 mile, 1963

British Columbia Department of Agriculture

KELOWNA, B.C.

March, 1963

S O I L S U R V E Y

of the

A S H C R O F T - S A V O N A A R E A

T H O M P S O N R I V E R V A L L E Y

B R I T I S H C O L U M B I A

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C O N T E N T S

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INTRODUCTION

The survey was undertaken in 1962 at the request of the Comptroller of Water Rights, in connection with a survey of tributary water supplies. The initial task was to determine the arable acreage and kinds of irrigable soils.

The survey was on a scale of 1,320 feet to an inch. The information was compiled on "Soil Map of the Ashcroft-Savona Area", scale two inches to a mile. Hand tinted copies of this map are available to government agencies only. Uncolored copies of the map may be obtained by others at nominal cost. At a later date the map-area will be incorporated into a general soil survey of the Thompson River Valley, which is in progress.

In October, 1962, a meeting of the Department of Agriculture Reclamation Committee was held to assign water requirements to the irrigable soil types. A report was distributed in November, called "Proceedings of the Reclamation Committee in the Ashcroft-Savona Area, Thompson River Valley, Brief 41, Department of Agriculture, Kelowna, B. C."

DESCRIPTION OF THE AREA

Physiography and Extent:

The map-area is situated within the physiographic province of the Interior Plateaux. The region is characterized by flat-topped to rolling uplands separated from one another by deeply entrenched valleys.

The classified area is confined chiefly to the valleys. It includes a section of the Thompson Valley between Kamloops Lake and Basque, a distance of 28 miles. Northward extensions consist of the valleys of the Bonaparte River, 20 miles, and Deadman River, 8 miles. Also included is the Semlin Valley, 8 miles long, situated between Cache Creek and McAbee.

In the map-area the Thompson Valley has an average width of from one to two miles, the greatest width being about five miles in the vicinity of Ashcroft. It is partly filled by glacio-fluvial and lacustrine deposits, which have been deeply incised and eroded to form terraces. Above the river, the terraces begin at about 30 feet, and rise to about 1,000 feet. The steep valley slopes are cut by many small gullies and a few coulees which are generally dry. Their outwash consists of fans, which are spread on top of many of the terraces.

The Deadman and Bonaparte valleys vary from a ¼-mile to a mile wide. The fill has not been incised to any marked degree, except near confluence with the Thompson River. The less prominent terraces seldom rise more than 50 feet above river level. Alluvial bottoms are the major deposits, and these are of importance for agriculture.

At the northern end of the mapped area, the Bonaparte River is at about 1,850 feet elevation, and Deadman River is at 1,750 feet elevation. At the exit from Kamloops Lake the Thompson River has an elevation of about 1,110 feet, and at Basque, about 850 feet.

Transportation and Communications:

The mapped area is well serviced with roads and railways. Trans-Canada Highway No. 1 follows the Thompson Valley, and Cariboo Highway No. 97 runs through Bonaparte Valley from a junction with No. 1 at Cache Creek. Both roads, which are paved, afford connection with Vancouver and the interior of British Columbia. The Deadman River valley is served by a gravelled secondary road.

The main lines of the C.N.R. and C.P.R. follow the Thompson River from Kamloops Lake to Ashcroft and westward. The area is also supplied with hydro-electric power by the B. C. Power Commission, and telephone and telegraph facilities are adequate.

HISTORY AND DEVELOPMENT

In the spring of 1808, Simon Fraser, John Stuart, and J. M. Quesnel with 19 men and two Indians, started in four canoes from Fort George. The purpose was to explore unknown waters to the south, then regarded as a main tributary of the Columbia River.

In June, 1808, they reached a large, rapid river flowing from the east. This was named Thompson River after David Thompson, astronomer to the Northwest Company, who shortly afterward founded Fort Kamloops.

In later years the Thompson River became known through a series of gold rushes. The first discovery of gold in British Columbia is said to have been made by an Indian at the junction of the Nicoamen and Thompson rivers. This locality became noted for its coarse gold, which was soon exhausted. (7)

In 1871 Cache Creek consisted of an inn and store combined, a blacksmith shop and some Indian huts. (16) From Cache Creek the road extended through the Semlin Valley, then not named. This valley was described by G. M. Dawson in 1877 as having been, at one time, the course of a river, but whether the Thompson had flowed through it to the Bonaparte, or the latter to join the Thompson, he could not determine. He reported that several good farms, with an abundant water supply for irrigation, were situated in this valley. (5)

In the Thompson Valley from the mouth of Semlin Valley to Savona's Ferry in 1877, trees were scarce and represented only by yellow pine, which grew in scattered clumps. Bunchgrass and sage were the characteristic plants, but as in many other localities, the bunchgrass was already almost entirely destroyed in the lower parts of the valley by overgrazing.

In 1877 the road from Cache Creek to Clinton followed the right bank of the Bonaparte River for several miles, then continued in a valley called Glen Hart, in which there were several small lakes.

The first sod was turned on the C.P.R. early in 1880 and the road was open for traffic in 1885. The Canadian Northern Pacific started construction in 1911 and was completed in 1914.

Apparently Ashcroft dates from the construction of the C.P.R. It was named after the House of Cornwallis in England. This was in honor of Clement Francis Cornwall Esq., Lieutenant Governor of British Columbia in 1881.

The Penny Ranch and Savona's Ferry were well known when the C.P.R. was built. The Penny Ranch, which had an orchard, was situated about two miles from Walhachin. Walhachin is an Indian name, meaning a spreading, bountiful valley. C. E. Barnes, a land surveyor, believed that the surrounding area could be irrigated for tree fruits.

Around 1910 "Barnes' Estates" was financed in the United Kingdom. Water was obtained at Snohoosh Dam, about 18 miles upstream from the mouth on Deadman River, and a distribution system was built to irrigate some 3,000 acres on the north side of the Thompson. A limited acreage on the south side of the river depended upon water rights on tributary creeks held by the Penny Ranch. When this source proved to be inadequate, a supply pipe was strung on cables across the river.

The land was subdivided into 8 to 15 acre units, and sold chiefly to young men from the United Kingdom. A town was built at Walhachin, which included a hotel, stores and a domestic water system. The population included about 300 Chinese, who had their Chinatown. By 1913 the place was booming and some of the orchards were beginning to bear.

In 1914 the war depleted the population of all unmarried men. Those remaining undertook to look after the land left by the volunteers, along with their own land. During the war one of the big investors, a man named Anglesey, dominated the project. After the war he developed his own townsite on the C.N.R. about three miles west of Walhachin, which was called Anglesey.

When the war was over, some of the survivors returned but the irrigation system had deteriorated, and they were unable to cope with it. The Anglesey interests cut losses by pulling out, and the remaining acreage in the hands of other settlers also was abandoned. (9)

CLIMATE

The main air movement aloft is from west to east, the amount of precipitation being dependent on evaporation and exposure. The lower areas are drier than the comparatively nearby highlands. In winter, west to east moving low pressure systems are common. They bring cloud over the valleys but very little precipitation. Several times each winter this regime is interrupted by invasions of artic air. At the change there are strong winds which clear away the clouds.

In the map-area the Thompson Valley is subject to more extreme low temperatures than other southern valleys. This is due in part to less continuous air movement and longer periods of calm. The calm periods permit the cold air to lay stagnant, thus increasing the depth of low extremes in winter, and also promoting May and September frosts.

In summer the low pressure systems from the west are separated by extended periods of high pressure which originate over the Pacific Ocean. These highs last for different lengths of time and bring sunny, hot and dry weather. The high pressure periods in summer are often featured by thunder storms.

Temperature:

The only temperature station in the map-area, with data suitable for use, is situated at the Range Radio Station, about three miles west of Ashcroft. Seasonal temperatures from this station are compared with other significant localities in Table 1.

Table 1: Average Seasonal Temperatures (Deg. F., Elevations in Feet)

Station	Elevation	Winter	Spring	Summer	Autumn	Year	Years of Record
Range Radio	1,600	23	46	65	45	45	16
Kamloops	1,133	26	49	67	47	47	30
Kelowna	1,160	29	47	65	47	47	30
Penticton	1,121	30	48	66	48	48	30
Oliver	1,008	29	50	68	49	49	30

At the Range Radio Station the winter, spring, autumn, and annual temperatures are lower than the other stations cited. The summer temperature compares with Kelowna.

In Canada, heat loving, frost tender annual crops are often profitable because there are few areas in which they can be grown. The requirements call for a comparatively long frost-free season, with enough heat to ripen the crops. It would appear that summer heat is adequate for such crops in the map-area, but more information should be obtained about frost conditions.

The winter climate governs the production of perennial crops which have limited ability to withstand low temperatures. The extremes for 16 years are shown in appended Table A. A cold extreme of -35° occurred once in the record, and there were lows of -20° or more in nine separate years. In view of the frequency of low extremes at the Range Radio Station, which may cast unwarranted doubt on the ability of other sections of the map-area to produce tree fruits and grapes, temperature records should be started at several selected locations.

Precipitation:

Most of the precipitation is supplied by low pressure systems moving from west to east. In winter the incoming lows discharge the bulk of their moisture on the western slopes of the Coast and Cascade mountains, but cloud continues eastward. Although most of the winter is cloudy, snowfall is light at the low elevations. Information about snowfall is available from two meterological stations. This is presented in Table 2.

Table 2: Average Monthly Snowfall in the Ashcroft Locality (Inches)

Station	Jan.	Feb.	March	April - Oct.	Nov.	Dec.	Year	Years of Record
Ashcroft	7.0	3.2	1.2	0.1 - 0.2	2.1	5.0	18.8	40
Range Radio	11.0	5.8	1.7	1.2 - Trace	4.8	7.7	32.2	11

Since the above figures are averages, it is obvious that in some winters there will be no snow cover, and in most the ground would be bare for variable periods. Without snow cover the ground may freeze to depths of several feet when the soil is moist. In the production of perennial crops, it would be necessary to irrigate so that soil moisture conditions in the fall are such as to keep frost damage to a minimum.

The precipitation data are confined to the Ashcroft and Range Radio stations. These indicate that with the help of the snowmelt, precipitation is probably enough to wet the soil in the spring of each year to a depth of about one foot, with occasional wettings deeper. Thereafter, dampening of the soil by rainfalls is from a fraction to an inch or two. The conclusion to be drawn from this information is that snowfall and rain are of little value as a source of moisture for agriculture, as shown in appended Tables B and C.

ORIGIN OF SOIL FORMING DEPOSITS

During deglaciation a large part of the Thompson Valley was occupied by a glacial lake which drained eastward. Named Lake Thompson, this lake had successive shorelines at about 1,800, 1,600 and 1,400 feet elevation (10). The valley between Savona and Ashcroft was a part of the lake.

At the 1,800 foot stage a large delta was built at the mouth of Deadman River. Composed chiefly of sands and gravels, this deposit has a thickness of at least 600 feet. It seems probable that the materials of which the data is composed were not derived from the Deadman River valley, but were conveyed over ice from distant sources to the northwest. At maximum the delta may have been built across the valley at the 1,800 foot level. At the stages of the 1,600 and 1,400 foot shorelines the 1,800 foot delta was in part reworked and spread over a larger area.

Two other deltas were built at the 1,600 foot lake level by Brassy Creek and by the Bonaparte River, both composed of sandy and gravelly materials. In between the three deltas the valley bottom was lined with silt, probably by all three streams, but chiefly by the Bonaparte, inasmuch as drainage was eastward.

It appears likely that the stream loads throughout the periods of major deposition were in part sands and gravels and partly silts. During the lake stages the sands and gravels accumulated in deltas, whereas the silts spread throughout the quiet waters of the lake. The valley was not completely filled with sands, gravels and silts during the stages of laking.

Glacial Lake Thompson probably lowered its shoreline considerably below the 1,400 foot level before drainage opened westward to the Fraser River. During this period, the Thompson River carved a channel through the whole area, partly reducing the deltas and terracing the lacustrine silts. The eroded sands and gravels from the deltas were spread as a thin veneer over the terraced lacustrine silts.

After the lake had drained, but before vegetation formed a protective cover, violent storms caused substantial erosion of the watersheds of the temporary and permanent streams. The products were a series of fan formations along the toe of the valley slopes. The fans, some of which are of considerable size, overlaid parts of the sandy and gravelly terraces, thus improving the land for agriculture.

Above the 1,600 foot level, the soil forming deposits consist mostly of glacial till, but localized thin remnants of glacio-lacustrine silts may overlie till at elevations up to 1,800 feet. Glacio-fluvial gravels, mostly in the form of kame terraces, in places flank the valley. The soils derived from glacial till were named Cheetsum and Basque series. Epsom soils are derived from remnants of glacio-lacustrine silt deposits. The gravelly kame terraces and also the lower lying gravelly outwash, form the parent material of the Anglesey and Walhachin series. A small acreage of sandy outwash, associated with the gravelly outwash terraces, composes the parent material from which the Nepa soils developed.

Between Cornwall and Minaberriet creeks, sediments accumulated in ponds along the inner margins of some of the outwash terraces. These deposits are stratified and of silty texture, and the soils derived from them were called the McAbee series.

The bottom lands of the Thompson, Deadman and Bonaparte rivers, some of which are low terraces, have a wide variation of texture and drainage. They form the parent material of the Thompson, Tsotin, Chrome, and Carquille series.

Fan formations occupy a large acreage in the mapped area. Fans cover terraces, glacial till and to some extent, the glacio-lacustrine silts. They vary greatly in texture and drainage, and they form the parent materials of nine soil series. These are the Barnes, Taweel, Bonaparte, Cache Creek, Semlin, Clemes, Venables, Tremont, and Minaberriet series.

The map-area, which supports scanty vegetation, is subject to fairly strong winds. As a result of wind erosion, there are eolian deposits in the form of sand dunes, and shallow deposits of sand on their lee side. Soils derived from the sandy eolian deposits consist of the Savona, Joeross and Lopez series.

There is also a thin mantle of loess over most of the map-area. Although generally less than six inches thick, it occasionally attains 14 inches. The loess is not deep enough to warrant differentiation, but in some places it has agricultural significance, particularly where it forms a stone-free horizon over an otherwise stony soil.

SOIL CLASSIFICATION

Soils develop on soil-forming deposits in relation to their environment. Within the map-area the influential environmental factors are the dry climate, natural grass vegetation and calcareous parent materials. The resulting soils contain variable amounts of organic matter in their surface horizons, and are only slightly leached. In the well drained soils the moderate accumulation of organic matter imparts a brownish color to the surface horizon, and on the basis of this color, most of the classified soils were assigned to the Brown Soil Group.

Also within the area are recently deposited materials and soils subject to a fluctuating or high water table. The recently deposited soil forming materials show little or no profile development, and therefore are classed as Regosols. Soils having sufficient age to show pronounced gleying and an accumulation of organic matter on the surface or in the upper mineral horizon were classified as Meadow and Gleysol soils. Short outlines of the profile features which characterize each of the subgroups of Brown, Regosol and other soils found in the map-area are presented in the section headed Description of Soils.

The basic mapping unit of soil classification is the soil series. Each series is distinct from all others. It comprises a group of closely related soils in one drainage position, derived from the same parent material. The profile characteristics are similar, but variation of surface texture is allowed. Soil series are given geographic or place names of the localities in which they were first identified.

Soil series are divided into soil types according to the texture of the surface or cultivated layer. Textural class names such as sandy loam, loam or silt loam are added to the series name to identify the texture type, Walhachin Sandy Loam being an example. In cases of variable landscape where it is not feasible to separate the soils into series and types, the soil complex is used as the mapping unit. The complex contains two or more soil types or series, each of which are identified and described in the report.

Table 3 outlines the relationship of the soil forming deposits to the subgroups and soil series in the Ashcroft-Savona map-area.

DESCRIPTION OF SOILS

1. ORTHIC REGOSOLIC SOILS:

This subgroup includes mineral soils with little or no profile development. They either lack observable horizons or have very weakly developed Ah horizons. Under forest cover a thin L-H horizon less than six inches thick may be present.

In the mapped area these soils occur on recently deposited material along the courses of the Thompson, Bonaparte and Deadman rivers. Such areas flood most years; drainage is variable and dependent upon river levels. The tree cover varies from occasional ponderosa pine to moderately heavy deciduous growth. The Thompson series was the only soil unit classified as an Orthic Regosol.

Table 3: Classification of Soils in the Ashcroft - Savona Area

Parent Material	Soil Subgroups				
	Orthic Regosols	Mull Regosols	Gleyed Mull Regosols	Rego-Brown	Saline Rego-Brown
Medium to Moderately Fine Textured Glacial Till Deposits				Cheetsum	
Medium Textured Lacustrine Deposits					Epsom
Gravelly River and Stream Deposits	Thompson	Tsotin		Anglesey	
Sandy River and Stream Deposits		Chrome	Carquille		
Coarse Textured Eolian Deposits		Savona		Joeross	
Coarse to Moderately Coarse Textured Shallow (14 to 24") Eolian Deposits overlying River Gravels or Fan Deposits				Lopez	
Coarse to Moderately Fine Textured Alluvial-Colluvial Deposits		Barnes		Taweel Bonaparte	Cache Creek

Table 3: (continued)

Parent Material	Soil Subgroups			
	Orthic Brown	Calcareous Meadow	Saline Meadow	Saline Gleysol
Medium to Moderately Fine Textured Glacial Till Deposits	Basque			
Medium Textured Lacustrine Deposits	McAbee			
Gravelly River and Stream Deposits	Walhachin			
Sandy River and Stream Deposits	Nepa			
Coarse Textured Eolian Deposits				
Coarse to Moderately Coarse Textured Shallow (14 to 24") Eolian Deposits overlying River Gravels or Fan Deposits				
Coarse to Moderately Fine Textured Alluvial-Colluvial Fan Deposits	Semlin	Venables	Tremont	Minaberriet

THOMPSON SERIES

The Thompson soils are restricted to the lowest terraces and islands along the Thompson River, and to a lesser extent, along the Deadman and Bonaparte rivers. The topography is from level to undulating; the undulations mark former stream channels. At elevations between 850 and 1,700 feet, a total of 757 acres were classified, none of which is arable.

The parent material consists of recently deposited sands, gravels, cobbles, and stones. Material is added by annual flooding. Deposition occurs in rapidly moving water, which leaves the coarser materials and carries away the fine sediments. The variable drainage is dependent on river levels. There is inundation during the freshet and excessive drainage at low water.

Since most areas are exposed during the greater part of the growing season, there is a light to moderately heavy tree cover. Along the Thompson and Deadman rivers the vegetation is composed of a light stand of ponderosa pine, juniper and stunted cottonwood and aspen, with grasses and some sage on the highest spots. In the Bonaparte Valley there is a heavier tree cover of cottonwood, aspen, willow, and red-osier dogwood. The soils have no profile development, and were classified as Orthic Regosols.

Land-use:

All areas were classified as non-arable, due to annual flooding, coarse textures and stoniness. In the native state the soils have limited value for grazing, owing to the general lack of groundcover. These soils have a low agricultural potential and do not warrant reclamation, such as dyking.

2. MULL REGOSOLIC SOILS:

The Mull Regosol subgroup consists of mineral soils whose profile development is restricted to a distinct Ah horizon. The Ah horizon is not of sufficient thickness, or does not have the organic matter content or color to meet the requirements of a Rego-Chernozem.

In the map-area the Mull Regosols occur on recently deposited fan materials, alluvial terraces and eolian sediments. Little leaching has occurred and free lime is at or near the surface; the reactions range from mildly to strongly alkaline.

Soils classified as Mull Regosols consist of the Tsotin, Chrome, Savona, and Barnes series. They vary from rapidly to moderately well drained, and they developed chiefly under bunchgrasses. It is only on the moderately well drained Chrome soils that sufficient moisture is available to support an appreciable number of trees.

TSOTIN SERIES

Most of the acreage of the Tsotin soils is situated on low terraces of the Deadman River. Scattered areas occur along the Thompson and Bonaparte rivers. The topography varies from smooth gently sloping to undulating. Stream channeling is evident in the undulating areas. Elevations range from 1,050 to 1,600 feet. A total of 771 acres were mapped as Tsotin series, of which 313 acres were classed as irrigable. An additional 8 acres were separated as a Tsotin Gravelly Sand-Carquille Fine Sandy Loam Complex.

The terraces from which the Tsotin soils are derived are second bottoms, inundated only by exceptional freshets. The parent material consists of coarse sands, gravels and cobbles which may be covered by a surface layer from three to four inches thick of gravelly loamy sand to gravelly sandy loam. Stoniness is usually heavy enough to render the soils unsuitable for cultivation.

The soils, which are droughty, support a sparse vegetation of sage, rabbitbush, pasture wormwood, cactus, cheatgrass, speargrass, and clumps of sumac. Profile development is limited to a thin Ah horizon and the soils were differentiated as Mull Regosols. The following profile description of Tsotin Loamy Sand indicates the characteristic features of the series:

Horizon	Depth	Description
Ahj	0- 3"	Dark grayish-brown (10YR 4/2 dry), very dark brown (10YR 2/2 moist) gravelly loamy sand. Weak medium granular structure, soft dry, very friable moist, common roots, cobbly. pH 7.4 Abrupt boundary to:
C_1	3- 9"	Gravelly and cobbly coarse sand, single-grained, loose. Lime plating on undersides of gravels and cobbles. Roots abundant. pH 8.3 Clear boundary to:

Horizon	Depth	Description
C_2	9"+	Gravelly and cobbly coarse sand, single-grained, loose. Lime plating on undersides of gravels and cobbles. Roots common to occasional to 24" depth. pH 8.3

Land-use:

In the native state these soils have low value for grazing. Natural forage is limited by drought and the absence of desirable grass species.

These are limited use soils. Most of the acreage was classed as non-arable, due to coarse texture and high stone content. The balance of 313 acres is 4th and 5th class irrigation land suitable only for the production of alfalfa or pasture. Cultivation should be kept to a minimum because of the shallow solum and stoniness.

Tsotin soils are low in nitrogen and available phosphorus. Moisture holding capacity is very low. When cultivated an effort should be made to build up the organic matter content. Sprinkler irrigation only is recommended, with a farm delivery requirement of 54 inches for all textures.

CHROME SERIES

These soils occupy low-lying but moderately well drained alluvial terraces in the Bonaparte and Deadman river valleys. The topography is chiefly gently undulating, but it varies from level to undulating. In undulating areas the Chrome soils generally form complexes with the imperfectly drained Carquille soils which occur in the depressions. A total of 428 acres were classified between 1,300 and 1,700 feet elevations. Complexes of Chrome and other soil series accounted for an additional 173 acres.

The parent material consists of medium textured river alluvium underlaid at depths of 12 to 48 inches by sand and gravels. Thin sand strata may occur in the upper part of the profile; gravels are present on the surface where the overlay is thin but otherwise the topsoil is gravel- and stone-free. As a general rule, the finer the surface texture the greater the depth to the coarse textured substratum.

The Chrome series was differentiated into four texture types and three complexes (See Table 4). The soils are moderately well drained, with a water table high enough in flood stages of the rivers to permit a rise of capillary moisture. This upward movement of moisture and its evaporation at the surface keeps the upper part of the soil profile charged with carbonates. In part some of the carbonate may be due to irrigation, inasmuch as these soils have been irrigated a long time with water containing carbonates. Surface reactions are from pH 8.0 to 8.3, but there is little associated salinity.

Most areas of Chrome soils are cleared and cultivated. The original vegetation probably was an open stand or ponderosa pine and Douglas fir, with a few deciduous trees such as cottonwood and aspen. The Chrome series is a Mull Regosol with profile development limited to the Ah horizon. A cultivated profile of Chrome Silt Loam, which is typical of the series, was described as follows:

Horizon	Depth	Description
Aa	0- 6"	Dark grayish-brown (2.5Y 4/2 dry), very dark brown (10YR 2/2 moist) silt loam. Weak fine subangular blocky breaking to medium granular structure, very friable moist. Abundant roots. pH 8.0 Abrupt boundary to:
C_1	6-13"	Grayish-brown (2.5Y 5/2 dry), very dark grayish-brown (10YR 3/2 moist) fine sandy loam. Weak fine subangular blocky breaking to fine granular structure. Very friable moist, abundant roots. pH 8.1 Abrupt boundary to:
C_2	13-18"	Grayish-brown (2.5Y 5/2 dry), dark grayish-brown (2.5Y 4/2 moist) silt loam. Weak fine subangular blocky breaking to fine granular structure. Very friable moist, abundant roots. pH 8.1 Abrupt boundary to:
pAh	18-23"	Dark grayish-brown (10YR 4/2 dry), very dark brown (10YR 2/2 moist) loam. Weak fine subangular blocky breaking to medium granular structure. Very friable moist, common roots. pH 8.3 Abrupt boundary to:

Horizon	Depth	Description
C_3	23-28"	Grayish-brown (2.5Y 5/2 dry), very dark grayish-brown (2.5Y 3/2 moist) loam. Weak fine subangular blocky breaking to fine granular structure. Very friable moist, common roots. pH 7.9 Abrupt boundary to:
IIC	28"+	Coarse sand becoming gravelly below 48". Single-grained, loose. Roots occasional to 48", thereafter absent. pH 7.7

Land-use:

Chrome soils are located close to an abundant water supply and most of the acreage is under irrigation. The main crops are alfalfa and pasture. Estimated yields are lower than on similar textured soils in the Thompson Valley because of the shorter growing season. These soils are subject to late spring and early fall frosts; carrots and late potatoes are the only vegetables recommended (See Table 7).

The Chrome soils are somewhat low in nitrogen and phosphorus, but are reasonably well supplied with other nutrients. They are friable and have good structure. The moisture holding capactiy is from fair to good, depending on the texture and depth to the sandy and gravelly substratum.

Sprinkler irrigation only is recommended for the Chrome Gravelly Sandy Loam and Sandy Loam, the annual requirement being 33 inches. Both sprinkler and furrow irrigation is suitable on other textures of the series. Under sprinklers the requirement is 27 inches for Chrome Fine Sandy Loam and 23 inches for the Silt Loam. Under furrow irrigation, 49 inches is the requirement for the Fine Sandy Loam and 39 inches for the Silt Loam.

SAVONA SERIES

The Savona series consists of a minor group of soils derived from dune sands. They occupy small, scattered areas in the Thompson Valley between Savona and Basque. All areas have irregular, dune topography which varies from undulating to strongly rolling and hilly. Blowouts are common and active sand movement occurs in some localities. A total of 638 acres were classified at elevations between 1,100 and 1,500 feet. In addition, 374 acres were mapped as complexes in which the Savona soils predominate. The complexes include such soils as the Joeross and Lopez series, which are derived from similar parent material, but show more profile development.

The parent material is composed of wind deposited, calcareous sands. The deposits vary from three to ten feet in thickness, overlying terrace gravels. An occasional stone may be found where the underlying gravels are close to the surface, otherwise the soils are gravel- and stone-free. Surface textures are sand and loamy sand (See Table 4).

The Savona soils, which are rapidly drained, were classed as Mull Regosols. The mapping units include Orthic Regosols where sand movement is still active. The native vegetation is composed of scattered ponderosa pine and a sparse ground cover of sage, rabbitbush, pasture wormwood, cheatgrass, speargrass, and cactus. A profile of Savona Sand was examined and described as follows:

Horizon	Depth	Description
Ahj	0- 4"	Gray to grayish-brown (10YR 5/1.5 dry), very dark grayish-brown (10YR 3/2 moist) medium sand. Weak medium granular breaking to single-grained structure. Very friable to loose, abundant roots. pH 8.3 Abrupt boundary to:
C_1	4- 8"	Light gray (10YR 7.2 dry), grayish-brown (10YR 5/2 moist) medium sand. Single-grained, loose, abundant roots. pH 8.4 Clear boundary to:
C_2	8"+	Medium sand, single-grained, loose. Roots common to occasional in the upper part. pH 8.6

Land-use:

The Savona soils make poor agricultural land because of coarse textures and rough topography. No farming is being undertaken on these soils at the present time (1963). In the native state they provide limited range. The production of natural forage is restricted by the low soil moisture holding capacity and the absence of desirable species of grasses.

Only alfalfa or sod-forming crops should be grown in these limited-use soils. Intertilled crops should be avoided, owing to rough topography and susceptibility to wind erosion. They have low cation exchange capacity and a low content of organic matter, nitrogen and available phosphorus, but they are friable and have a deep rooting zone. Only sprinkler irrigation is recommended, the farm delivery requirement being 50 inches for both textures.

BARNES SERIES

Barnes soils occur on coarse textured fans scattered throughout the map-area. The topography is smooth moderately to very steeply sloping toward the valley centre. On larger fans the gradient gradually decreases from the apex towards the margin. Some fans may be gullied by stream channels. The Barnes soils are a minor group, with a total of 292 acres mapped between 1,500 and 1,700 feet elevations. An additional 8 acres were differentiated as a complex of Barnes Gravelly Loamy Sand and Savona Sand.

The parent material consists of coarse alluvial-colluvial fan debris. A thin capping of gravelly sandy loam occurs on some areas, but stone content is always heavy to excessive. Most deposits are calcareous to the surface, and are rapidly drained.

The series was differentiated into 68 acres of Gravelly Loamy Sand and 61 acres of Gravelly Sandy Loam. An additional 163 acres of the series were non-arable. These soils were classified as Mull Regosols, the natural vegetation being sage, rabbitbush, pasture wormwood, cheatgrass, speargrass, and cactus. An occasional ponderosa pine occurs in small gullies. A soil profile of the Barnes Gravelly Loamy Sand was given the following description:

Horizon	Depth	Description
Ahj	0- 3"	Grayish-brown (10YR 5/2 dry), very dark grayish-brown (10YR 3/2 moist) gravelly loamy sand. Weak medium granular structure, soft dry and very friable moist. Very stony, abundant roots. pH 8.2 Abrupt boundary to:
C_1	3-11"	Variable colored cobbly and gravelly sand. Single-grained, loose. Lime plating on gravels and cobbles, abundant roots. pH 8.3

Horizon	Depth	Description
C_2	11"+	Variable colored cobbly and gravelly coarse sand. Single-grained, loose. Roots common to abundant in the upper part, diminishing with depth. pH 8.4

Land-use:

These soils are of limited use for agriculture. About half of the classified acreage is non-arable, due to coarse texture, stoniness and steep topography. The remainder is 4th and 5th class irrigation land. Cultivation should be kept to a minimum; only alfalfa and sod crops are recommended. In the native state the Barnes soils have low grazing value, due to drought and the absence of desirable species of grasses.

The Barnes soils are low in organic matter, nitrogen and available phosphorus, and the moisture holding capacity is very low. With cultivation an effort should be made to build up the content of organic matter. Only sprinkler irrigation is recommended; the farm delivery requirement is 54 inches for both textures.

3. GLEYED MULL REGOSOLIC SOILS:

This Regosolic subgroup is composed of mineral soils with a distinct Ah horizon and a weakly gleyed and mottled subsoil. The Ah horizon is not of sufficient thickness, or does not have the organic matter content or color to qualify as a Chernozemic horizon.

In the mapped area, the Gleyed Mull Regosols occupy low terraces near runoff levels. They are imperfectly drained and calcareous to the surface, with moderately alkaline reactions from pH 7.8 to 8.4. The extra subsoil moisture permits growth of a moderately heavy forest of deciduous trees. The Carquille series was the only one classified as a Gleyed Mull Regosol.

CARQUILLE SERIES

Carquille soils occupy low lying imperfectly drained alluvial terraces in the Bonaparte and Deadman river valleys. The topography varies from level to undulating. Most slopes average two to three percent, with a maximum of not more than five percent. Between elevations of 1,500 and 1,900 feet, a total of 1,180 acres were classified. Complexes with other soil types amounted to an additional 436 acres.

The parent material consists of moderately coarse to medium textured river alluvium from 12 to 48 inches thick, which overlies sands and gravels. Thin, coarser textured strata often occurs in the overlay. Gravels are present to the surface in areas where the overlay is thin, but otherwise the soils are gravel- and stone-free. Although the soils are calcareous to the surface, there is little associated salinity.

The Carquille series was differentiated into six texture types and two soil complexes (See Table 4). As a general rule, as surface textures become finer, the thickness of the overlay increases. The water table fluctuates with the river level, and the soils are imperfectly drained. In most years, the water table is at or close to the surface during spring runoff, and a few of the lower lying areas are flooded. All areas could be inundated in years of exceptionally high water.

In the native state the Carquille soils support a moderately heavy deciduous forest of cottonwood, aspen, willow, and red-osier dogwood. Profile development is that of a Gleyed Mull Regosol. A description of a cultivated Carquille Fine Sandy Loam profile is as follows:

Horizon	Depth	Description
Aa	0- 7"	Dark grayish-brown (2.5Y 4/2 dry), very dark gray (10YR 3/1 moist) fine sandy loam. Weak medium subangular breaking to medium granular structure, very friable moist, abundant roots. pH 8.1 Abrupt boundary to:
Cgj_1	7-11"	Grayish-brown (2.5Y 5/2 dry), very dark grayish-brown (10YR 3/2 moist) sandy loam. A few faint mottles, massive, very friable moist, abundant roots. pH 8.1
Cgj_2	11-24"	Grayish-brown (2.5Y 5/2 dry), very dark grayish-brown (10YR 3/2 moist) silt loam. Common dark yellowish-brown (10YR 4/4 moist) mottles. Weak medium subangular blocky structure, friable moist, common roots. pH 8.1 Abrupt boundary to:

Horizon	Depth	Description
$IICgj_1$	24-27"	Coarse sand statum containing a few faint mottles. Single-grained, loose, common to occasional roots. pH 8.2 Abrupt boundary to:
Cgj_3	27-32"	Grayish-brown (2.5Y 5/2 dry), very dark grayish-brown (10YR 3/2 moist) fine sandy loam. Common dark yellowish-brown (10YR 4/4 moist) mottles. Massive, friable moist, occasional root. pH 8.0 Abrupt boundary to:
$IICgj_2$	32-38"	Grayish-brown (2.5Y 5/2 dry), very dark grayish-brown (10YR 3/2 moist) loamy sand. A few faint mottles. Massive, very friable moist, occasional root. pH 8.0 Clear boundary to:
IIIC	38"+	Gravelly coarse sand. Single-grained, loose, roots absent. pH 8.1

Land-use:

Carquille soils are among the most important for agriculture in the map-area; most of the acreage is cleared and cultivated. The high water table during the freshet season restricts alfalfa, favoring the more water tolerant legumes and grasses. Control of the spring run-off would permit better stands of alfalfa, but yields would be lower than on similar textured soils in the Thompson Valley because of the shorter growing season. These soils are subject to late spring and early fall frosts. Carrots and late potatoes are the only intertilled crops recommended (See Table 7).

The Carquille soils are friable and fairly well supplied with most plant nutrients. The content of nitrogen and available phosphorus is low; phosphorus deficiency could occur in carrots, potatoes and possibly alfalfa, but there may be enough for hay and pasture. The moisture holding capacity varies from fair to good, depending on texture and depth of the overlay.

For Carquille Gravelly Sandy Loam and Sandy Loam to Loamy Sand, sprinkler irrigation only is recommended, the farm water requirement being 36 and 33 inches respectively. Both sprinkler and furrow irrigation may be used on the other textures. Under sprinklers the requirement is 28 inches for Carquille Gravelly Fine Sandy Loam, 25 inches for the Fine Sandy Loam, 20 inches for the Silt Loam and 16 inches for the Silty Clay Loam.

Under furrow irrigation, 45 inches is recommended for the Gravelly Fine Sandy Loam, 37 inches for the Fine Sandy Loam, 28 inches for the Silt Loam and 21 inches for the Silty Clay Loam. These recommendations are based on the assumption that with formation of an irrigation district, there would be better control of spring runoff, which would provide better drainage in the spring.

4. REGO-BROWN SOILS:

The subgroup of Rego-Brown soils consists of mineral soils which developed in a dry climate under natural bunchgrasses. The profile development is restricted to the formation of a brownish Ah horizon containing an accumulation of organic matter.

A strongly calcareous Ck horizon is generally present beneath the Ah horizon at from six to 14 inches from the surface. Salts may or may not be present in the subsoil. Leaching is slight and the surface reactions range from slightly to moderately alkaline, pH values being from pH 7.4 to 8.4. Cultivated soils are calcareous to the surface.

The Rego-Brown soils in the map-area are the Cheetsum, Anglesey, Joeross, Lopez, Taweel, and Bonaparte series. They are derived from a variety of parent materials, and they are from rapidly to moderately well drained.

CHEETSUM SERIES

These soils are confined to steeply sloping areas situated east and south of Cache Creek, excepting a small area along the upper slopes of the Bonaparte Valley. The topography is rolling to very steeply sloping and hilly. Slopes are never less than 15%, and generally they exceed 30%. Between elevations of 1,500 and 2,500 feet, a total of 7,985 acres were mapped, of which 7,608 were rated non-arable. Complexes of Cheetsum with other soil series amount to an additional 1,768 acres.

The parent material consists of calcareous glacial till of medium to moderately fine texture. The unweathered till is compact, and contains a moderate to heavy content of gravels and stones. A thin capping of loess up to four inches in thickness may be present. Because of erosion, the loess is less prevalent than on the associated Basque soils. The surface textures range from gravelly fine sandy loam to silt loam; four texture types were mapped (See Table 4).

The Cheetsum soils were classified as Rego-Brown, and are well drained. Surface reactions are from pH 7.4 to 8.0, and free lime is present at depths of from six to 10 inches. Salts are present at from 12 to 18 inches from the surface.

The native vegetation is dominated by sagebrush, rabbitbush, pasture wormwood, and cactus. Bunchgrass is present in varying amounts, depending on the intensity of grazing. A Cheetsum Gravelly Silt Loam profile was examined and described as follows:

Horizon	Depth	Description
Ah	0- 7"	Brown (10YR 4.5/3 dry), dark grayish-brown to dark brown (10YR 4/2.5 moist) gravelly silt loam. Weak medium subangular blocky breaking to granular structure, soft dry, very friable moist, abundant roots, cobbly. pH 8.0 Abrupt boundary to:
Ck	7-12"	Very pale brown to pale brown (10YR 6.5/3 dry), grayish-brown (10YR 5/2 moist) gravelly silt loam. Moderate medium subangular blocky structure, hard dry, firm moist, cobbly, occasional root. pH 8.4; conductivity 1.0* Clear boundary to:
Cs_1	12-23"	Grayish-brown (10YR 5/2 dry), grayish-brown to brown (10YR 5/2.5 moist) gravelly silt loam till which breaks with plate-like cleavage. Slightly hard dry, friable moist, cobbly, common roots. pH 8.1; conductivity 10.4 Diffuse boundary to:

*Conductivity values in millimhos per centimeter at 25°C.

Horizon	Depth	Description
Cs_2	23"+	Dark grayish-brown (10YR 4/2 dry), dark brown (10YR 3/3.5 moist) compacted gravelly silty clay loam till breaking to strong plate-like structure. Very hard dry, very firm moist, occasional root in upper part, cobbly. pH 8.2; conductivity 6.7

Land-use:

The Cheetsum soils are not under cultivation. Most of the acreage has slopes in excess of 30% and suitable only for range. The small arable acreage would produce alfalfa or sod crops.

The limitations of the Cheetsum series consist of shallow solums, unfavorable topography, stoniness and salts at shallow depths. When cultivated, care should be taken to prevent erosion, which would expose the unproductive subsoil. The Ah horizon is friable and moderately fertile, but these soils are low in nitrogen and available phosphorus. Sprinkler irrigation only is recommended, with a farm delivery requirement of 25 inches for all textures.

ANGLESEY SERIES

This series is an extensive group of soils situated on gravelly glacio-fluvial deposits. The average topography is undulating to level. There are a few eroded areas, which are rolling to steeply sloping. The series occurs throughout the map-area, the total acreage being 7,506 and the elevations 1,000 to 2,000 feet. In addition, five soil complexes were differentiated, which occupy 1,400 acres.

The parent material is composed of gravelly and stony deposits in the form of glacial outwash terraces, some of which are kames. More recently deposited terraces of similar composition are included. All of the coarse textured deposits are surfaced with six to 12 inches of finer textured material. The capping, which ranges from loamy sand to silt loam, was deposited by water and wind. The range of gravel and stone content is from excessive to none at all.

The Anglesey series was separated into eleven texture types (See Table 4). All are rapidly drained and classed as Rego-Brown soils. They have thin solums, the depth of the Ah horizon coinciding with that of the surface capping. The Ah horizon is slightly to moderately alkaline. The underlying gravels and cobbles are commonly lime plated. These soils support a sparse native cover of sage, rabbitbush, pasture wormwood, cactus, cheatgrass, speargrass, and miscellaneous weeds. A profile of the Anglesey Gravelly Sandy Loam was given the description which follows:

Horizon	Depth	Description
Ah_1	0- 2"	Brown (10YR 5/3 dry), very dark grayish-brown to dark brown (10YR 3/2.5 moist) gravelly sandy loam. Moderate very coarse subangular blocky structure formed as a result of polygonal cracks which extend to bottom of horizon. Soft dry, very friable moist, cobbles and stones abundant, roots common. pH 7.9 Abrupt boundary to:
Ah_2	2- 9"	Grayish-brown to brown (10YR 5/2.5 dry), very dark grayish-brown (10YR 3/2 moist) gravelly sandy loam. Weak fine subangular blocky breaking to fine granular structure, soft dry, very friable moist. Cobbles and stones abundant, roots common. pH 7.4 Clear boundary to:
Ck-IICk	9-19"	Dark grayish-brown (10YR 4/2 dry), very dark brown (10YR 2/2 moist) stony gravelly sandy loam to gravelly loamy sand. Weak fine granular structure, soft dry, very friable moist, abundant roots. About 90% gravels, cobbles and stones, all lime coated. pH 8.4 Clear boundary to:
IIC_1	19-30"	Light gray to light brownish-gray (10YR 6/1.5 dry), gray (10YR 5/1 moist) stony gravelly loamy sand to gravelly sand. Weak fine granular to single-grained structure, loose, abundant roots, slight lime plating on some cobbles. pH 8.2 Clear boundary to:

Horizon	Depth	Description
IIC_2	30"+	Roughly stratified coarse sand, gravels, cobbles and stones. Single-grained, loose, occasional pocket of salts under larger cobbles, no roots. pH 8.1

Land-use:

In the native state the Anglesey soils provide some range. Forage production is low, due to the droughty nature of the soils and the absence of desirable grasses. There was no cultivation of Anglesey soils at the time of the survey (1962).

With irrigation these are limited-use soils regardless of texture. Alfalfa, hay or pasture are the most suitable crops. Intertilled crops should be avoided, because of the thin solum and stoniness.

The Anglesey soils are reasonably well supplied with plant nutrients, excepting nitrogen and available phosphorus. Sufficient phosphorus may be available for hay crops, but a periodic check should be made for phosphorus response. The moisture holding capacity is very low. Only sprinkler irrigation should be used. The farm delivery requirement for Anglesey Loamy Sand, Gravelly Loamy Sand, Sandy Loam, Gravelly and Stony Sandy Loam, and Fine Sandy Loam is 50 inches. The requirement for Anglesey Loam, Stony Loam, Silt Loam, and Gravelly Silt Loam is 46 inches.

JOEROSS SERIES

This is a minor group of soils which occur as small, scattered areas in the Thompson Valley between Savona and Basque. All areas have irregular duned topography, which varies from undulating to rolling. A total of 604 acres were differentiated at elevations between 1,100 and 1,500 feet. Complexes in which Joeross soils predominate account for an additional 272 acres.

The parent material consists of wind blown calcareous sands. The deposits vary mostly from three to 10 feet in thickness, with occasional deeper deposits. They may have a surface capping of finer texture up to 20 inches thick. The sand deposits overlie terrace gravels. An occasional stone may occur in areas where the underlying gravels are close to the surface, otherwise the parent material is gravel- and stone-free.

Surface textures range from sand to fine sandy loam. The Joeross series was differentiated into four soil types and four complexes (See Table 4). All types are rapidly drained and were classified as Rego-Brown. They developed on deposits similar to the parent material of the Savona series, but differ by having been stabilized long enough to have a well developed Ah horizon. Surface reactions range from pH 7.7 to 8.4, with free lime at from six to 12 inches deep.

The original vegetation of bunchgrasses has been practically eliminated by overgrazing, and the present cover consists of sage, rabbitbush, pasture wormwood, cheatgrass, speargrass, and cactus. A profile of the Joeross Loamy Sand was described as follows:

Horizon	Depth	Description
Ah_1	0- 6"	Grayish-brown (10YR 5/2 dry), very dark grayish-brown (10YR 3/2 moist) loamy sand. Weak fine subangular blocky breaking to fine granular structure. Soft dry, very friable moist, abundant roots. pH 8.2 Clear boundary to:
Ah_2	6-11"	Light brownish-gray (10YR 6/2 dry), dark grayish-brown to very dark grayish-brown (10YR 3.5/2 moist) sand. Weak medium subangular blocky structure, soft dry, very friable moist, common roots. pH 8.3 Clear boundary to:
AC	11-15"	Light gray to light brownish-gray (10YR 6/2.5 dry), grayish-brown to dark grayish-brown (10YR 4/2.5 moist) sand. Very weak medium subangular blocky structure, soft dry, very friable moist, occasional root. pH 8.4 Clear boundary to:
Ck	15-24"	Variable colored sand. Single-grained, loose, occasional root. Visible concentration of carbonates. pH 8.4 Gradual boundary to:
C	24"+	Variable colored sand. Single-grained, loose, occasional root in upper part. pH 8.4

Land-use:

There was no cultivation of the Joeross soils at the time of the survey (1962). In the native state they provide limited range. These soils are fair to poor for agriculture, depending on the topography and surface texture.

With irrigation, all textures could produce alfalfa, hay and pasture. Vegetables may be grown on Joeross Loamy Sand, Sandy Loam and Fine Sandy Loam where slopes do not exceed 5%. Tomatoes are not recommended on the Loamy Sand type because of sand blasting (See Table 7).

Joeross soils have low moisture holding and cation exchange capacities. Also they are low in organic matter, nitrogen and available phosphorus. Sufficient phosphorus may be available for hay and pasture, but its addition would be necessary for vegetable crops. All types are very friable, and they have deep rooting zones. Only sprinkler irrigation is recommended, the farm delivery requirement being 50 inches for Joeross Sand and Loamy Sand, and 46 inches for Sandy Loam and Fine Sandy Loam.

LOPEZ SERIES

The Lopez soils are a minor group derived from shallow wind-blown deposits. They occupy small areas in the Thompson Valley between Deadman River and McAbee. The topography is mostly level to very gently sloping, with occasional variation to undulating, but slopes do not exceed 5%. A total of 292 acres were classified between 1,300 and 1,500 feet elevations.

The parent material consists of shallow, wind-blown, calcareous sand. These eolian sandy deposits occur on the lee side of duned areas, or as a thin strip adjacent to the edge of bluffs. The deposits vary from 14 to 24 inches thick, overlying terrace gravels and sometimes fan deposits. An occasional gravel or cobble may be present. Surface textures range from sand to sandy loam.

The Lopez series was separated into Lopez Sand, 90 acres; Loamy Sand, 78 acres; and Sandy Loam, 131 acres. This rapidly drained group of soils was classified as Rego-Brown. Some of the map units include patches of Regosolic soils where blowing is active or was recent. The surface is moderately alkaline, free lime occurring at depths of 12 inches or less.

The native vegetation consists mainly of sage, rabbitbush and pasture wormwood, with inclusions of cheatgrass, speargrass and cactus. A cultivated profile of the Lopez Sandy Loam was described as follows:

Horizon	Depth	Description
Aa	0- 8"	Grayish-brown to dark grayish-brown (10YR 4.5/2 dry), very dark grayish-brown to very dark brown (10YR 2.5/2 moist) sandy loam. Weak medium blocky structure, very friable moist, abundant roots. pH 8.4 Abrupt boundary to:
Ah	8-12"	Grayish-brown to dark grayish-brown (10YR 4.5/2 dry), very dark grayish-brown (10YR 3/2 moist) sandy loam. Weak coarse blocky structure, very friable moist, common roots. pH 8.2 Abrupt boundary to:
Ck	12-20"	Brown (10YR 5/3 dry), dark brown (10YR 3.5/3 moist) sandy loam. Weak coarse blocky structure, very friable moist, occasional gravels and cobbles in lower part, roots common. pH 8.3 Clear boundary to:
IICk	20-26"	Light gray (10YR 7/1 dry), gray (10YR 5/1 moist) gravelly coarse sand. Weakly lime cemented, massive, very firm moist, roots occasional to absent. pH 8.3
IIC	26"+	Gravelly coarse sand of variable colors, single-grained, loose, cobbly, no roots. pH 8.5

Profiles may occur which have a buried Ah horizon (pAh) near contact with the gravelly substratum.

Land-use:

In the native state the Lopez soils provide limited range. They vary from good to poor for agriculture, depending on the texture. One area of Lopez Sandy Loam was irrigated and had a good stand of alfalfa at the time of the survey (1962). With irrigation all soil types of the series are suitable for alfalfa, hay and pasture. A wide range of vegetables could be grown on Lopez Loamy Sand and Sandy Loam (See Table 7).

The Lopez soils have favorable topography for agriculture. They have reasonably deep solums and are very friable. They are moderately fertile, but low in organic matter, nitrogen and available phosphorus. Sufficient phosphorus may be available for forage crops, but phosphorus fertilization appears necessary for vegetables. Only sprinkler irrigation is recommended. The farm delivery requirement is 50 inches for the Lopez Sand, 44 inches for the Loamy Sand, and 39 inches for the Sandy Loam.

TAWEEL SERIES

The Taweel soils are derived from medium to coarse textured fans which occur throughout the mapped area. The topography is typical of fan formations. There is an overall smooth downward slope from the apex toward the valley centre. The steepest gradients are in the upper parts of the fans, and decrease gradually toward the margins. Slopes vary from three to over 30%. Gullies formed by runoff are common on some of the fans. A total of 7,608 acres were mapped at elevations between 1,000 and 2,200 feet, of which 1,665 acres were classed as non-arable. An additional 522 acres were differentiated as complexes in which Taweel soils predominate.

The parent material is poorly sorted and roughly stratified, the strata ranging in texture from gravelly loam to gravelly sand. The surface six to 12 inches may be finer textured than the subsoil. In some cases this was due to an addition of loess; where loess occurs the content of surface gravels and stones is light or absent. Otherwise gravels and stones are present in moderate to excessive quantities. Free lime is encountered at six to 12 inches from the surface, but salts have been removed to depths of 24 inches or more.

The Taweel series was differentiated into eight texture types and three complexes (See Table 4). They vary from rapidly to well drained and were classified as Rego-Brown soils. The native vegetation consists of sage, rabbitbush, pasture wormwood, cactus, cheatgrass, and occasional bunchgrass. A profile of Taweel Gravelly Loam, which is typical of the series, was described as follows:

Horizon	Depth	Description
Ah_1	0-2½"	Grayish-brown to dark grayish-brown (10YR 4.5/2 dry), very dark grayish-brown to very dark brown (10YR 2.5/2 moist) gravelly loam. Weak fine

Horizon	Depth	Description
		granular structure, soft dry, very friable moist, occasional root. pH 8.0 Abrupt boundary to:
Ah_2	2½- 6"	Gray to dark gray (10YR 4.5/1 dry), very dark gray (10YR 3/1 moist) gravelly loam. Weak coarse blocky structure, slightly hard dry, friable moist. Moderately stony, abundant roots. pH 7.6 Clear boundary to:
Ah_3	6- 9"	Gray to dark gray (10YR 4.5/1 dry), very dark gray (10YR 3/1 moist) gravelly sandy loam. Weak fine granular structure, soft dry, very friable moist, moderately stony, abundant roots. pH 7.9 Abrupt boundary to:
Ck	9-23"	Gray (10YR 5.5/1 dry), dark gray (10YR 4/1 moist) gravelly sandy loam. Massive, weakly lime cemented, hard dry, firm moist, roots common. pH 8.1 Clear change to:
IICs-Cs	23"+	Light gray (10YR 6/1 dry), gray to dark gray (10YR 4.5/1 moist) roughly stratified material which varies from gravelly loam to gravelly sand. Moderate medium blocky to single-grained structure. Varies from slightly hard to loose, depending on texture. Occasional root in upper part. pH 8.3; conductivity 8.3

Land-use:

Most of the acreage was in the native state at the time of the survey (1962), and provided limited range. A small acreage bordering better soil types is irrigated. With irrigation these are poor to doubtful soils because of unfavorable topography, coarse textures and heavy stone content. Alfalfa, hay and pasture are the only crops recommended.

These soils have lime accumulation within 10 inches of the surface, and moisture holding capacity is low to moderately low. They are reasonably well supplied with plant nutrients, excepting nitrogen and possibly phosphorus. Sufficient phosphorus may be available for alfalfa and other forage, but a periodic check should be made for phosphorus response. Salts are present in the subsoil, but usually too deep to have harmful effects on plants.

Only sprinkler irrigation is recommended. The farm delivery requirement is 46 inches for Taweel Gravelly Loamy Sand, 36 inches for the Gravelly Sandy Loam, Sandy Loam and Fine Sandy Loam, and 32 inches for the Gravelly Loam, Loam, Gravelly Silt Loam, and Silt Loam.

BONAPARTE SERIES

The Bonaparte series comprises a group of soils derived from medium to moderately fine textured fan materials. They occupy small areas scattered over most of the soil map. The topography is very gently to gently sloping, with gradients seldom more than 5%. A total of 2,481 acres were differentiated at elevations between 1,100 and 1,600 feet.

The parent material is composed of silty alluvial fan deposits which are calcareous and saline at depths. These sediments generally occur at the lower extremities of large fans, although in a few localities where the material has eroded from silty glacio-lacustrine deposits, the whole fan is silty. The silty deposits average from two to three feet thick, with extremes from 18 inches to five feet or more. The silty materials overlie fan deposits of coarser texture or gravelly terraces. Scattered gravels and stones occur in a few areas, but as a rule the Bonaparte soils are gravel- and stone-free.

Surface textures vary from fine sandy loam to silty clay loam; four soil types were differentiated (See Table 4). The Bonaparte series was classed with the Rego-Brown soils, moderately to well drained. They often contain free lime to the surface; surface reactions vary from pH 7.6 to 8.2. The native vegetation is composed of sage, rabbitbush, pasture wormwood, cheatgrass, speargrass, Russian thistle, and cactus. A profile of the Bonaparte Silt Loam was examined and described as follows:

Horizon	Depth	Description
Ah_1	0-2½"	Grayish-brown (10YR 5/2 dry), dark grayish-brown to very dark grayish-brown (10YR 3.5/2 moist) silt loam. Macrostructure very coarse subangular blocky resulting from polygonal

Horizon	Depth	Description
		cracking. Blocks break to very thin platy structure. Vesicular, slightly hard dry, very friable moist, occasional root. pH 7.4 Abrupt boundary to:
Ah_2	2½- 8"	Brown (10YR 5/3 dry), dark grayish-brown (10YR 4/2 moist) silt loam. Weak coarse blocky structure, slightly hard dry, friable moist, abundant roots. pH 7.8 Gradual boundary to:
AC	8-14"	Light brownish-gray (10YR 6/2 dry), dark gray to dark grayish-brown (10YR 4/1.5 moist) silt loam. Massive, hard dry, friable moist, a few lime concretions, abundant roots. pH 8.0 Gradual boundary to:
Ck	14-34"	Light brownish-gray (2.5Y 6/2 dry), grayish-brown (2.5Y 5/2 moist) silt loam. Massive, hard dry, friable moist, numerous lime concretions, common roots. pH 8.6 Clear boundary to:
IICs	34"+	Gray (10YR 5/1 dry), dark gray to very dark gray (10YR 3.5/1 moist) medium sand. Single-grained, loose, occasional root in upper part. pH 8.0; conductivity 5.4

Land-use:

These are fair to good irrigation soils with good textures and favorable topography. A large part of the total acreage is irrigated, with alfalfa the main crop. The Bonaparte soils are suitable for a number of vegetables (See Table 7). Onions and carrots are not recommended because the soils are too compact for adequate root development and a smooth finish. The structure and tilth could be improved by the use of crop residues to build up the content of organic matter.

Although reasonably fertile, these soils are somewhat low in nitrogen and available phosphorus. They may have enough available phosphorus for alfalfa, but additions would be necessary for vegetables. Soluble salts are present in the subsoil, but too deep to impose a harmful effect on plant growth.

The Bonaparte soils have good moisture holding capacity, and they are suitable for both sprinkler and furrow irrigation. Under sprinkler irrigation the farm delivery requirement is 29 inches for Bonaparte Fine Sandy Loam, 26 inches for the Loam, 24 inches for the Silt Loam, and 23 inches for the Silty Clay Loam. With furrow irrigation, 45 inches are required for Bonaparte Fine Sandy Loam, 39 inches for the Loam, and 32 inches for the Silt Loam and Silty Clay Loam.

5. SALINE REGO-BROWN SOILS:

This subgroup of Rego-Brown soils consists of mineral soils which have developed in a dry climate under natural bunchgrass vegetation. Profile development is restricted to the formation of a brownish Ah horizon indicative of organic matter accumulation. There is also a visible concentration of soluble salts near the surface.

In the mapped area the high content of salts is caused either by erosion keeping pace with the downward leaching of the salts, or by saline seepage water. These soils are calcareous in addition to their salinity. Surface reactions vary from pH 7.9 to 8.5, and electrical conductivities from 2.0 to 7.0 millimhos per centimeter.

Saline Rego-Brown soils in the mapped area consist of the Epsom and Cache Creek series.

EPSOM SERIES

The Epsom soils occupy a minor acreage along the sides of the Thompson Valley between Savona and McAbee. The topography is undulating to rolling and very steeply sloping. The range of elevation of the series is between 1,500 and 1,800 feet.

The parent material consists of stratified glacio-lacustrine sediments which range in texture from fine sand to silty clay. Silt loam and silty clay loam are the most common textures. The glacio-lacustrine deposits exist as small remnants overlying outwash gravels and glacial till. They do not occur in units large enough for separate classification. It was necessary to map the total acreage of the Epsom soils as complexes with the Anglesey series (See Table 4).

The soils erode easily; many of the knolls are devoid of vegetation. Erosion keeps pace with weathering and leaching, so that profile development is restricted and soluble salts are present at the surface. The soils are moderately well to well drained and classed as Saline Rego-Brown. The native vegetation is composed of sage, rabbitbush, cheatgrass, wild ryegrass, meadow foxtail, and Russian thistle. A representative soil profile was described as follows:

Horizon	Depth	Description
Ah	0- 1"	Light brownish-gray (10YR 6/2 dry), dark grayish-brown to very dark grayish-brown (10YR 3.5/2 moist) silt loam. Weak, thin platy structure, soft dry, very friable moist. Highly vesicular, roots common. pH 8.5 Abrupt boundary to:
Ahs	1- 4"	Grayish-brown (10YR 5/2 dry), very dark grayish-brown (10YR 3/2 moist) silty clay. Moderate coarse prismatic macrostructure breaking to strong medium to fine blocky structure. Very hard dry, firm moist, roots common. pH 8.6; conductivity 3.8 Abrupt boundary to:
Cs_1	4-15"	Light brownish-gray (10YR 6/2 dry), dark grayish-brown (10YR 4/2 moist) silty clay loam. Medium coarse prismatic breaking to strong coarse blocky structure, very hard dry, firm moist. Visible salt concentration, roots common. pH 8.6; conductivity 10.2 Gradual change to:
Cs_2	15"+	Light gray (10YR 6.5/1 dry), grayish-brown to dark grayish brown (10YR 4.5/2 moist) silty clay loam to silt loam. Weak coarse blocky structure, slightly hard dry, friable moist. Visible salt concentration, occasional root. pH 8.9; conductivity 13.4

Land-use:

The Epsom soils are classed as non-arable, due to unfavorable topography and high salt content. Although these soils have good moisture holding capacity, they only have fair value as range. The high salinity reduces the growth of desirable grasses, and erosion is the cause of numerous spots which are bare of vegetative cover.

CACHE CREEK SERIES

Cache Creek soils are situated on moderately coarse to medium textured fans located chiefly in the Bonaparte River valley. A few areas also were classified in the vicinity of Ashcroft. They have typical fan topography, which is characterized by a smooth downward slope from the apex toward the valley centre. The upper part of the fans have the steepest slopes, from which the gradient decreases gradually toward the fan margins, most of the slopes being between two and 15%. A total of 411 acres were mapped between 1,500 and 1,900 feet elevations.

The parent material consists of poorly sorted, roughly stratified alluvial-colluvial fan debris. Usually the material is very gravelly and moderately stony, but a small acreage of better sorted gravel- and stone-free silt loam to silty clay loam is also included. All areas are calcareous and saline at or near the surface. Saline seepage water draining from the nearby Cache Creek Formation (8) appears to be responsible for maintenance of the high salt content.

The Cache Creek series was differentiated into Gravelly Sandy Loam, 268 acres; Silt Loam, 78 acres; and Silt Loam to Silty Clay Loam, 76 acres. These are Saline Rego-Brown soils, which are moderately well drained. The native vegetation is composed of cheatgrass, dropseed, cactus, Russian thistle, and other weeds. A profile of the Cache Creek Gravelly Sandy Loam was examined and described as follows:

Horizon	Depth	Description
Ahs_1	0- 2"	Gray (10YR 5/1 dry), very dark gray to very dark grayish-brown (10YR 3/1.5 moist) sandy loam. Moderate very thin platy structure, soft dry, very friable moist, moderate stone content, roots common. pH 8.0; conductivity 4.3 Abrupt boundary to:
Ahs_2	2- 5"	Grayish-brown (10YR 5/2 dry), very dark grayish-brown (10YR 3/2 moist) gravelly sandy loam. Weak very

Horizon	Depth	Description
		thin platy breaking to weak very fine granular structure. Slightly hard dry and very friable moist. Moderately stony, roots common. pH 7.9; conductivity 7.3 Abrupt boundary to:
Ahs_3	5- 8"	Light brownish-gray (10YR 6/2 dry), dark grayish-brown (10YR 4/2 moist) gravelly sandy loam. Weak medium subangular blocky breaking to medium granular structure. Slightly hard dry, very friable moist, moderately stony, roots common. Visible concentration of salts. pH 8.4; conductivity 12.2 Abrupt boundary to:
Cks	8-16"	Light gray (10YR 6.5/1 dry), grayish-brown (2.5Y 5/2 moist) gravelly sandy loam. Weak fine subangular blocky structure, slightly hard dry, very friable moist, moderately stony, occasional root, visible salts. pH 8.8; conductivity 14.6 Clear boundary to:
Cs	16"+	Light gray (10YR 6/1 dry), dark grayish-brown (10YR 4/2 moist) gravelly loam. Moderate fine subangular blocky structure, very friable moist, very stony, occasional root in upper part. pH 8.5; conductivity 11.1 at 16 to 24", and 7.4 below 24"

Land-use:

No areas of Cache Creek soils were cultivated at the time of the survey (1962). In the native state these soils provide limited range. Overgrazing has been followed by invasion of weeds, Russian thistle being most common. With irrigation these are limited use soils, owing to heavy gravel content, salinity and unfavorable topography.

In order to obtain satisfactory crop yields, the high content of soluble salts should be reduced by leaching with excess irrigation water. Analyses show that these soils have an exchangeable sodium percentage value of 15 or more somewhere in the profile. Ordinarily this would require additions of gypsum to counteract the harmful effects of sodium. However, it is not anticipated that gypsum would be necessary, inasmuch as considerable quantities of it occur naturally. Once reclaimed the Cache Creek soils would be moderately fertile, and would return fair yields of alfalfa.

Only sprinkler irrigation is recommended, the farm delivery requirement being 36 inches for Cache Creek Gravelly Sandy Loam, 29 inches for the Silt Loam, and 26 inches for the Silt Loam to Silty Clay Loam.

6. ORTHIC BROWN SOILS:

This subgroup consists of mineral soils which developed in a dry climate under natural bunchgrasses. The profile is characterized by a brownish Ah horizon underlaid by a structured Bm horizon, which is slightly brighter in color and free of carbonates. A lighter colored Ck horizon of carbonate accumulation is found at depths of from 12 to 24 inches from the surface. Salts may be present at depths which generally exceed 24 inches. Slightly more leaching occurs than in the Rego-Brown soils. The surface reactions range from neutral to slightly alkaline, the pH values being from 7.0 to 7.7.

The Orthic Brown soils in the mapped area consist of the Basque, McAbee, Walhachin, Nepa, Semlin, and Clemes series. These soils developed on a variety of parent materials, and range from rapidly to well drained.

BASQUE SERIES

The soil areas assigned to the Basque series are situated chiefly between Cache Creek and Basque; a smaller acreage occurs in the Semlin Valley. The topography varies from gently undulating to rolling, most slopes being between five and 30%. Wherever slopes exceed 30%, erosion has retarded profile development and the areas were assigned to the Cheetsum series. Elevations range between 1,500 and 2,300 feet. A total of 400 acres were mapped as Basque series, and an additional 1,346 acres were assigned to complexes in which Basque soils occupy the largest proportions of the areas.

The parent material consists of calcareous glacial till. The till is compact, of medium to moderately fine texture, and contains a moderate to heavy content of cobbles and stones. A loess capping from four to 16 inches thick generally overlies the till and gives the surface soil a silt loam texture. When loess is absent the surface textures range from gravelly loam to gravelly clay loam.

The Basque series consists of well drained Orthic Brown soils. All areas have been heavily grazed, and the now dominant secondary vegetation is composed of sage, pasture wormwood, rabbitbush, cheatgrass, cactus, Russian thistle, and a few surviving clumps of bunchgrass. A profile of Basque Silt Loam, with a loess capping 11 inches thick, was described as follows:

Horizon	Depth	Description
Ah_1	0-2½"	Brown (10YR 5/3 dry), dark brown (10YR 3/3 moist) silt loam. Massive, vesicular, soft dry, very friable moist. Abundant roots. pH 7.4 Abrupt boundary to:
Ah_2	2½- 8"	Brown (10YR 5/3 dry), dark brown (10YR 3/3 moist) silt loam. Moderate medium subangular blocky structure. Hard dry, friable moist, abundant roots. pH 7.7 Clear change to:
AB	8-11"	Yellowish-brown (10YR 5/4 dry), brown to dark brown (10YR 4/3 moist) silt loam. Moderate medium subangular blocky structure, hard dry, friable to slightly firm moist, common roots. pH 7.6 Clear boundary to:
IIBm	11-16"	Light yellowish-brown (10YR 6/4 dry), dark brown to dark yellowish-brown (10YR 4/3.5 moist) silty clay loam. Moderate medium blocky structure, slightly hard dry, friable to slightly firm moist. Many gravels, roots common. pH 7.9 Clear boundary to:
IICk	16-21"	Very pale brown to pale brown (10YR 6.5/3 dry), yellowish-brown (10YR 5/4 moist) silty clay loam. Weak fine blocky structure, hard dry, firm moist, many gravels, occasional cobble, occasional root. pH 8.4 Gradual boundary to:

Horizon	Depth	Description
$IICs_1$	21-27"	Pale brown (10YR 6/3 dry), yellowish-brown (10YR 5/4 moist) slightly compacted silty clay loam till which breaks to plate-like structures. Very hard dry, very firm moist. Many gravels, occasional cobble, occasional root. Visible concentration of salts. pH 8.2; conductivity 6.9 Gradual boundary to:
$IICs_2$	27" +	Grayish-brown (10YR 5/2 dry), dark grayish-brown to brown (10YR 4/2.5 moist) silty clay loam moderately compacted till which breaks to strong plate-like structures. Very hard dry, very firm moist, many gravels, occasional cobble, occasional root, visible salt concentration. pH 8.1; conductivity 10.22

Land-use:

The unfavorable topography limits the range of crops that can be grown on the Basque soils. The most satisfactory crop is alfalfa; intertilled crops should be avoided because of erosion hazard and stoniness. Care should be taken to prevent erosion, and exposure of the infertile calcareous and saline subsoil.

These soils are friable and moderately fertile, nitrogen being the main limiting nutrient. The solum is one of the deepest for Brown soils, hence rooting depth is fairly good. The medium to moderately heavy textures have good moisture holding capacity. Only sprinkler irrigation is recommended; the farm delivery requirement is 24 inches for all textures.

McABEE SILT LOAM

The McAbee soils mainly occur in the Thompson Valley to the southeast of Ashcroft. There is also a minor acreage in the vicinity of McAbee, which was classified in association with the Basque soils. The topography varies from very gently sloping to undulating and rolling. A total of 322 acres were mapped as McAbee Silt Loam, at elevations between 1,300 and 1,600 feet.

The parent material consists of stratified lacustrine deposits, which vary in texture from fine sand to silty clay loam. Surface textures are mostly silt loam, with minor inclusions of fine sandy loam. In part, the McAbee series is derived from glacio-lacustrine deposits which occur as remnants overlying glacial till. The remainder developed on pond deposits which are associated with outwash terraces. These ponds were probably back-swamps situated along the inner margins of floodplains, parts of which later became terraces. The sediments are gravel- and stone-free, and calcareous and somewhat saline at depths.

The McAbee Silt Loam is a well drained Orthic Brown soil. The native vegetation is mostly sage, pasture wormwood, rabbitbush, cactus, and occasional clumps of bunchgrass. A typical profile was described as follows:

Horizon	Depth	Description
Ah_1	0- 2"	Grayish-brown to brown (10YR 5/2.5 dry), dark grayish-brown (10YR 4/2 moist) silt loam. Weak very thin platy structure, soft dry, very friable moist, highly vesicular, occasional root. pH 7.0 Abrupt boundary to:
Ah_2	2- 9"	Brown (10YR 5/3 dry), dark brown (10YR 3/3 moist) silt loam. Weak coarse subangular blocky structure, slightly hard dry, friable moist, roots common. pH 7.6 Clear boundary to:
Bm	9-15"	Yellowish-brown (10YR 5/4 dry) dark brown (10YR 3/3 moist) silt loam. Moderate coarse subangular blocky structure, slightly hard dry, friable moist, roots common. pH 8.3 Clear change to:
BC	15-18"	Brown (10YR 5/3 dry), dark grayish-brown (10YR 4/2 moist) silt loam. Massive, hard dry, friable moist, occasional root. pH 8.7
Ck	18-26"	Light gray (10YR 7/2 dry), grayish-brown (10YR 5/2 moist) silt loam. Massive, some limey concretions, very hard dry, firm moist, occasional root. pH 8.3

Horizon	Depth	Description
Cs	26"+	Light brownish-gray (10YR 6/2 dry), dark grayish-brown (10YR 4/2 moist) fine sandy loam. Massive, soft dry, very friable moist, no roots. pH 8.1; conductivity 9.1

Land-use:

The McAbee soils are from good to excellent for agriculture. Stones are absent, the texture is favorable, and the topography is sufficiently level so that erosion is a minor hazard. Portions have been furrow irrigated for vegetables. Yields were good and these soils are well suited to alfalfa and a wide range of vegetables (See Table 7). Onions and carrots are not recommended because the soils are too compact for good root development and smooth finish.

Although the McAbee Silt Loam is moderately fertile, it is somewhat low in organic matter, nitrogen and phosphorus. Fertilization would be necessary to obtain optimum yields of vegetables. The incorporation of crop residues and green manure would help to build up organic matter and improve the physical structure of the soil. The McAbee Silt Loam has good moisture holding capacity, and is suitable for either sprinkler or furrow irrigation. The recommended farm delivery requirement is 23 inches for sprinklers and 32 inches when furrow irrigation is used.

WALHACHIN SERIES

This series comprises an extensive group of soils located in the Thompson Valley between Deadman River and Basque. The topography varies from level to gently rolling. The steeper slopes occur in areas of complexes with other soils. A total of 1,470 acres were classified between 1,000 and 1,800 feet elevations. Complexes of Walhachin soils with others amount to an additional 150 acres.

The parent material consists chiefly of gravelly and stony glacial outwash terraces. A few alluvial terraces of similar composition deposited by the Thompson River in subsequent times were included. All terraces have a surface capping of finer texture, which varies from 10 to 18 inches in thickness. In most cases materials deposited by wind have contributed to the finer textured surface layer, and in consequence, the loess derived portion of this layer is free of gravels where it has not been disturbed. The stone content in the surface layer varies from none at all to heavy.

The Walhachin series was differentiated into six texture types and two complexes (See Table 4). It is rapidly drained and was classed as Orthic Brown. The native vegetation is composed of sage, rabbitbush, pasture wormwood, cactus, cheatgrass, and weeds. A profile of the Walhachin Sandy Loam was examined and described as follows:

Horizon	Depth	Description
Ah_1	0- 3"	Dark grayish-brown (10YR 4/2 dry), very dark brown (10YR 2/2 moist) sandy loam. Weak thin platy breaking to medium granular structure, soft dry, very friable moist, abundant roots. pH 7.7 Abrupt boundary to:
Ah_2	3- 8"	Grayish-brown (10YR 5/2 dry), very dark grayish-brown (10YR 3/2 moist) sandy loam. Weak medium subangular blocky structure, slightly hard dry, friable moist, common gravels, occasional cobble and root. pH 7.3 Abrupt boundary to:
Bm	8-12"	Brown (10YR 5/3 dry), very dark grayish-brown to dark brown (10YR 3/2.5 moist) gravelly sandy loam. Moderate medium blocky structure, slightly hard dry, friable moist, common cobbles, occasional root. pH 7.7 Clear boundary to:
IICk	12-19"	Grayish-brown (2.5Y 5/2 dry), dark gray to dark grayish-brown (10YR 4/1.5 moist) stony gravelly loamy sand to gravelly sand. Weak fine granular structure, soft dry, very friable moist, heavy lime coatings on gravels and cobbles, roots common. pH 8.3 Gradual boundary to:
IIC_1	19-29"	Stony gravelly sand, single-grained, loose, thin lime coatings on undersides of cobbles, abundant roots. pH 8.3 Gradual boundary to:

Horizon	Depth	Description
IIC_2	29"+	Stony gravelly coarse sand. Single-grained, loose, thin lime coatings on undersides of cobbles, no roots. pH 8.5

Land-use:

Areas of Walhachin soils have been cultivated in the past, but most are now abandoned. In the native state they provide limited range. They are fair to poor irrigation soils, due mainly to the shallow solum and variable content of stones. Alfalfa is suitable for all areas; tomatoes, cucumbers and cantaloupes are recommended only on areas which are moderately stony to stone-free (See Table 7).

Walhachin soils are friable and have favorable topography. They are moderately fertile, but somewhat low in nitrogen and available phosphorus. Sufficient phosphorus may be available for alfalfa, but fertilization would be necessary for vegetables. The moisture holding capacity is low and only sprinkler irrigation is recommended. The farm delivery requirement is 46 inches for Walhachin Stony Sandy Loam and Sandy Loam, 44 inches for the Fine Sandy Loam, and 41 inches for the Stony Loam, Loam and Silt Loam.

NEPA SERIES

The Nepa series consists of a minor group of soils situated on high outwash terraces in the Thompson Valley between Savona and Basque. The topography varies from very gently sloping to gently rolling. A total of 490 acres were mapped between 1,200 and 1,500 feet elevations.

The parent material is composed of a relatively thin deposit of sandy outwash. The sands overlie terrace gravels or more rarely glacio-lacustrine sediments and range from four to 10 feet thick. The sands are calcareous and stone-free, but they may contain scattered gravels. Most areas have a finer textured mantle from 12 to 14 inches thick, with variations from eight to 24 inches. In some cases the surface capping consists in part of wind deposited sediments. The main surface texture is sandy loam, but loamy sand and loam textures also were differentiated.

The rapidly drained Nepa soils were classed as Orthic Brown. They developed under natural bunchgrass, but overgrazing has brought dominance of secondary vegetation which includes sage, pasture wormwood, rabbitbush, speargrass, and dropseed. A profile of Nepa Sandy Loam, typical of the series, was described as follows:

Horizon	Depth	Description
Ah	0- 7"	Brown (10YR 4.5/3 dry) dark grayish-brown to very dark grayish-brown (10YR 3.5/2 moist) sandy loam. Weak medium subangular blocky structure, soft dry, very friable moist, abundant roots. pH 7.7 Clear boundary to:
Bm	7-11"	Yellowish-brown (10YR 5/4 dry), brown to dark brown (10YR 4/3 moist) sandy loam to loamy sand. Weak medium blocky structure, soft dry, very friable moist, roots common. pH 8.0 Clear boundary to:
BC	11-14"	Pale brown to brown (10YR 5.5/3 dry), brown (10YR 4.5/3 moist) loamy sand. Massive, soft dry, very friable moist, roots common. pH 8.3 Abrupt boundary to:
IICk	14-18"	Light brownish-gray (10YR 6/2 dry), grayish-brown (10YR 5/2 moist) coarse sand containing common gravels. Massive, weakly lime cemented, slightly hard dry, friable moist, occasional root. pH 8.4 Clear boundary to:
IIC	18"+	Gray (10YR 5.5/1 dry), dark gray (10YR 4/1 moist) coarse sand. Single-grained, loose, no roots. pH 8.5

Land-use:

In the native state the Nepa soils provide limited range. The natural production of forage is low because of the low proportion of bunchgrasses and the droughty soils. None of these soils are cultivated, due largely to the difficulty of obtaining a supply of irrigation water.

These soils have relatively shallow solums, but they are friable and nearly free of gravels. They are suitable for the production of alfalfa and a wide range of vegetables (See Table 7). Asparagus is not recommended because the sandy loam layer is not thick enough.

The Nepa soils are somewhat deficient in organic matter and nitrogen. The content of available phosphorus is low for vegetable crops and marginal for alfalfa. The other plant nutrients appear to be adequate.

Only sprinkler irrigation is recommended for the Nepa soils, which have low moisture holding capacity. The farm delivery requirement for Nepa Loamy Sand is 46 inches, for the Sandy Loam and Gravelly Sandy Loam 41 inches, and 37 inches for the Nepa Loam.

SEMLIN SERIES

Semlin soils occur in the Thompson Valley between Savona and Basque. They occupy moderately coarse to medium textured fans, and the topography is typical of fan deposits. There is an overall, smooth downward slope from the apex toward the valley centre. The steepest slopes occur near the apex and gradually decline toward the margin of the fans. Most slopes range between three and 15%. Gullies formed by stream channeling are the cause of an irregular surface on some fans. Between 1,200 and 1,800 feet elevations, a total of 1,336 acres were mapped and differentiated into five texture types (See Table 4).

The parent material consists of roughly stratified and poorly sorted fan debris containing a medium to high content of angular gravels and cobbles. The surface six to 12 inches may be finer textured than the subsoil, due in some cases to the addition of wind deposited sediments. Where eolian materials occur, the content of gravels and stones is light to non-existant, but otherwise surface stoniness is moderate to heavy. Free lime is encountered at from 12 to 16 inches depth, but salts have been leached to depths of 24 inches or more.

The Semlin soils, which are rapidly drained, are Orthic Brown soils which developed under bunchgrasses. These grasses have largely been eliminated, and the prevailing cover consists of sage, rabbitbush, pasture wormwood, cactus, cheatgrass, and speargrass. A profile of the Semlin Gravelly Loam was examined and given the following description:

Horizon	Depth	Description
Ah_1	0- 2"	Grayish-brown (10YR 5/2 dry), very dark grayish-brown (10YR 3/2 moist) gravelly loam. Weak thin platy breaking to weak fine granular structure. Highly vesicular, soft dry, very friable moist, many cobbles, abundant roots. pH 6.9 Abrupt boundary to:
Ah_2	2- 9"	Brown (10YR 5/3 dry), very dark grayish-brown to dark brown (10YR 3/2.5 moist) gravelly loam. Weak medium subangular blocky structure, slightly hard dry, friable moist, many cobbles, roots common. pH 7.5 Abrupt boundary to:
Bm	9-15"	Pale brown to brown (10YR 5.5/3 dry), very dark grayish-brown to dark brown (10YR 3/2.5 moist) gravelly loam. Moderate medium to fine blocky structure. Slightly hard dry, friable moist, many cobbles, common roots. pH 8.1 Abrupt boundary to:
Ck	15-28"	Light brownish-gray (10YR 6/2 dry), dark grayish-brown (10YR 4/2 moist) gravelly loam. Moderate fine blocky structure, slightly hard dry, friable moist, very cobbly, common roots. pH 8.6 Gradual boundary to:
IIC-C	28"+	Light brownish-gray (10YR 6/2 dry), dark grayish-brown (10YR 4/2 moist) roughly stratified material with strata that varies from gravelly loam to gravelly sand. Weak medium blocky to single-grained structure. Varies from slightly hard to loose, abundant roots in upper 6", absent beneath. pH 8.5

Land-use:

A limited acreage of Semlin soils is irrigated in conjunction with other soil types. Alfalfa and to a lesser extent, vegetables are grown with fairly good results. These are limited use soils rated as fair to poor for agriculture, depending on slope and stoniness. Alfalfa, hay and pasture are suitable for all areas, while a limited variety of vegetables are recommended only for areas with slopes up to 5% and with moderate to light stone content.

Although the Semlin soils are moderately fertile, they are low in nitrogen, and phosphorus fertilization would be necessary for vegetables. Salts are present in the subsoil, but usually deep enough to do no harm to plant growth. The solum is fairly deep for a Brown soil, has good physical structure, and a moderately good moisture holding capacity.

Only sprinkler irrigation is recommended, with a farm delivery requirement of 32 inches for Semlin Sandy Loam and Gravelly Sandy Loam, and 29 inches for the Gravelly Loam, Silt Loam and Gravelly Silt Loam.

CLEMES SERIES

Soils assigned to the Clemes series occupy medium to moderately fine textured fans between Walhachin and Basque in the Thompson Valley. The topography varies from very gently to gently sloping, with gradients seldom exceeding 5%. They are a minor group of soils with a total of 510 acres at elevations between 1,200 and 1,600 feet.

The parent material consists chiefly of silty alluvial fan sediments. Such materials usually occur at the lower extremities of large fans, but in localities where a fan has eroded directly from glacio-lacustrine silts, the whole fan is fine textured. The series is mostly gravel- and stone-free, but a few areas having light to moderate gravel and stone content are included. The silty fan sediments average from two to three feet thick, with extremes of 18 to 60 inches or more, overlying coarser textured fan debris or gravelly terraces.

The Clemes series was differentiated into Fine Sandy Loam, 30 acres; Loam, 158 acres; Silt Loam, 273 acres; and Clay Loam, 48 acres. Surface reactions range from pH 6.5 to 8.0, free lime being at from 12 to 18 inches deep. Salts are at depths exceeding 14 inches. They are classified as well drained Orthic Brown soils.

The natural vegetation is composed of sage, rabbitbush, pasture wormwood, cactus, cheatgrass, and scattered bunchgrass. A profile of the Clemes Silt Loam was described as follows:

Horizon	Depth	Description
Ah_1	0- 3"	Grayish-brown to brown (10YR 5/2.5 dry), very dark grayish-brown (10YR 3/2 moist) silt loam. Moderate coarse macroprismatic breaking to weak thin platy structure, vesicular. Soft dry, very friable moist, abundant roots. pH 6.5 Abrupt boundary to:
Ah_2	3- 8"	Brown (10YR 5/3 dry), dark brown (10YR 3/3 moist) silt loam. Moderate coarse prismatic breaking to moderate medium subangular blocky structure. Slightly hard dry, friable moist, roots common. pH 7.4 Clear boundary to:
Bm	8-17"	Pale brown to brown (10YR 5.5/3 dry), brown to dark brown (10YR 4/3 moist) silt loam. Moderate coarse prismatic breaking to moderate coarse blocky structure, hard dry, friable moist, roots common. pH 7.9 Clear boundary to:
BC	17-26"	Pale brown (10YR 6/3 dry), brown (10YR 4.5/3 moist) silt loam. Moderate coarse prismatic breaking to moderate coarse blocky structure. Hard dry, friable moist, occasional root. pH 8.8 Clear boundary to:
Ck	26-36"	Light brownish-gray (10YR 6/2 dry), grayish-brown to dark grayish-brown (10YR 4.5/2 moist) silt loam. Strong medium blocky structure, vesicular. Very hard dry, firm moist, common gravels and cobbles, occasional root. pH 9.1 Clear boundary to:
IIC	36"+	Stony and gravelly coarse sand. Single-grained, loose, lime plating on gravels, roots in upper 2" and absent below. pH 8.4

Land-use:

The Clemes series rates as some of the best agricultural soils in the map-area, with very good to fair suitability for irrigation. Stones are absent or few in number, textures are good and the topography is favorable. These soils excepting the Clay Loam, are suitable for alfalfa and a wide range of vegetables (See Table 7). Carrots are not recommended inasmuch as the textures are too heavy and the soil too compact to permit good root development and smooth finish. The surface soil tends to pack on cultivation, but this in part could be overcome by improving the structure and tilth by use of green manure crops and other forms of organic matter.

Although reasonably well supplied with plant nutrients, the Clemes soils are low in nitrogen and additional phosphorus is probably required for the production of vegetables. Salts are present in the subsoil of many areas, but usually too deep to affect plant growth.

These soils have good moisture holding capacity, and sprinkler or furrow irrigation could be used. Under sprinklers the farm delivery requirement is 29 inches for the Clemes Fine Sandy Loam, 26 inches for the Loam, 24 inches for the Silt Loam and 23 inches for the Clay Loam. For furrow irrigation, 47 inches is recommended for the Clemes Fine Sandy Loam, 39 inches for the Loam, 34 inches for the Silt Loam and 32 inches for the Clay Loam.

7. CALCAREOUS MEADOW SOILS:

This subgroup of Meadow soils consists of mineral soils subject to a high, fluctuating water table. Intermittent poor drainage produced an Ah horizon of darker color and higher content of organic matter than well drained soils of the area. The Ah horizon, which is more than two inches thick, grades into a dull colored subsoil that may or may not be gleyed or mottled. The soil is calcareous thoughout, and reactions are moderately alkaline, but there is little associated salinity.

These soils developed under grass or mixed grass and deciduous trees. In the mapped area the Calcareous Meadow subgroup is confined to the Venables series.

VENABLES SERIES

The Venables soils occupy medium to moderately fine textured fans and slopewash. The deposits are situated in the Semlin Valley and in the Thompson Valley between Ashcroft and Basque. The topography is from gently to steeply sloping, the gentle to moderate slopes predominating. A total of 686 acres were classified between 1,300 and 2,300 feet elevations.

The parent material consists of silty alluvial fan and slopewash deposits. The fan sediments occupy the lower parts of large fans, and the slopewash deposits are in depressional areas of the till-plain west of Ashcroft. The parent materials are similar to those of the Bonaparte and Clemes series, but the Venables soils are subject to a high, fluctuating water table, resulting in poor drainage during part of the year. Gravels and stones are absent or few in number.

The Venables series was differentiated into Loam, 27 acres; Silt Loam, 546 acres; Silt Loam to Silty Clay Loam, 55 acres, and Silty Clay Loam, 58 acres. All areas are calcareous to the surface, the reactions being from pH 7.9 to 8.3. The upward movement of capillary moisture is probably responsible for the maintenance of the high content of carbonates.

The native vegetation consists of reeds, sedges, wild rye grass, redtop, meadow foxtail, and others. Profile development is that of a Calcareous Meadow soil. A cultivated profile of the Venables Silt Loam was given the following description:

Horizon	Depth	Description
Aa	0- 4"	Gray (10YR 4/1 dry), dark gray (10YR 3/1 moist) silt loam. Weak medium granular structure, soft dry, very friable moist, abundant roots. pH 8.3 Clear boundary to:
ACk	4- 9"	Light gray to gray (10YR 6/1 dry), gray to dark gray (10YR 4.5/1 moist) silt loam. Weak fine sub-angular blocky structure, slightly hard dry, friable moist, roots common. pH 8.4 Gradual change to:
Ckg$\overline{j}$	9-21"	Light gray (10YR 6.5/1 dry), grayish-brown to dark grayish-brown (2.5Y 4.5/2 moist) silt loam. Massive, friable moist, common roots. pH 8.1 Abrupt boundary to:
Cg	21"+	Light gray (5Y 7/2 dry), olive gray (5Y 5/2 moist) silty clay. Common distinct mottles, weakly stratified, firm moist, sticky wet, roots absent. pH 8.3

In virgin areas up to three inches of peat occur on the surface.

Land-use:

A small acreage of Venables series is irrigated in conjunction with other soil types, and used for the production of alfalfa and other hay. The results are generally good, although alfalfa may be killed out in patches by excess moisture. Since the soil tends to pack on cultivation, vegetables are not recommended. Structure and tilth could be improved by the incorporation of crop residues.

Inasmuch as the Venables soils are low in available phosphorus, this element should be added in fertilizers. Total nitrogen supplies are good, but it is unlikely that crop requirements can be supplied entirely from the soil, and additions of chemical fertilizers appears necessary, particularly for optimum yields of grasses. The other nutrient elements are in good supply.

Although the salt content of the soils is at a safe level, the soils are located in natural seepages, surrounded by lands having salty subsoils. With irrigation, the salts will be washed from the surrounding land and tend to concentrate in the Venables soils. To avoid this possibility, the Venables soils should be under-drained.

The Venables soils have good moisture holding capacity and generally favorable topography; sprinkler or furrow irrigation may be used. The extra moisture provided by a high water table in the spring would reduce the length of the irrigation season. Under sprinklers, the farm delivery requirement is 18 inches for all textures. For furrow irrigation, 32 inches is recommended for Venables Loam and Silt Loam, and 21 inches for the Silty Clay Loam.

8. SALINE MEADOW SOILS:

These are mineral soils subject to seepage and a high, fluctuating water table. The intermittent poor drainage results in an Ah horizon darker colored and of higher organic matter content than well drained soils of the area. The Ah horizon is more than two inches thick, grading into a dull colored subsoil that may or may not be gleyed or mottled. The soil throughout is calcareous and saline. Surface reactions vary from pH 7.7 to 8.3, and electrical conductivities from 5.0 to 16.0 millimhos per centimeter. The soils developed under swampy vegetation which consists of reeds, sedges and water-tolerant grasses.

Tremont Silt Loam was the only soil type classed as a Saline Meadow soil.

TREMONT SILT LOAM

The Tremont Silt Loam developed on medium to moderately fine textured fans situated mainly in the Semlin Valley. A small acreage in the Bonaparte Valley was included. The topography is very gently to gently sloping, with gradients that do not exceed 5%. A total of 423 acres were classified at elevations between 1,200 and 1,800 feet.

The parent material is composed of silty alluvial sediments which were deposited in the lower parts of large fans. A minor acreage of similar textured river alluvium in the Bonaparte Valley was included in the mapping unit. The sediments are gravel- and stone-free, and similar to those from which the Bonaparte and Clemes series are derived. However, the Tremont Silt Loam is subject to seepage and poor drainage for a large part of the year. Seepage water carries carbonates and soluble salts into Tremont soil areas, making the soil calcareous and saline to the surface. The surface reaction varies from pH 7.7 to 8.3, with conductivity values from 5.0 to 16.0. In some cases conductivity decreases with depth; in others a high level occurs throughout the profile. Surface salt efflorescence is common. Classed as a Saline Meadow soil, the Tremont Silt Loam developed in open swampy land supporting water-tolerant plants such as reeds, sedges, wild rye grass, redtop, and meadow foxtail.

A cultivated profile of the Tremont Silt Loam was given the following description:

Horizon	Depth	Description
Aas	0- 6"	Very dark gray to black (10YR 2.5/1 moist) silt loam. Moderate medium platy breaking to very fine blocky structure, firm moist, abundant roots. pH 8.3; conductivity 8.6 Abrupt boundary to:
Cgj_1	6-12"	Very dark grayish-brown (10YR 3/2 moist) silty clay loam. Moderate medium platy breaking to very fine blocky structure. Common faint mottles, firm moist, slightly sticky wet, roots common to occasional. pH 8.3; conductivity 1.9 Clear boundary to:

Horizon	Depth	Description
Cgj_2	12-25"	Very dark grayish-brown (10YR 3/2 moist) silty clay loam. Massive, occasional vertical crack. Common faint mottles, moderately vesicular due to old root channels, friable moist, sticky wet, occasional root. pH 8.3; conductivity 1.1 Gradual boundary to:
Cg	25"+	Dark grayish-brown to very dark grayish-brown (10YR 3.5/2 moist) silty clay loam. Common faint mottles, massive, sticky and plastic wet, occasional root in upper part. pH 8.3

Land-use:

Most of the classified acreage is utilized for the production of hay. Alfalfa does not do well; most of a planting reverts to couchgrass, meadow foxtail and redtop. Reed canarygrass, bromegrass or sweet clover would be more suitable on this soil than alfalfa (See Table 7).

Reclamation requires drainage to intercept seepage and lower the water table, and irrigation to remove salts and supply moisture to the topsoil. When this is done the Tremont Silt Loam would become good agricultural land.

This soil type has a deep solum, good texture and a favorable topography. The fertility level is reasonably good excepting phosphorus, which could be supplemented through fertilization. Although the total nitrogen content is high, it is unlikely that crop requirements can be supplied entirely from this source. With drainage, some irrigation would be necessary. The farm delivery requirement for sprinklers is 15 inches, and 21 inches for furrow irrigation.

9. SALINE GLEYSOL SOILS:

This Gleysol subgroup consists of mineral soils which developed under the influence of very poor drainage and a swamp vegetation of sedges, reeds and tulees. The soil profile is characterized by a surface mat of organic matter less than six inches thick, underlain by a strongly gleyed subsoil which may be mottled.

An Ah horizon less than two inches thick may be present. The soil is calcareous and saline. This subgroup is represented in the mapped area by the Minaberriet Silt Loam. Surface reactions are from pH 7.7 to 8.5 and conductivities are in excess of 5.0 millimhos per centimeter.

MINABERRIET SILT LOAM

This soil type occupies a minor acreage on fan and slopewash deposits of medium to moderately fine texture. Most of the acreage is in the Semlin Valley; small, scattered areas also occur in the Thompson Valley between Ashcroft and Basque. The topography is depressional to very gently sloping, with gradients generally less than one percent. A total of 353 acres were classified at elevations between 1,400 and 2,300 feet.

The Minaberriet Silt Loam developed in very poorly drained depressions which contain silty alluvial fan and slopewash deposits. The fan sediments occupy the lower margins of large fans, while the slopewash occupies depressions in the till-plain west of Ashcroft. The depressions collect seepage, and the water table is at or close to the surface the year around. Seepage supplies the depressions with carbonates and salts, and the soil is calcareous and saline. The main surface texture is silt loam, with minor inclusions of silty clay loam. Gravels and stones are absent.

The Minaberriet Silt Loam is a Saline Gleysol. The high water table retards decomposition of plant residues, so a thin layer of peat is common on the surface. The peat is often interlayered with inwashed silt. The Minaberriet Silt Loam developed under a swamp vegetation of reeds, sedges, tulees, meadow foxtail, and water-tolerant weeds. A profile was described as follows:

Horizon	Depth	Description
Ls & Cgs	0- 5"	Dark grayish-brown to dark yellowish-brown (10YR 4/2 - 4/4 moist) interstratified fibrous peat and silt loam. Visible salt concentration. Abundant roots which bind the mass together. pH 7.7; conductivity 7.7 Abrupt boundary to:
Cgs_1	5-11"	Very dark gray (5Y 3/1 moist) silt loam. Weak medium subangular blocky structure, common distinct brown to dark brown (10YR 4/3 moist) mottles.

Horizon	Depth	Description
		Firm moist, slightly sticky and plastic wet, abundant roots. pH 7.8; conductivity 3.1 Clear boundary to:
Cgs_2	11"+	Very dark gray (2.5Y 3/0 moist) strongly gleyed silt loam. No mottles, massive, firm moist, sticky and plastic wet. Roots common in upper part. pH 7.7; conductivity 3.4 falling to 2.5 below 20"

Land-use:

In the unreclaimed state the Minaberriet Silt Loam is poor to doubtful for agriculture, owing to high salt content and a high water table. It affords some grazing of low quality forage. Reclamation works would include drainage to lower the water table, and irrigation to supply moisture to the topsoil and remove salts. Once this is accomplished the Silt Loam would make good agricultural land.

This soil type has good texture and topography, and is reasonably fertile. At the time of the survey (1962), the soil had poor structure, but this would improve with drainage. It would not be economical to entirely eliminate the high water table, so reed canarygrass, bromegrass and sweet clover are the only crops recommended. With establishment of a good sward, limited irrigation may be necessary in the middle and latter part of the growing season. Under sprinkler irrigation the farm water requirement would be 10 inches.

10. MISCELLANEOUS LAND TYPES:

BLUFFS

The Bluffs are areas of steeply sloping land with gradients that generally exceed 50%. They include a variety of materials, including sandy and gravelly outwash, glacio-lacustrine silts, glacial till and bedrock.

The topography is so steep that the Bluffs are actively eroding. There is little or no profile development and generally a lack of vegetation. A total of 4,996 acres were mapped, all of which has no value for grazing or any other purpose.

SWAMPS

There are about 184 acres of swamps which occupy depressions in the Semlin Valley, and low lying areas in the alluvial bottomland of the Bonaparte Valley. The swamps contain water for most or all of the year. They support water-tolerant vegetation, and usually are bottomed with a variable thickness of plant remains. In their natural state the swamps have value as a source of water for livestock, and they may furnish a limited amount of browse.

ROCK OUTCROPS

In the classified area, outcroppings of bedrock are frequent on the valley sides, or as in the area west of Ashcroft, they form low hills within the valley. About 2,736 acres were mapped. Generally the surface of the rock is shattered and weathered, and able to maintain a limited growth of grasses and weeds. Wherever the topography is moderate, these areas have some value for range.

GRAVEL PIT

One gravel pit covering 44 acres was mapped in the vicinity of McAbee. This area is mined by the C.N.R. The material consists of bedrock and crushed aggregate is stockpiled on an adjoining terrace. Numerous small gravel pits are scattered throughout the map-area, which were too small to be delineated.

CLASSIFICATION ACCORDING TO SUITABILITY FOR IRRIGATION

Table 4 gives the classification of soils in the Ashcroft-Savona map-area according to suitability for irrigation. Table 5 lists the recommended farm delivery requirements of soil types for sprinkler irrigation. Table 6 shows the recommended farm delivery requirements of the soils which are suitable for furrow irrigation.

The method of classification according to suitability for irrigation is outlined in Reclamation Committee Brief 22 (14). Short definitions of the irrigable soil classes are as follows:

CLASS I SOILS:

This class includes deep, uniform, well drained soils of medium to moderately fine textures, such as fine sandy loam, loam, silt loam, and silty clay loam. Class I soils have desirable structure and other profile features with little or no deduction for alkali, salinity, stoniness of adverse topography. Soils of this class are the most suitable for irrigation and are capable of producing most commercial crops which can be grown under the prevailing climatic conditions.

CLASS II SOILS:

Included in this class are well drained clays and sandy loams as well as soils of medium to moderately fine textures with moderate deductions for stoniness, adverse topography, impeded drainage, etc. Most Class II soils have crop adaptations similar to those of Class I, but are given a lower classification because of less uniformity.

CLASS III SOILS:

Class III, which includes soils with similar textures to those in Class I and II, has moderate to high deductions for stoniness, adverse topography, impeded drainage, etc. Class III also includes moderately well drained heavy clays and comparatively stone-free gravelly river terrace and channel deposits. These soils are classed by a more limited range of crop adaptation or less compatibility to irrigation practices.

CLASS IV SOILS:

This class includes soils having limited use as a result of thin solums, heavy concentrations of gravels or stones, adverse topography, salinity, poor drainage, etc. The range of crops is definitely limited, and good management is required for satisfactory results.

CLASS V SOILS:

This class includes soils of poor to doubtful suitability for irrigation. Such soils are characterized by coarse and shallow solums, or very rough topography, high salt content, extreme stoniness, etc. They are of very limited use, often restricted to growing only one crop, or to crops which form a permanent cover.

AGRICULTURE AND SOIL MANAGEMENT

The map-area is situated in a region known as the Lower Grassland Zone. This zone has value for spring, fall and winter range. It lies adjacent to important areas of upland range, and to take advantage of the grasslands, ranching evolved as the predominant type of agriculture.

Limited acreages within the classified area are irrigated for winter feed production, but most of it is still in the native state. Overgrazing has destroyed the original climax of bluebunch wheatgrass, seriously reducing the carrying capacity of the range. Inasmuch as the land in the map-area is easily accessible, and has value for late season grazing, it may be economically feasible to restore the original productivity. To do this, several measures are necessary, but the main requirements are to remove the undesirable existing vegetation and seed the land to suitable grasses. Crested wheatgrass is one of the best because it tolerates very dry conditions, survives close grazing and is best for use in fall and spring (11).

Perhaps the most important asset of the area are the hot summers, which can be utilized to get good yields of alfalfa, and which permit the production of heat-loving vegetables. Table 7 gives the recommended crops and probable yields of the classified soil types (15). Alfalfa could be produced on all but two soil types, but vegetables are much more restricted. The approximate total acreages suitable for commercial vegetable production are as follows:

Crop	Acreage	Mixed Acreage*
Onions	672	-
Tomatoes	5,025	1,354
Cucumbers	5,025	1,695
Peppers	3,947	445
Asparagus	3,457	445
Carrots	2,421	445
Cantaloupes	1,078	1,250
Sweet Corn	3,947	445
Potatoes	3,947	445
Late Potatoes	1,779	-

The above acreages indicate the best land in the map-area, much of which is used for the production of forage. To attain these limited acreages would require changing the use of a large part of the land cultivated at present.

Soil quality is the main limiting factor in growing vegetables. Features such as coarse textures, thin solums, heavy stone content and unfavorable topography precludes their production in most of the area. Apart

*Acreages of soil types having variable slopes and stoniness. In these soil types, vegetables are limited to slopes up to 5% and to moderate stoniness (S_3 or less), the exact acreage of which was not differentiated.

from stone removal, little can be done to alter these features. However, good yields could be obtained by choosing the most suitable crop for each location.

Good yields require good management. A major problem is the low organic matter content of most of the soils. A primary objective of soil management should be to maintain an adequate supply of actively decomposing organic matter in the form of crop residues, green manure crops and barnyard manure. If an intertilled crop is being grown, there should be provision to rotate with a green manure crop every three or four years. Austrian Winter Peas sown early in the spring, followed by Siberian Millet in the summer, permits the growing of two green manure crops in one season, and the incorporation of a large quantity of organic matter. One of the most desirable results of this practice would be the maintenance of a good soil structure, which improves tilth.

Under the natural conditions, the low organic matter content of the soil also means a low level of naturally occurring nitrogen. Nitrogen fertilization is necessary for non-leguminous crops. When planting a legume such as alfalfa, the seed should be inoculated.

Phosphorus and potassium are the other major nutrients which may be limiting to plant growth. Analyses of samples taken during the soil survey (See Tables 10 and 11) indicate that available phosphorus is in short supply in many of the soils. Available potassium is present in adequate amounts in some soils, but could be limiting in others, particularly those of coarse texture having thin solums.

The test values reported in Tables 10 and 11 do not express the absolute amounts of nutrients available for plant growth, but they are an index of the relative amounts available. For example, a test of 20 lbs. per acre of phosphorus does not mean 20 lbs. available for a crop during a growing season. In consequence, the test values become more meaningful when they are correlated with actual availability to the growing plant. This can be accomplished only by controlled test correlation experiments, and only limited information is available for the classified area.

Tables 8 and 9 are presented as a general guide for the interpretation of test results. The groupings of crops into categories of phosphorus and potassium requirement is based on research done elsewhere. This work has shown that plants vary in their demand for nutrient elements. Alfalfa, for example, can give maximum yields when the phosphorus

Table: 4

CLASSIFICATION OF SOILS ACCORDING TO SUITABILITY FOR IRRIGATION (Acres)

Soils	Irrigable Land Classes					Total irri-gable	Non-irri-gable	Total
	1st	2nd	3rd	4th	5th			
Anglesey L.S.	-	-	-	10	69	79	-	79
Anglesey G.L.S.	-	-	-	-	12	12	-	12
Anglesey S.L.	-	-	14	246	217	477	-	477
Anglesey G.S.L.	-	-	24	332	785	1,141	-	1,141
Anglesey Stony S.L.	-	-	-	13	112	125	-	125
Anglesey F.S.L.	-	-	278	125	57	460	-	460
Anglesey L.	-	-	19	46	-	65	-	65
Anglesey G.L.	-	-	57	-	-	57	-	57
Anglesey Stony L.	-	-	-	-	24	24	-	24
Anglesey Silt L.	-	-	329	144	80	553	-	553
Anglesey G. Silt L.	-	-	-	93	30	123	-	123
Anglesey Series	-	-	-	-	-	-	4,390	4,390
Anglesey-Cache Creek	-	-	-	-	-	-	49	49
Anglesey-Cheetsum	-	-	-	-	-	-	137	137
Anglesey-Epsom	-	-	-	-	-	-	583	583
Anglesey-Joeross	-	-	-	15	7	22	273	295
Anglesey Walhachin	-	-	-	108	228	336	-	336
Barnes G.L.S.	-	-	-	-	68	68	-	68
Barnes G.S.L.	-	-	-	25	36	61	-	61
Barnes Series	-	-	-	-	-	-	163	163
Barnes G.L.S.-Savona S.	-	-	-	-	-	-	8	8
Basque G.L.	-	-	-	7	13	20	-	20
Basque Silt L.	-	-	18	160	50	228	-	228
Basque G.C.L.	-	-	-	74	-	74	-	74
Basque Series	-	-	-	-	-	-	78	78
Basque-Anglesey	-	-	-	-	249	249	-	249
Basque-Cheetsum	-	-	-	180	564	744	281	1,025
Basque-McAbee	-	-	-	72	-	72	-	72
Bonaparte F.S.L.	-	71	3	-	-	74	-	74
Bonaparte F.S.L.-Si.L.	-	72	68	-	-	140	-	140
Bonaparte L.-Si.L.	-	304	-	-	-	304	-	304
Bonaparte L.	-	34	8	-	-	42	-	42
Bonaparte Si.L.	-	1,557	301	-	-	1,858	-	1,858
Bonaparte Si.C.L.	-	39	24	-	-	63	-	63
Cache Creek G.S.L.	-	-	-	7	250	257	-	257
Cache Creek Si.L.	-	-	58	20	-	78	-	78
Cache Creek Si.L.-Si.C.L.	-	-	76	-	-	76	-	76

(Continued)

Table: 4 (Continued)

Soils	Irrigable Land Classes 1st	2nd	3rd	4th	5th	Total irri-gable	Non-irri-gable	Total
Carquille G.S.L.-L.S.	-	-	-	22	-	22	-	22
Carquille S.L.	-	-	13	73	18	104	-	104
Carquille F.S.L.	-	-	18	118	194	330	-	330
Carquille G.F.S.L.	-	-	-	19	-	19	-	19
Carquille F.S.L.-Si.L.	-	-	52	233	-	285	-	285
Carquille Si.L.	-	14	144	163	71	392	-	392
Carquille Si.C.L.	-	-	28	-	-	28	-	28
Carquille-Tremont	-	-	-	70	-	70	-	70
Carquille-Tsotin	-	-	-	92	274	366	-	366
Cheetsum G.F.S.L.	-	-	-	15	-	15	-	15
Cheetsum L.	-	15	-	-	95	110	-	110
Cheetsum G.Si.L.	-	-	-	-	32	32	-	32
Cheetsum Si.L.	-	9	-	81	130	220	-	220
Cheetsum Series	-	-	-	-	-	-	7,608	7,608
Cheetsum-Anglesey	-	-	-	-	-	-	278	278
Cheetsum-Basque	-	-	-	-	243	243	373	616
Cheetsum-Rock Outcrop	-	-	-	-	-	-	874	874
Chrome S.L.	-	-	6	114	32	152	-	152
Chrome G.S.L.	-	-	-	15	-	15	-	15
Chrome F.S.L.	-	31	42	22	-	95	-	95
Chrome Si.L.	-	127	30	9	-	166	-	166
Chrome-Carquille	-	24	121	11	-	156	-	156
Chrome-Tsotin	-	-	-	17	-	17	-	17
Clemes F.S.L.	15	9	7	-	-	31	-	31
Clemes L	22	60	76	-	-	158	-	158
Clemes Si.L.	44	151	78	-	-	273	-	273
Clemes C.L.	-	48	-	-	-	48	-	48
Joeross S.	-	-	-	23	42	65	-	65
Joeross L.S.	-	-	22	162	65	249	4	253
Joeross S.L.	-	-	44	-	-	44	7	51
Joeross F.S.L.	-	-	141	34	-	175	-	175
Joeross F.S.L.-L.S.	-	-	60	-	-	60	-	60
Joeross-Anglesey	-	-	-	-	57	57	52	109
Joeross-Bonaparte	-	-	10	-	-	10	-	10
Joeross-Lopez-Savona	-	-	-	153	-	153	-	153
Lopez S.	-	-	-	80	10	90	-	90
Lopez L.S.	-	-	-	78	-	78	-	78
Lopez S.L.	-	10	97	-	17	124	-	124
McAbee Si.L.	80	242	-	-	-	322	-	322
Minaberriet Si.L.	-	-	-	108	245	353	-	353

(Continued)

Table: 4 (Continued)

Soils	Irrigable Land Classes 1st	2nd	3rd	4th	5th	Total irri- gable	Non- irri- gable	Total
Nepa L.S.	-	-	-	50	-	50	-	50
Nepa L.S.-L.	-	-	-	22	-	22	-	22
Nepa S.L.-G.S.L.	-	-	57	-	-	57	-	57
Nepa S.L.	-	-	164	107	82	353	-	353
Nepa L.	-	8	-	-	-	8	-	8
Savona S.	-	-	-	29	178	207	-	207
Savona S.-L.S.	-	-	-	-	28	28	312	340
Savona L.S.	-	-	-	-	91	91	-	91
Savona-Anglesey	-	-	-	-	153	153	14	167
Savona-Joeross	-	-	-	-	176	176	-	176
Savona-Lopez	-	-	-	-	31	31	-	31
Semlin S.L.	-	-	37	48	-	85	-	85
Semlin S.L.-L.	-	-	8	65	-	73	-	73
Semlin G.S.L.	-	-	-	102	194	296	36	332
Semlin G.S.L.-G.L.	-	-	-	-	184	184	-	184
Semlin G.L.	-	-	-	383	75	458	50	508
Semlin Si.L.	-	-	60	-	-	60	-	60
Semlin G.Si.L.	-	-	-	16	78	94	-	94
Taweel G.L.S.	-	-	-	-	161	161	-	161
Taweel G.L.S.-G.S.L.	-	-	-	3	533	536	-	536
Taweel S.L.	-	-	-	27	431	458	-	458
Taweel G.S.L.	-	-	-	308	2,262	2,570	-	2,570
Taweel G.S.L.-G.L.	-	-	-	-	242	242	-	242
Taweel F.S.L.	-	-	-	127	168	295	-	295
Taweel L.	-	-	-	80	216	296	-	296
Taweel G.L.	-	-	-	20	332	352	-	352
Taweel Si.L.	-	-	-	323	319	642	-	642
Taweel G.Si.L.	-	-	-	176	215	391	-	391
Taweel Series	-	-	-	-	-	-	1,665	1,665
Taweel-Anglesey	-	-	-	12	-	12	298	310
Taweel-Barnes	-	-	-	-	38	38	60	98
Taweel-Bonaparte	-	-	-	-	114	114	-	114
Thompson Series	-	-	-	-	-	-	757	757
Tremont Si.L.	-	-	-	161	206	367	56	423
Tsotin G.L.S.	-	-	-	-	42	42	-	42
Tsotin G.S.L.	-	-	-	-	243	243	-	243
Tsotin S.L.	-	-	8	20	-	28	-	28
Tsotin Series	-	-	-	-	-	-	458	458
Tsotin-Carquille	-	-	-	-	8	8	-	8
Venables L.	-	14	13	-	-	27	-	27
Venables Si.L.	-	30	192	324	-	546	-	546
Venables Si.L.-Si.C.L.	12	19	24	-	-	55	-	55
Venables Si.C.L.	58	-	-	-	-	58	-	58

(Continued)

Table: 4 (Continued)

Soils	Irrigable Land Classes 1st	2nd	3rd	4th	5th	Total irri-gable	Non-irri-gable	Total
Walhachin St. S.L.	-	-	-	372	61	433	-	433
Walhachin S.L.	-	-	124	207	79	401	-	401
Walhachin F.S.L.	-	-	112	-	51	163	-	163
Walhachin St. L.	-	-	-	38	-	38	-	38
Walhachin L.	-	-	30	-	-	30	-	30
Walhachin Si.L.	-	-	165	72	97	334	-	334
Walhachin Series	-	-	-	-	-	-	71	71
Walhachin-Anglesey	-	-	-	133	-	133	-	133
Walhachin-Lopez	-	-	-	17	-	17	-	17
Bluffs	-	-	-	-	-	-	4,996	4,996
Swamps	-	-	-	-	-	-	184	184
Rock Outcrops	-	-	-	-	-	-	2,736	2,736
Gravel Pitt	-	-	-	-	-	-	44	44

Abbreviations:

S: Sand; L.S.: Loamy Sand; G.L.S.: Gravelly Loamy Sand; S.L.: Sandy Loam; G.S.L.: Gravelly Sandy Loam; St. S.L.: Stony Sandy Loam; F.S.L.: Fine Sandy Loam; L: Loam; G.L.: Gravelly Loam; St. L.: Stony Loam; Si.L.: Silt Loam; G.Si.L.: Gravelly Silt Loam; G.C.L.: Gravelly Clay Loam; Si.C.L.: Silty Clay Loam; C.L.: Clay Loam; G.F.S.L.: Gravelly Fine Sandy Loam.

Total Acreages of Irrigable Land Classes:

1st Class	231	Acres
2nd "	2,888	"
3rd "	3,260	"
4th "	6,631	"
5th "	11,455	"
Total irrigable land	24,465	Acres
Non-arable land	26,895	"
Total acreage of classified area	51,360	Acres

Table: 5

RECOMMENDED WATER REQUIREMENTS OF SOIL TYPES USING SPRINKLER IRRIGATION

Soil Type and Complex	A*	B*	C*	D*	E*
Anglesey Loamy Sand	50	6	10	79	329
Anglesey Gravelly Loamy Sand	50	6	10	12	50
Anglesey Sandy Loam	50	6	10	477	1,987
Anglesey Gravelly Sandy Loam	50	6	10	1,141	4,754
Anglesey Stony Sandy Loam	50	6	10	125	521
Anglesey Fine Sandy Loam	50	6	10	460	1,917
Anglesey Loam	46	7	9.5	65	249
Anglesey Gravelly Loam	46	7	9.5	57	218
Anglesey Stony Loam	46	7	9.5	24	92
Anglesey Silt Loam	46	7	9.5	553	2,120
Anglesey Gravelly Silt Loam	46	7	9.5	123	472
Anglesey-Joeross Complex	50	6	10	22	92
Anglesey-Walhachin Complex	50	6	10	336	1,400
Barnes Gravelly Loamy Sand	54	5	11	68	306
Barnes Gravelly Sandy Loam	54	5	11	61	274
Basque Gravelly Loam	24	23	6	20	40
Basque Silt Loam	24	23	6	228	456
Basque Gravelly Clay Loam	24	23	6	74	148
Basque-Anglesey Complex	39	10	8.5	249	809
Basque-Cheetsum Complex	24	23	6	744	1,488
Basque-McAbee Complex	24	23	6	72	144
Bonaparte Fine Sandy Loam	29	18	6.5	74	179
Bonaparte Fine Sandy Loam-Si.L.	26	20	6	140	303
Bonaparte Loam-Silt Loam	26	20	6	304	659
Bonaparte Loam	26	20	6	42	91
Bonaparte Silt Loam	24	23	5.5	1,858	3,716
Bonaparte Silty Clay Loam	23	25	5.5	63	121
Cache Creek Gravelly Sandy Loam	35	12	8	257	771
Cache Creek Silt Loam	29	18	6.5	78	188
Cache Creek Si.L.-Si.C.L.	26	20	6	76	165
Carquille Gravelly Sandy Loam-Loamy Sand	36	7	9.5	22	66
Carquille Sandy Loam	33	10	8.5	104	286
Carquille Fine Sandy Loam	25	16	7	330	687
Carquille Gravelly Fine Sandy Loam	28	12	8	19	44
Carquille Fine Sandy Loam-Silt Loam	25	16	7	285	594
Carquille Silt Loam	20	20	6	392	653
Carquille Silty Clay Loam	16	25	5.5	28	37
Carquille-Tremont Complex	15	30	5	70	87
Carquille-Tsotin Complex	54	5	11	366	1,647

(Continued)

Table: 5 (Continued)

Soil Type and Complex	A*	B*	C*	D*	E*
Cheetsum Gravelly Fine Sandy Loam	25	20	6	15	31
Cheetsum Loam	25	20	6	110	229
Cheetsum Gravelly Silt Loam	25	20	6	32	66
Cheetsum Silt Loam	25	20	6	220	458
Cheetsum-Basque Complex	25	20	6	243	506
Chrome Sandy Loam	33	12	8	152	418
Chrome Gravelly Sandy Loam	33	12	8	15	41
Chrome Fine Sandy Loam	27	16	7	95	214
Chrome Silt Loam	23	20	6	166	318
Chrome-Carquille Complex	23	20	6	156	299
Chrome-Tsotin Complex	54	5	11	17	76
Clemes Fine Sandy Loam	29	18	6.5	31	75
Clemes Loam	26	20	6	158	342
Clemes Silt Loam	24	23	5.5	273	546
Clemes Clay Loam	23	25	5.5	48	92
Joeross Sand	50	6	10	65	270
Joeross Loamy Sand	50	6	10	249	1,037
Joeross Sandy Loam	46	7	9.5	44	169
Joeross Fine Sandy Loam	46	7	9.5	175	671
Joeross Fine Sandy Loam-Loamy Sand	46	7	9.5	60	230
Joeross-Anglesey Complex	50	6	10	57	237
Joeross-Bonaparte Complex	39	10	8.5	10	32
Joeross-Lopez-Savona Complex	50	6	10	153	637
Lopez Sand	50	6	10	90	375
Lopez Loamy Sand	44	8	9	78	286
Lopez Sandy Loam	39	10	8.5	124	403
McAbee Silt Loam	23	25	5.5	322	617
Minaberriet Silt Loam	10	30	4	353	294
Nepa Loamy Sand	46	7	9.5	50	192
Nepa Loamy Sand-Loam	41	9	9	22	75
Nepa Sandy Loam-Gravelly Sandy Loam	41	9	9	57	195
Nepa Sandy Loam	41	9	9	353	1,206
Nepa Loam	37	11	8	8	24
Savona Sand	50	6	10	207	862
Savona Sand-Loamy Sand	50	6	10	28	117
Savona Loamy Sand	50	6	10	91	379
Savona-Anglesey Complex	50	6	10	153	637
Savona-Joeross Complex	50	6	10	176	733
Savona-Lopez Complex	50	6	10	31	129

(Continued)

Table: 5 (Continued)

Soil Type and Complex	A*	B*	C*	D*	E*
Semlin Sandy Loam	32	15	7	85	227
Semlin Sandy Loam-Loam	32	15	7	73	195
Semlin Gravelly Sandy Loam	32	15	7	296	789
Semlin Gravelly Sandy Loam-Gravelly Loam	32	15	7	184	491
Semlin Gravelly Loam	29	18	6.5	458	1,107
Semlin Silt Loam	29	18	6.5	60	145
Semlin Gravelly Silt Loam	29	18	6.5	94	227
Taweel Gravelly Loamy Sand	46	7	9.5	161	617
Taweel Gravelly L.S.-Gravelly Sandy Loam	46	7	9.5	536	2,055
Taweel Sandy Loam	36	12	8	458	1,374
Taweel Gravelly Sandy Loam	36	12	8	2,570	7,710
Taweel Gravelly Sandy Loam-Gravelly Loam	36	12	8	242	726
Taweel Fine Sandy Loam	36	12	8	295	885
Taweel Loam	32	15	7	296	789
Taweel Gravelly Loam	32	15	7	352	939
Taweel Silt Loam	32	15	7	642	1,712
Taweel Gravelly Silt Loam	32	15	7	391	1,043
Taweel-Anglesey Complex	39	10	8.5	12	39
Taweel-Barnes Complex	54	5	11	38	171
Taweel-Bonaparte Complex	32	15	7	114	304
Tremont Silt Loam	15	30	5	367	459
Tsotin Gravelly Loamy Sand	54	5	11	42	189
Tsotin Gravelly Sandy Loam	54	5	11	243	1,093
Tsotin Sandy Loam	54	5	11	28	126
Tsotin-Carquille Complex	54	5	11	8	36
Venables Loam	18	30	5	27	38
Venables Silt Loam	18	30	5	546	819
Venables Silt Loam-Si.C.L.	18	30	5	55	82
Venables Silty Clay Loam	16	30	5	58	77
Walhachin Stony Sandy Loam	46	7	9.5	433	1,660
Walhachin Sandy Loam	46	7	9.5	401	1,537
Walhachin Fine Sandy Loam	44	8	9	163	598
Walhachin Stony Loam	41	9	8.5	38	130
Walhachin Loam	41	9	8.5	30	102
Walhachin Silt Loam	41	9	8.5	334	1,141
Walhachin-Anglesey Complex	50	6	10	133	554
Walhachin-Lopez Complex	50	6	10	17	71
Total acreage and water requirements				24,465	71,935

<u>Note</u>: See Table 6 for abbreviations and definitions of A, B, C, D, and E.

Table: 6

FARM WATER REQUIREMENTS OF CERTAIN SOIL TYPES FOR FURROW IRRIGATION

Soil Type and Complex	A*	B*	C*	D*	E*
Bonaparte Fine Sandy Loam	45	18	10	74	277
Bonaparte Fine Sandy Loam-Silt Loam	39	20	9	140	455
Bonaparte Loam-Silt Loam	39	20	9	304	988
Bonaparte Loam	39	20	9	42	136
Bonaparte Silt Loam	32	23	7.5	1,858	4,955
Bonaparte Silty Clay Loam	32	25	7.5	63	168
Carquille Fine Sandy Loam	37	16	10.5	330	1,017
Carquille Gravelly Fine Sandy Loam	45	12	13	19	71
Carquille Fine Sandy Loam-Silt Loam	37	16	10.5	285	879
Carquille Silt Loam	28	20	8.5	392	915
Carquille Silty Clay Loam	21	25	7	28	49
Carquille-Tremont Complex	21	30	6.5	70	122
Chrome Fine Sandy Loam	49	16	12.5	95	388
Chrome Silt Loam	39	20	10	166	539
Chrome-Carquille Complex	39	20	10	156	507
Clemes Fine Sandy Loam	47	18	10.5	31	124
Clemes Loam	39	20	9	158	513
Clemes Silt Loam	34	23	8	273	773
Clemes Clay Loam	32	25	7.5	48	128
McAbee Silt Loam	32	25	7.5	322	859
Tremont Silt Loam	21	30	6.5	367	642
Venables Loam	23	30	6.5	27	52
Venables Silt Loam	23	30	6.5	546	1,046
Venables S.L.-Si.C.L.	23	30	6.5	55	105
Venables Silty Clay Loam	21	30	6.5	58	101
Total acreage and water requirements				5,907	15,809

Abbreviations: Si.L.: Silt Loam; Si.C.L.: Silty Clay Loam; L.S.: Loamy Sand

*A - Farm delivery requirement in acre-inches.
*B - Interval between irrigations in days.
*C - Carrying capacity of the irrigation system for peak month in acre-inches.
*D - Irrigable and potentially irrigable land in acres.
*E - Total water requirements for each soil type and complex in acre-feet.

Table: 7

SUITABLE CROPS AND PROBABLE YIELDS PER ACRE

Soils	Alfalfa Tons	Onion Tons	Tomato Tons	Cucumber Tons	Pepper Tons	Asparagus Tons	Carrot Tons	Sweet Corn Dozen	Potato Tons
Anglesey Series and Complexes	4.5	NR	NR	NR	NR	NR	NR	NR	NR
Barnes Series	4.5	NR	NR	NR	NR	NR	NR	NR	NR
Basque Series and Complexes	6.0	NR	NR	NR	NR	NR	NR	NR	NR
Bonaparte Series	6.5	NR	15	8	3	2	NR	1,200	12
Cache Creek Series	4.5	NR	NR	NR	NR	NR	NR	NR	NR
Carquille Series	5.0	NR	NR	NR	NR	NR	8	NR	10-12*
Carquille Complexes	5.0	NR	NR	NR	NR	NR	NR	NR	NR
Cheetsum Series and Complexes	5.5								
Chrome Gravelly Sandy Loam	5.0	NR	NR	NR	NR	NR	NR	NR	NR
Chrome Series and Complexes	5.5	NR	NR	NR	NR	NR	8	NR	10-12*
Clemes Fine Sandy Loam	7.0	12	15	8	2	1.5	NR	1,000	8
Clemes Loam-Silt Loam	7.0	NR	15	8	2	1.5	NR	1,000	8
Clemes Clay Loam	7.0	NR	NR	NR	NR	NR	NR	NR	NR
Joeross Sand	6.0	NR	NR	NR	NR	NR	NR	NR	NR
Joeross Loamy Sand	6.0	NR	NR	5-6	2	1.5	7	700	8- 9**
Joeross Sandy Loam	6.0	NR	8-9	6	2	1.5	8	800	9-10**
Joeross Fine Sand Loam-L.S.	6.0	NR	8-9	6	2	1.5	8	800	9-10**
Joeross Complexes	6.0	NR	NR	NR	NR	NR	NR	NR	NR
Lopez Sand	6.0	NR	NR	NR	NR	NR	NR	NR	NR
Lopez Loamy Sand-Sandy Loam	6.0	10-12	8-9	5-6	2	1.5	8	900	8- 9

L.S.: Loamy Sand
NR: Not Recommended
*: Late Potatoes Only
**: Vegetables limited to slopes up to 5%, and moderate stoniness (S3) or less

Table: 7 (Continued)

Soils	Alfalfa Tons	Onion Tons	Tomato Tons	Cucumber Tons	Pepper Tons	Asparagus Tons	Carrot Tons	Sweet Corn Dozen	Potato Tons
McAbee Silt Loam	7.5	NR	15	8	2	2	NR	1,000	10
Minaberriet Silt Loam		Brome grass or other grass only - Drainage required							
Nepa Loamy Sand	7.0	NR	10	6-8	2	NR	NR	800	9-10
Nepa Series	7.0	12	15	8-9	3	NR	8	1,000	10-12
Savona Sand-Loamy Sand	6.0	NR	NR	NR	NR	NR	NR	NR	NR
Savona Loamy Sand	6.0	NR	NR	5-6	.2	1.5	7	700	8- 9**
Savona Complexes	6.0	NR	NR	NR	NR	NR	NR	NR	NR
Senlin Series	6.5	NR	10	7	3#	NR	NR	NR	NR**
Taveel Series	6.0	NR	NR	NR	NR	NR	NR	NR	NR
Taveel Complexes	6.0	NR	NR	NR	NR	NR	NR	NR	NR
Tremont Silt Loam			Reed Canary, Brome, Sweet Clover - 4 tons						
Tsotin Series	4.5	NR	NR	NR	NR	NR	NR	NR	NR
Tsotin Complex	4.5	NR	NR	NR	NR	NR	NR	NR	NR
Venables Series	6.0	NR	NR	NR	NR	NR	NR	NR	NR
Walhachin Series	6.0	NR	10	6	3#	NR	NR	NR	NR**
Walhachin Complexes	6.0	NR	10	6	3#	NR	NR	NR	NR**

NR: Not Recommended
*: Late Potatoes Only
**: Vegetables limited to slopes up to 5%, and moderate stoniness (S_3) or less
#: Canteloupes

test indicates 40 lbs. per acre, but onions require about one hundred pounds per acre for optimum production. As more local field data becomes available, the rates of fertilizer application, and the crop groupings may be altered or refined. The values presented in Tables 8 and 9 are not valid for test procedures that are different from those outlined in this report.

The other main problem in the mapped area is the concentration of soluble salts in the subsoils of most soils. Under natural conditions, the salts generally occur at sufficient depth to be of little concern. However, when the land is irrigated, solution and movement of the salts can occur. Since seepage water tends to accumulate downslope and in depressions, the salinization of a considerable acreage is possible. For example, Tremont Silt Loam, a saline soil type, is probably the result of existing irrigation. Areas of potential seepage are often associated with the better, finer textured soils, so the prevention of seepage is important. Studies on the probability of salt movements should be undertaken before large scale irrigation works are installed, or as soon as new seepages are noticed. Salt movement is not a problem in soils derived from sandy or gravelly river terraces or eolian deposits, which have porous substrata.

Table: 8

RECOMMENDED PHOSPHORUS APPLICATIONS FOR SELECTED CROPS BASED ON SOIL TEST VALUES

Soil Test Values for Phosphorus lbs. (P) per Acre*				Recommended Phosphorus Application, lbs. P_2O_5 per Acre
			5	200
		5	10	175
		10	15	150
	5	15	20	125
5	10	20	30	100
10	15	30	40	70
15	20	40	60	50
20	30	60	75	25
30	40	75	100	15**
Barley Oats Rye Grass Corn Pasture Clover	Alfalfa Carrots Wheat Sweet Corn Cucumbers	Asparagus Potatos Tomatoes	Onion	

*To obtain lbs. per acre of phosphorus from Table 11, multiply by 2.
**15 lbs. P_2O_5 is recommended as starter fertilizer regardless of soil test.

Table: 9

RECOMMENDED POTASSIUM APPLICATIONS FOR SELECTED CROPS, BASED ON SOIL TEST VALUES

Soil Test Values for Potassium, lbs. (K) per Acre*				Recommended Potassium Application, lbs. K_2O per Acre
			70	300
		50	100	250
	50	70	130	200
50	70	100	160	150
70	100	130	200	100
100	130	160	250	80
130	160	200	300	60
160	200	250	350	40
200	250	300	400	20**
Barley Oats Rye Wheat Grass Pasture	Clover Corn Sweet Corn	Alfalfa Carrots Cucumbers	Asparagus Potatoes Onions Tomatoes	

*To obtain lbs. per acre of potassium from Table 10, multiply by 782.

**At these levels response to potassium fertilization is not likely, but 20 lbs. per acre can be added to small areas on a trial basis.

CHEMICAL ANALYSES

Partial chemical analyses are presented for most soils occurring in the map-area. The analyses provide information pertaining to the classification of these soils, and serve as a general guide to their fertility and management. It must be mentioned, however, that the fertility status of individual farms would vary considerably according to past management practices and also that the number of analyses performed are too limited to make positive fertilizer recommendations. 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 the various soil properties is given as an aid to the interpretation of the chemical data presented in Tables 10, 11, and 12.

Soil Reaction:

Pure water has a pH of 7, a value which represents neutrality. Values less than pH 7 denote acidic conditions while those above pH 7 alkaline conditions. The pH range for soils may vary from about 3 to 10. Soils in the Ashcroft area range mainly from pH 7.0 to 8.5.

Soils with a pH value of 7.5 to 8.0 usually contain free carbonates of calcium and magnesium, while those with pH values of 8.5 or more generally contain considerable amounts of exchangeable sodium and sodium carbonate. Plants vary in their ability to grow at different pH values, and while no single factor may be responsible for limiting growth, an important consideration is nutrient availability. For example, in alkaline soils growth may be limited by the low availability of phosphorus, zinc, iron, manganese, and boron. Soils with reactions of 6.2 to 7.5 are practically neutral and this represents the ideal situation for most crops. Between the pH range of 7.5 to 8.5, the growth of many crops may be limited and only alkaline tolerant crops should be grown. Soils with pH values above 8.5 are strongly alkaline. With special attention, alkaline tolerant plants may make fair growth, but generally reclamation measures are necessary before such soils can be successfully farmed.

Organic Matter:

The content of organic matter in the soil may vary from less than one percent in mineral soils to as high as one hundred percent in organic soils. The maintenance of an adequate supply of organic matter is one of the most important requirements of soil fertility and management.

Organic matter contributes to plant growth through its effect on the physical, chemical and biological properties of the soil. Most if not all of the nitrogen and some of the phosphorus and sulphur are held in organic combinations. However, the organic form of these nutrients must be mineralized before being utilized by higher plants, a process accomplished by the micro-biological population of the soil.

The frequent additions of easilty decomposable organic residues cause the synthesis of complex organic compounds that bind soil particles into structural units called aggregates. These aggregates help maintain a loose, open granular condition which improves the tilth, increases resistance to erosion and facilitates the movement of air and water through the soil. In short, the presence of adequate amounts of organic matter in the soil improves the structure of both coarse and fine textured soils, increases the moisture holding and cation exchange capacities, and creates a favorable carbon dioxide-oxygen relationship which is beneficial to plant root development.

Phosphorus:

Phosphorus is one of the major elements essential for plant growth. Most of the total phosphorus occurs in forms not immediately available to the growing plant. Available soil phosphorus originates from the breakdown of soil minerals, soil organic matter, or from previous additions of phosphate fertilizer. Only inorganic phosphorus is utilized by higher plants, and organic phosphorus forms must first be mineralized by organisms.

The chemistry of phosphorus is complex, but a knowledge of a few basic principles will aid in its utilization.

One characteristic feature of soil phosphorus is its low solubility in the soil solution. Phosphorus applied as fertilizer changes into less soluble compounds similar to the native forms present. This process is called fixation. The nature of the fixation may affect phosphorus fertilizer efficiency differently on different types of soil. Acid soils contain a large excess of active iron and aluminum while alkaline soils an excess of calcium. These elements combine with water soluble phosphorus producing less soluble compounds. Iron and aluminum phosphates are least soluble at pH 4, with their maximum availability in the pH range of 6.5 to 7.0. As the pH increases from 7 to 8.5 in alkaline soils, the availability of phosphorus decreases as a result of the formation of calcium phosphates.

The fixation processes take place quite rapidly so that applied phosphorus does not move any appreciable distance through the soil. This means that the plant root must move to the phosphorus rather than the phosphorus moving to the plant root as is the case for nitrogen. Consequently, phosphorus should be distributed throughout the cultivated layer either by discing or drilling. Topdress applications are beneficial primarily when the crop has abundant feeding roots in the upper one or two inches of soil, a condition which occurs most commonly in humid areas or in irrigated soils. In most dry farmed soils, the roots tend to concentrate at lower depths, although this is somewhat dependent on the type of plant and rooting habit.

The data on available phosphorus levels in Table 11, are on the basis of bicarbonate extractable forms. A discussion on the desirable levels for various crops is presented in the section on agriculture.

Nitrogen:

Nitrogen is a major element of special importance because it is utilized by plants 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 ability to maintain an adequate nitrogen supply.

The atmosphere is the ultimate source of soil nitrogen. Higher plants cannot utilize gaseous nitrogen directly and it must first be combined with other elements, a process called nitrogen-fixation. 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, Clostridia, are responsible for fixing large quantities of atmospheric nitrogen. The bacteria, Rhizobia, living in symbiotic relationship with legumes also makes a considerable 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.

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. 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.

The dependence of nitrogen availability on microbial activity makes interpretation of the analytical values even more difficult than is the case for available phosphorus and potassium. The probable response of crops to nitrogen fertilizers can be determined primarily by taking into account previous yields and cropping history, kinds of residues returned to the soil, adequacy of other nutrients, the weather and soil conditions. Analytical values of total nitrogen can serve only as a partial guide, and the following levels may be used:

Very low	.10%
Low	.10 - .25%
Medium	.25 - .40%
High	.40% plus

Cation Exchange Capacity and Exchangeable Cations:

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 are 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. 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 variation in behavior between soil types, and between soil horizons of the same profile. Total cation exchange capacities below 5 milli-equivalents per 100 grams of soil are regarded as very low, 5 to 10 as low and 10 to 20 as medium. Over 20 is considered high.

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.

Exchangeable potassium levels constitute an important indication of the potassium supplying power of a soil. The exchangeable potassium is in equilibrium with less available mineral and fixed forms. As exchangeable potassium is removed by plants, potassium is gradually released from the less available forms to restore the equilibrium. The maintenance of an adequate exchangeable potassium supply therefore depends upon the amount in reserve and the rate of release. A discussion on the desirable levels of exchangeable potassium for different crops is presented in the section on agriculture.

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.

Conductivity:

The content of soluble salts in the soil solution is estimated electrically through conductivity measurements. The greater the conductivity the greater the content of soluble salts present in the soil solution. The greater the soluble salt concentration the greater the osmotic pressure against which plants must draw their nutrients. Conductivity measurements are estimated in terms of millimhos per centimetre (electrical conductivity $X\ 10^3$). Concentrations of soluble salts of four or more millimhos/cm. are considered harmful to normal plant growth although the amount of damage at any particular level varies with the salt tolerance of the crop.

Soluble Cations:

In regions of low precipitation, soluble salts accumulate in soils which are subject to seepage and restricted drainage. The salts usually present consist of sulphates and chlorides of calcium, magnesium and sodium. Such salts produce harmful effects to plants by increasing the salt content of the soil solution, and in some cases by increasing the degree of saturation of the soil exchange complex with sodium. The latter effect occurs when the soluble constituents consist largely of sodium salts, and is of a more permanent nature since exchangeable sodium usually persists after the soluble salts are removed.

Empirical equations have been devised for expressing the relationship between soluble and exchangeable cations. By this method the exchangeable-sodium-percentage can be calculated using the values obtained for calcium, magnesium and sodium in a saturated soil extract. Depending upon the conductivity and kinds of salts present, the soils may be classed as follows (6):

a. Saline Soils - the conductivity values are in excess of 4 millimhos/cm., but the exchangeable-sodium-percentage is less than 15. In no case does the pH exceed 8.5

b. Non-saline - Alkali Soils - the exchangeable-sodium-percentage of these soils exceeds 15, but the soluble salt contents are low. Usually the pH exceeds 8.5

c. Saline-Alkali Soils - the conductivity values are greater than 4 millimhos/cm., and the exchangeable-sodium-percentage exceeds 15. The pH readings may vary considerably, but are commonly less than 8.5

The kinds and relative amounts of salt a soil contains places it in one of the classes described above and governs the recommendations made regarding its reclamation. The reclamation of saline soils requires leaching only, providing drainage is adequate. Replacement of the exchangeable sodium is required for the reclamation of non-saline-alkali soils, and this can be accomplished by the application of an amendment such as gypsum or sulphur. Saline-alkali soils require both leaching and the addition of an amendment for their reclamation.

<u>Methods of Analyses:</u>

Determination of cation exchange capacity was by the method described by Peach (13). Total exchangeable bases were determined on the ammonium acetate extract. 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. Calcon 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 (13).

Total nitrogen was determined by the procedure described by Atkinson (1), with the modification that selenium was used as the catalyst, as suggested by Bremner (2). Available phosphorus was estimated by extraction with sodium bicarbonate as described by Olsen (12).

Interpretation of Chemical Analyses:

(a) Table 10

This table presents data pertaining to the Cation Exchange Capacity and Exchangeable Cations of selected soil profile horizons and composite surface samples. The reaction of the surface horizons of most soils are neutral to mildly alkaline, becoming moderately to strongly alkaline in the subsoils. All soils are highly base saturated, indicating that leaching is slight in this area. Abundant quantities of calcium and magnesium are present in all soils. Exchangeable potassium is adequate to abundant in the better textured soils. In fact certain soils such as McAbee and Semlin series show unusually high amounts of exchangeable potassium. Coarse textured soils with thin solums such as Anglesey, Nepa, Taweel, and Walhachin series contain the lowest amounts. Exchangeable sodium is at a low and safe level in the surface horizons of most soils. Soils with moderately fine textured or impervious subsoils (eg. Basque and Clemes series) often show exchangeable sodium levels of 15% or more. It is only in the Cache Creek series that the surface horizons show exchangeable sodium levels harmful to plant growth.

(b) Table 11

This table lists the organic matter, nitrogen and available phosphorus levels for the profile horizons of most soil types and selected composite surface samples. Most of the soils developed under a grass vegetation, and the organic matter is concentrated in the Ah horizons, beneath which it generally decreases abruptly. Certain coarse textured fans and terraces do not show this abrupt increase, as the subsoil horizons also contain appreciable organic matter contents. This may be due to the excellent root distribution in these soils. The same distribution pattern also applies to the Mull Regosols derived from alluvium, although in this case buried surface horizons are also a contributing factor.

The organic matter content in the surface horizons of the Brown soils is mostly within the range of one to two percent, with occasional higher values in the surface two to three inches. The highest organic contents occur in the Meadow soils, a factor attributable to the lush native vegetation supported by these poorer drained soils.

There is a positive correlation between the organic matter content and nitrogen levels. The nitrogen levels in the surface horizons of the Brown soils ranges mostly between .05% and .2%, while those in the Meadow soils vary from .25% to .35%. The carbon to nitrogen ratios of all soils are narrow, varying from 15 to 9. In spite of these narrow ratios, nitrogen deficiencies would occur in most soils. Only the Meadow soils appear capable of supplying a large part of the crop requirement for nitrogen, providing drainage is adequate.

The data on available phosphorus indicates a generally low content for the soils of the area. Those soils with surface horizons of pH 7.7 or less show slightly higher available phosphorus levels, on the average, than those of pH 7.8 or more. Many of the surface horizons of pH 7.8 or more contain free lime, and these particularly show low phosphorus values. It appears likely that all the soils require some phosphorus fertilization, and this aspect is discussed more fully in the section on agriculture.

(c) Table 12

Included in this table are conductivity values, soluble cations and estimated exchangeable-sodium-percentages of saline soils. These data indicate that with the exception of the Cache Creek series, all the soils contain low quantities of soluble sodium and reclamation could be effected by leaching with excess irrigation, providing drainage is adequate. The estimated exchangeable-sodium-percentage for the Cache Creek soil is 15% to 16%, and the soil can be classed as Saline-Alkali (6). To reclaim these soils, the usual procedure involves both leaching and the addition of an amendment such as gypsum. However, in this case, there is a high test for soluble sulphates and it is very likely that additions of gypsum would not be necessary.

Table: 10

CATION EXCHANGE CAPACITY AND EXCHANGEABLE CATIONS
OF PROFILE AND COMPOSITE SURFACE SAMPLES

Soil Type Horizon	Depth	pH 1:1	Cation Exchange Capacity m.e./100 gm	Exchangeable Cations m.e./100 gms Ca	Mg	K	Na	Total	Percent Base Saturation
Anglesey Gravelly Sandy Loam - Rego-Brown Soil									
Ah$_1$	0- 2"	7.9	17.52	10.25	4.40	1.50	0.23	17.52	93.5
Ah$_2$	2- 9	7.4	23.15	13.45	5.57	0.16	0.26	19.44	84.0
Ck-IICk	9-19	8.4	14.54	22.86		0.14	0.58	23.58	100.0
Basque Silt Loam - Orthic Brown Soil									
Ah$_1$	0-2½"	7.4	19.89	13.29	3.46	1.80	0.16	18.71	94.1
Ah$_2$	2½- 8	7.7	17.56	7.78	5.97	1.58	0.16	15.49	88.2
AB	8-11	7.6	18.09	6.64	8.90	0.93	0.27	16.74	92.5
IIBm	11-16	7.9	15.40	8.03	8.09	0.67	0.34	17.13	100.0
IICk	16-21	8.4	9.10	16.74	5.99	0.28	0.31	23.32	100.0
Basque Silt Loam Composite									
#1	0- 6"	7.1	25.77	11.17	9.27	1.21	0.60	22.25	86.3
Bonaparte Silt Loam - Rego-Brown Soil									
Ah$_1$	0-2½"	7.4	16.41	9.29	3.02	1.68	0.14	14.13	86.1
Ah$_2$	2½- 8	7.8	16.20	10.03	3.27	0.61	0.21	14.11	87.1
AC	8-14	8.0	14.21	11.40	16.84	0.31	0.24	28.79	100.0
CK	14-34	8.6	10.22	18.88	5.30	0.18	0.50	24.86	100.0
IICs	34+	8.0	10.86	13.46	4.59	1.21	0.97	20.23	100.0
Bonaparte Silt Loam Composites									
#1	0- 6"	7.6	16.21	10.46	3.59	0.93	0.14	15.12	93.3
#4	0- 8	7.9	26.34	19.65	3.79	1.12	0.30	24.86	94.4
Cache Creek Gravelly Sandy Loam - Saline Rego-Brown Soil									
Ahs$_1$	0- 2"	8.0	8.92	17.16	3.17	1.31	1.46	23.10	100.0
Ahs$_2$	2- 5	7.9	13.03	17.07	6.29	0.94	>2.50	-	100.0
Ahs$_3$	5- 8	8.4	11.21	25.96	12.20	0.32	>2.50	-	100.0
Cks	8-16	8.8	6.72	52.23	11.97	0.13	>2.50	-	100.0
Cs	16-24	8.5	5.57	34.70	8.71	0.16	>2.50	-	100.0

> Greater than

(Continued)

Table: 10 (Continued)

Soil Type Horizon	Depth	pH 1:1	Cation Exchange Capacity m.e./100 gm	Exchangeable Cations m.e./100 gms Ca	Mg	K	Na	Total	Percent Base Saturation
Chrome Silt Loam - Mull Regosol Soil									
Aa	0- 6"	8.0	25.07	31.30		0.68	0.37	32.35	100.0
C_1	6-13	8.1	18.58	28.27		>2.50	0.66	-	100.0
C_2	13-18	8.1	24.70	33.02		2.48	0.68	36.18	100.0
pAh	18-23	8.3	25.39	13.46	11.79	0.49	0.53	26.27	100.0
C_3	23-28	7.9	24.53	11.10	11.21	0.35	0.54	23.20	94.6
Clemes Silt Loam - Orthic Brown Soil									
Ah_1	0- 3"	6.5	39.85	11.20	9.97	10.51	0.38	32.06	80.5
Ah_2	3- 8	7.4	44.63	14.39	11.17	10.00	2.03	37.59	84.2
Bm	8-17	7.9	49.89	14.21	18.91	7.51	7.71	47.80	95.8
BC	17-26	8.8	46.37	18.83	19.33	5.38	10.74	54.28	100.0
Ck	26-36	9.1	36.82	-	-	2.92	12.29	-	-
McAbee Silt Loam - Orthic Brown Soil									
Ah_1	0- 2"	7.0	16.51	7.97	4.80	1.17	0.10	14.04	85.0
Ah_2	2- 9	7.6	18.12	9.37	7.21	0.41	0.29	17.28	95.4
Bm	9-15	8.3	18.51	8.14	8.86	0.30	1.52	18.82	100.0
McAbee Silt Loam Composite									
#1	0- 6"	7.5	17.42	11.45	3.69	0.86	0.19	16.19	92.9
Nepa Sandy Loam - Orthic Brown Soil									
Ah	0- 7"	7.7	19.32	8.78	3.11	0.51	0.12	12.52	64.8
Bm	7-11	8.0	14.57	9.34	3.49	0.11	0.18	13.12	90.0
BC	11-14	8.3	15.79	17.50	4.92	0.09	0.26	22.77	100.0
Nepa Sandy Loam Composites									
#1	0- 6"	7.9	15.18	10.87	2.90	0.35	0.15	14.28	94.1
#2	0- 6	7.8	16.07	11.42	2.65	0.29	0.18	14.54	89.8
Semlin Gravelly Loam - Orthic Brown Soil									
Ah_1	0- 2"	6.9	32.33	11.60	8.99	5.07	0.19	25.85	80.0
Ah_2	2- 9	7.5	40.04	15.75	13.48	3.26	1.64	34.13	85.2
Bm	9-15	8.1	42.84	18.47	15.79	2.26	3.56	40.08	93.6
Ck	15-28	8.6	39.59	42.65		2.73	3.67	49.05	100.0
IIC-C	28+	8.5	34.81	37.67		3.53	5.10	46.30	100.0
Semlin Gravelly Loam Composite									
#1	0- 6"	7.4	21.59	12.92	5.41	1.14	0.16	19.63	90.9

> Greater than

(Continued)

Table: 10 (Continued)

Soil Type			Cation Exchange Capacity	Exchangeable Cations m.e./100 gms					Percent Base Satura-
Horizon	Depth	pH 1:1	me/100 gm	Ca	Mg	K	Na	Total	tion
Taweel Gravelly Loam - Rego-Brown Soil									
Ah_1	0-2½"	8.0	16.47	10.71	3.44	1.48	0.21	15.84	96.1
Ah_2	2½- 6	7.6	18.68	11.32	4.76	0.33	0.24	16.65	89.1
Ah_3	6- 9	7.9	16.85	21.80		0.31	0.41	22.52	100.0
Ck	9-23	8.1	13.25	25.09		0.19	0.90	26.18	100.0
Taweel Gravelly Loam (1) and Gravelly Sandy Loam (2) Composites									
#1	0- 6"	7.6	17.21	12.82	2.31	0.72	0.13	15.98	92.8
#2	0- 6	7.5	17.26	14.16	3.74	1.47	0.16	19.53	100.0
Walhachin Sandy Loam - Orthic Brown Soil									
Ah_1	0- 3"	7.7	19.19	10.62	4.52	1.80	0.13	17.07	89.0
Ah_2	3- 8	7.3	19.72	11.61	4.76	0.18	0.18	16.73	84.8
Bm	8-11	7.7	19.10	13.54	4.29	0.13	0.32	18.28	96.1
IICk	11-19	8.3	12.35	22.94		0.13	0.29	23.36	100.0
Walhachin Sandy Loam Composites									
#1	0- 6"	7.9	16.43	11.56	3.81	0.64	0.13	16.14	98.2
#2	0- 6	7.4	22.35	14.19	6.96	0.67	0.20	22.02	98.5

$>$ Greater than

Table: 11

ORGANIC MATTER, NITROGEN AND AVAILABLE PHOSPHORUS OF PROFILE AND COMPOSITE SURFACE SAMPLES

Soil Type Horizon	Depth	pH 1:1	Percent Organic Matter	Percent Total Nitrogen	C/N Ratio	P.P.M. Available Phos-phorus
Anglesey Gravelly Sandy Loam - Rego-Brown Soil						
Ah_1	0- 2"	7.9	2.00	0.103	11.2	18
Ah_2	2- 9	7.4	2.04	0.104	10.8	7
Ck-IICk	9-19	8.4	1.46	0.083	10.2	8
Anglesey Gravelly Sandy Loam Composite						
#1	0- 6"	8.1	1.47	0.082	10.4	4
Basque Silt Loam - Orthic Brown Soil						
Ah_1	0-2½"	7.4	4.31	0.192	13.0	27
Ah_2	2½- 8	7.7	1.55	0.091	9.9	21
AB	8-11	7.6	1.55	0.096	9.3	8
IIBm	11-16	7.9	1.49	0.086	10.0	6
IICk	16-21	8.4	1.11	0.096	7.2	13
IICs	21-27	8.2	0.36	0.022	9.8	5
Basque Silt Loam Composite						
#1	0- 6"	7.1	1.91	0.107	10.3	11
Bonaparte Silt Loam - Rego-Brown Soil						
Ah_1	0-2½"	7.4	2.98	0.138	12.5	31
Ah_2	2½- 8	7.8	1.35	0.077	10.0	3
AC	8-14	8.0	0.94	0.060	9.0	3
Ck	14-34	8.6	0.91	0.044	11.8	6
IICs	34+	8.0	0.14	0.010	8.6	3
Bonaparte Silt Loam Composites						
#1	0- 6"	7.6	1.55	0.085	15.5	12
#2	0- 6	8.2	2.82	0.147	11.1	6
#3	0- 6	8.2	3.17	0.201	9.1	11
#4	0- 8	7.9	3.54	0.210	9.8	5
Cache Creek Gravelly Sandy Loam - Saline Rego-Brown Soil						
Ahs_1	0- 2"	8.0	2.50	0.116	12.6	43
Ahs_2	2- 5	7.9	2.26	0.123	10.7	11
Ahs_3	5- 8	8.4	1.93	0.118	9.5	5
Cks	8-16	8.8	1.26	0.076	9.6	7
Cs	16-24	8.5	0.69	0.057	7.1	7

(Continued)

Table: 11 (Continued)

Soil Type Horizon	Depth	pH 1:1	Percent Organic Matter	Percent Total Nitrogen	C/N Ratio	P.P.M. Available Phos- phorus
Carquille Fine Sandy Loam - Gleyed Mull Regosolic Soil						
Aa	0- 7"	8.1	4.14	0.176	13.6	8
Cgj1	7-11	8.1	1.72	0.072	13.9	3
Cgj2	11-24	8.1	3.05	0.123	14.4	2
IICgj1	24-27	8.2	C.56	0.022	14.1	2
Cgj3	27-32	8.0	2.85	0.140	11.8	3
Carquille Fine Sandy Loam Composites						
#1	0- 7"	7.8	4.14	0.192	12.5	4
#2	0- 7	8.4	6.04	0.272	12.9	9
Cheetsum Gravelly Silt Loam - Rego-Brown Soil						
Ah	0- 7"	8.0	2.26	0.119	11.0	7
Ck	7-12	8.4	1.91	0.102	10.8	3
Cs_1	12-23	8.1	0.37	0.018	12.1	8
Cs_2	23+	8.2	0.36	0.018	11.8	4
Cheetsum Gravelly Silt Loam Composites						
#1	0- 6"	7.6	1.89	0.103	10.7	11
#2	0- 6	7.4	1.69	0.096	10.2	10
Chrome Silt Loam - Mull Regosol Soil						
Aa	0- 6"	8.0	4.47	0.197	13.2	5
C_1	6-13	8.1	1.27	0.064	11.5	3
C_2	13-18	8.1	2.34	0.102	13.3	3
pAh	18-23	8.3	2.55	0.125	11.4	4
C_3	23-28	7.9	1.77	0.087	11.8	4
Chrome Silt Loam Composites						
#1	0- 8"	8.0	5.47	0.226	11.9	5
#2	0- 6	8.3	5.13	0.235	12.7	5
#3	0- 8	8.1	4.19	0.218	11.2	4
Clemes Silt Loam - Orthic Brown Soil						
Ah_1	0 -3"	6.5	3.92	0.179	12.7	59
Ah_2	3- 8	7.4	1.60	0.084	10.9	20
Bm	8-17	7.9	1.31	0.074	10.3	11
BC	17-26	8.8	0.58	0.040	8.4	3
Ck	26-36	9.1	0.63	0.025	14.6	8
Clemes Loam (1) and Silt Loam (2) Composites						
#1	0- 6"	8.1	1.98	0.092	12.5	13
#2	0- 6	8.3	2.48	0.099	13.4	18

(Continued)

Table: 11 (Continued)

Soil Type Horizon	Depth	pH 1:1	Percent Organic Matter	Percent Total Nitrogen	C/N Ratio	P.P.M. Available Phosphorus
Joeross Loamy Sand - Rego-Brown Soil						
Ah_1	0- 6"	8.2	0.83	0.049	9.9	7
Ah_2	6-11	8.3	0.55	0.034	9.6	3
AC	11-15	8.4	0.41	0.026	9.4	4
Ck	15-24	8.4	0.28	0.019	8.4	5
Joeross Loamy Sand Composite						
#1	0- 6"	7.7	1.12	0.053	12.3	6
McAbee Silt Loam - Orthic Brown Soil						
Ah_1	0- 2"	7.0	1.68	0.096	10.2	15
Ah_2	2- 9	7.6	1.13	0.073	9.0	3
Bm	9-15	8.3	0.86	0.062	7.9	3
BC	15-18	8.7	0.86	0.060	8.2	3
Ck	18-26	8.3	0.72	0.043	9.5	8
Cs	26+	8.1	0.33	0.016	12.2	6
McAbee Silt Loam Composites						
#1	0- 6"	7.5	1.61	0.095	9.8	7
#2	0- 6	8.0	1.41	0.097	8.4	14
Minaberriet Silt Loam - Saline Gleysol Soil						
Ls-Cgs	0- 5"	7.7	23.51	0.974	13.9	31
Cgs_1	5-11	7.8	-	-	-	12
Cgs_2	11-19	7.7	6.31	0.294	12.5	14
Nepa Sandy Loam - Orthic Brown Soil						
Ah	9- 7"	7.7	1.46	0.068	12.4	5
Bm	7-11	8.0	1.12	0.059	11.0	2
BC	11-14	8.3	1.18	0.054	12.7	3
Ck	14-18	8.4	1.26	0.055	13.3	3
Nepa Sandy Loam Composites						
#1	0- 6"	7.9	1.04	0.062	9.7	5
#2	0- 6	7.8	1.66	0.110	8.9	7
Savona Sand - Mull Regosol Soil						
Ahj	0- 4"	8.3	0.84	0.027	18.0	5
C_1	4- 8	8.4	0.33	0.011	17.6	3
C_2	8-16	8.6	0.14	0.006	13.5	2

(Continued)

Table: 11 (Continued)

Soil Type Horizon	Depth	pH 1:1	Percent Organic Matter	Percent Total Nitrogen	C/N Ratio	P.P.M. Available Phosphorus
Semlin Gravelly Loam - Orthic Brown Soil						
Ah_1	0- 2"	6.9	3.57	0.139	14.9	48
Ah_2	2- 9	7.5	2.23	0.081	14.9	8
Bm	9-15	8.1	1.51	0.070	12.5	3
Ck	15-28	8.6	1.45	0.070	12.0	7
IIC-C	28+	8.5	1.44	0.059	14.1	10
Semlin Gravelly Loam Composite						
#1	0- 6"	7.4	1.70	0.079	12.5	13
Taweel Gravelly Loam - Rego-Brown Soil						
Ah_1	0-2½"	8.0	2.16	0.107	11.7	15
Ah_2	2½- 6	7.6	2.06	0.108	11.1	3
Ah_3	6- 9	7.9	2.71	0.127	12.4	4
Ck	9-23	8.1	2.27	0.114	11.6	5
Taweel Gravelly Loam Composites						
#1	0- 6"	7.6	1.61	0.091	10.2	10
#2	0- 6	7.5	1.99	0.089	13.0	13
#3	0- 6	8.0	2.17	0.094	13.5	7
Tremont Silt Loam - Saline Meadow Soil						
Aas	0- 6"	8.3	5.14	0.265	11.2	8
Cgj_1	6-12	8.3	2.22	0.129	10.0	3
Cgj_2	12-25	8.3	1.57	0.103	8.8	2
Cg	25+	8.3	0.85	0.076	6.5	2
Tremont Silt Loam Composites						
#1	0- 6"	7.7	4.56	0.236	11.2	7
#2	0- 6	8.1	7.07	0.294	13.9	4
Venables Silt Loam - Calcareous Meadow Soil						
Aa	0- 4"	8.3	9.03	0.426	12.3	4
ACk	4- 9	8.4	3.81	0.190	11.6	2
Ckgj	9-21	8.1	3.73	0.138	15.6	2
Cg	21+	8.3	1.00	0.040	14.5	1
Venables Silt Loam Composite						
#1	0- 6"	8.3	8.35	0.363	12.6	5

(Continued)

Table: 11 (Continued)

Soil Type Horizon	Depth	pH 1:1	Percent Organic Matter	Percent Total Nitrogen	C/N Ratio	P.P.M. Available Phosphorus
Walhachin Sandy Loam - Orthic Brown Soil						
Ah_1	0- 3"	7.7	2.54	0.134	11.0	10
Ah_2	3- 8	7.3	1.55	0.079	11.4	3
Bm	8-11	7.7	1.27	0.075	9.8	2
IICk	11-19	8.3	1.60	0.091	10.2	5
Walhachin Sandy Loam Composites						
#1	0- 6"	7.9	1.69	0.088	11.1	10
#2	0- 6	7.4	1.62	0.083	11.3	16

Table: 12

CONDUCTIVITY VALUES, SOLUBLE CATIONS AND EXCHANGEABLE SODIUM PERCENTAGES FOR SELECTED SALINE PROFILES AND COMPOSITE SURFACE SAMPLES

Soil Type Horizon	Depth	pH 1:1	Electrical Conductivity Mmhos./ cm	Soluble Cations m.e./litre Ca + Mg	Na	Exchangeable Sodium Percentage
Cache Creek Gravelly Sandy Loam - Saline Rego-Brown Soil						
Ahs_1	0- 2"	8.0	4.26	46.32	13.00	2.5
Ahs_2	2- 5	7.9	7.30	135.20	47.00	6.6
Ahs_3	5- 8	8.4	12.16	156.00	114.00	15.0
Cks	8-16	8.8	13.57	178.10	129.00	15.9
Cs	16-24	8.5	11.13	137.80	114.00	15.9
	24 +	8.3	7.36	96.20	51.00	8.8
Cheetsum Gravelly Silt Loam - Rego-Brown Soil						
Ah	0- 7"	8.0	0.45	6.24	6.50	4.0
Ck	7-12	8.4	1.00	10.92	24.50	13.3
Cs_1	12-23	8.1	10.44	150.80	46.00	6.0
Cs_2	23 +	8.2	6.67	200.20	57.00	6.0
Minaberriet Silt Loam - Saline Gleysol Soil						
Ls-Cgs	0- 5"	7.7	7.71	114.40	21.00	2.5
Cgs_1	5-11	7.8	3.14	42.12	4.50	<1.0
Cgs_2	11-19	7.7	3.41	49.92	4.50	<1.0
	19 +	7.8	2.50	40.04	3.90	<1.0
Tremont Silt Loam Composite - Saline Meadow Soil						
#1 (Aa)	0- 6"	7.7	5.16	47.32	19.20	4.0
#2 (Aa)	0- 6	8.1	7.78	243.36	33.50	3.0

$<$: Less than.

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APPENDIX

Table: A

EXTREMES OF TEMPERATURE BY MONTHS AND ABSOLUTE TEMPERATURE AT RANGE RADIO STATION, ELEVATION 1,600 FEET

(Degrees F.)

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Absolute	
1947	51	55	70	81	92	86	96	94	89	78	48	47	96	Max
	-26	-17	11	26	33	43	44	40	27*	23	9	12	-26	Min
1948	43	48	62	72	90	96	92	88	84	65	50	45		
	4	-15	1	23	35	47	44	42	24*	20	12	-13		
1949	22	47	56	79	M	90	96	95	91	63	62	54		
	-22	-22	9	26	M	37	40	44	29*	16	22	-18		
1950	19	52	53	66	77	92	95	96	93	70	60	53		
	-35	-18	0	25	33	39	48	42	29*	22	- 6	2	-35	
1951	39	40	57	77	80	86	96	94	88	69	51	46		
	-23	-11	-10	21	35	38	48	42	31*	20	12	-29		
1952	43	50	63	75	84	82	96	96	87	76	60	54		
	-22	0	8	24	25*	35	38	39	32*	28	12	12		
1953	49	46	61	67	79	83	95	91	87	71	56	47		
	- 7	13	19	21	31*	40	43	41	33	27	21	15		
1954	40	54	54	65	81	85	92	91	74	64	64	48		
	-27	0	10	16	20*	36	45	45	26*	18	21	10		
1955	37	44	56	67	80	95	97	93	92	66	47	40	97	
	1	-15	-21	23	29*	38	45	38	28*	24	-13	-25		
1956	40	42	52	79	89	82	100	94	84	67	56	56	100	
	-22	-20	- 7	24	28*	40	44	43	32*	8	16	-23		

*May and September Frosts

(Continued)

APPENDIX

Table: A (continued)

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Absolute	
1957	37	52	60	84	88	92	89	89	88	78	51	58		Max
	-28	-13	13	30	40	43	42	37	29*	24	16	16		Min
1958	44	49	60	76	95	99	99	96	88	73	59	55		
	15	20	18	25	34	50	45	43	27*	23	- 1	1		
1959	44	56	57	72	85	84	102	93	85	69	50	46	102	
	-17	- 3	19	21	27*	43	47	42	39	28	-11	12		
1960	47	50	69	75	78	89	102	100	87	72	58	43	102	
	- 8	7	- 7	26	32*	39	48	44	31*	25	16	5		
1961	53	51	64	70	87	101	102	98	77	78	49	49	102	
	5	11	15	24	36	42	44	48	29*	22	11	4		
High	53	56	70	84	95	101	102	100	93	79	64	54	102	
Low	-35	-22	-21	16	25	35	40	38	24	8	-13	-29	-35	

*May and September Frosts

Table: B

PRECIPITATION AT ASHCROFT, FOR 37 YEARS, AT 1,000 FEET ELEVATION

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Snow	Year	Rainfall April to Sept.
1924	0.61	0.39	0.09	0.07	0.24	1.94	0.89	0.43	0.71	0.30	0.57	1.21	16.65	7.45	4.28
1925	0.57	0.22	0.34	0.45	0.32	0.69	0.32	1.06	0.39	0.44	0.00	0.91	14.05	5.71	3.23
1926	0.86	0.35	0.38	0.30	0.64	0.90	0.68	0.83	0.52	0.41	0.50	0.78	7.90	7.15	3.87
1927	0.25	0.17	0.22	0.13	0.53	1.31	0.98	1.68	0.97	0.77	1.37	1.41	22.15	9.79	5.60
1928	0.40	0.00	0.26	0.22	0.09	1.53	0.23	0.41	0.26	0.06	0.25	0.19	6.30	3.90	2.74
1929	1.30	0.10	0.13	0.22	0.47	0.70	0.43	0.30	0.50	0.22	0.58	0.89	22.50	5.84	2.62
1930	0.30	0.22	0.38	0.85	0.39	0.44	0.09	0.04	0.34	0.77	0.20	0.00	4.00	4.02	2.15
1931	0.59	0.36	0.58	0.12	0.19	2.43	0.32	0.08	0.36	0.15	0.50	1.26	22.70	6.94	3.50
1932	0.34	0.10	0.90	0.46	0.60	0.12	0.81	0.90	0.33	1.39	1.21	0.35	11.80	7.51	3.22
1933	0.08	0.38	0.30	0.05	0.56	0.30	0.49	1.04	1.17	1.96	0.36	1.13	21.90	7.82	3.61
1934	0.40	0.45	0.54	0.08	1.12	0.84	0.81	0.13	0.66	0.42	1.08	0.88	15.80	7.41	3.64
1935	1.23	0.05	0.22	0.06	0.53	0.28	1.76	0.55	0.08	0.47	0.15	0.19	14.30	5.57	3.26
1936	1.34	0.55	0.17	0.03	0.61	0.94	0.26	1.56	0.48	0.11	0.17	1.54	32.50	7.76	3.88
1937	2.50	1.00	0.06	0.29	0.30	0.36	0.19	0.11	0.18	0.05	0.42	0.60	44.50	6.06	1.43
1938	0.30	0.20	0.09	0.05	0.18	0.05	0.31	0.32	0.12	0.19	0.29	0.70	–	2.80	1.03
1939	0.92	0.10	0.65	0.90	3.71	0.32	0.10	0.41	0.42	0.42	0.42	0.42	–	8.37	5.86
1940	0.24	0.82	0.39	0.33	1.91	0.17	1.21	0.08	0.00	0.24	0.57	0.48	–	6.12	3.70
1941	0.12	0.37	0.00	0.92	0.74	1.59	0.34	2.43	1.78	0.66	–	–	–	–	7.80
1943	–	0.06	0.42	0.20	0.69	1.86	0.40	0.21	0.19	0.88	0.31	0.32	–	–	3.55
1944	0.75	1.25	0.20	0.13	1.39	1.89	0.50	1.08	1.42	0.00	0.84	0.45	–	9.90	6.41
1945	0.50	0.43	0.13	0.47	0.86	1.38	0.72	0.64	0.62	1.92	1.46	0.75	–	9.88	4.69
1946	0.84	0.24	0.76	0.08	0.52	1.93	0.00	0.46	0.46	0.84	0.73	0.17	–	6.99	3.45
1947	0.40	0.47	0.57	0.61	0.65	2.07	0.02	0.83	0.43	0.96	0.71	1.41	–	9.13	4.61
1948	0.48	1.25	0.08	0.70	0.55	1.34	1.10	2.34	0.30	0.14	0.95	0.28	–	9.51	6.33

(Continued)

Table: B (continued)

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Snow	Year	Rainfall April to Sept.
1949	0.70	0.38	0.16	0.33	0.10	1.44	1.03	0.05	0.11	0.07	0.96	1.83	-	7.16	3.06
1950	0.35	0.64	0.55	0.37	0.31	0.73	0.18	0.32	0.00	1.43	0.53	0.97	-	6.38	1.91
1951	2.20	0.55	0.32	0.00	0.95	0.26	0.35	0.89	0.84	2.00	0.87	1.12	-	10.35	3.29
1952	1.35	1.60	0.17	0.00	0.30	0.95	0.92	0.24	0.26	0.29	0.00	0.38	-	6.46	2.67
1953	2.15	0.15	0.31	0.70	0.38	1.37	0.45	0.70	0.61	0.04	0.25	0.20	-	7.31	4.21
1954	2.13	0.90	0.32	0.70	0.34	1.31	0.71	2.92	1.84	0.00	0.12	0.38	-	11.67	7.82
1955	0.71	0.83	0.20	0.20	1.13	0.89	0.17	0.10	0.47	0.49	2.10	1.33	-	8.62	2.96
1956	0.68	0.55	0.35	0.12	0.00	1.27	0.50	1.35	0.81	0.50	0.04	0.26	18.80	6.43	4.05
1957	0.75	0.50	0.15	0.13	1.07	1.14	0.53	0.59	0.00	1.19	1.09	0.29	13.80	7.43	3.46
1958	0.48	0.57	0.97	0.72	0.01	0.82	0.71	0.04	0.97	0.39	0.36	0.40	6.20	6.44	3.27
1959	1.17	0.15	0.21	0.09	0.67	0.82	0.16	1.45	1.54	0.41	1.03	0.30	9.80	8.00	4.73
1960	0.66	0.10	0.19	0.57	0.22	0.46	0.08	0.37	0.07	0.45	0.41	0.89	12.60	4.47	1.77
1961	0.67	0.42	0.24	0.00	0.68	0.07	1.02	1.06	0.93	0.57	0.52	0.73	15.90	6.91	3.76
High	2.50	1.60	0.97	0.92	1.91	2.43	1.76	2.43	1.84	2.00	2.10	1.83	44.50	11.67	7.82
Low	0.12	0.00	0.00	0.00	0.00	0.05	0.00	0.04	0.00	0.00	0.00	0.00	4.00	2.80	1.03

Table: C

PRECIPITATION AT RANGE RADIO STATION, FOR 15 YEARS AT 1,600 FEET ELEVATION

(Degrees F.)

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Snow	Year	Rainfall April to Sept.
1946	0.97	0.34	0.95	0.09	0.43	2.27	0.00	0.56	0.57	1.02	0.55	0.28	-	8.03	3.92
1947	0.56	0.84	0.71	0.50	0.72	2.33	0.06	0.97	0.56	1.19	0.65	0.79	-	9.88	5.14
1948	0.27	1.38	0.00	0.91	0.97	1.92	1.95	2.24	0.37	0.33	1.21	0.75	-	12.30	8.36
1949	1.24	0.80	0.12	0.33	0.34	0.98	1.02	0.13	0.10	0.26	0.76	2.69	-	8.77	2.90
1950	1.00	0.25	0.21	0.36	0.22	1.01	0.53	0.96	0.00	1.28	1.21	1.75	-	8.78	3.08
1951	2.26	1.06	0.46	0.01	0.55	0.59	0.65	1.09	0.53	2.21	1.41	1.37	-	12.19	3.42
1952	1.21	0.78	0.25	0.11	0.29	1.05	0.85	0.24	0.32	0.28	0.23	0.48	-	6.09	2.86
1953	2.29	0.50	0.30	0.86	0.63	1.64	0.48	0.72	0.93	0.20	0.41	0.80	-	9.76	5.26
1954	1.61	0.93	0.62	0.82	0.43	1.32	0.82	3.19	1.76	0.01	0.15	0.40	-	12.06	8.34
1955	0.74	0.67	0.17	0.28	1.03	1.29	0.59	0.38	0.45	0.79	1.57	1.66	-	9.62	4.02
1956	1.43	0.40	0.96	0.12	0.06	1.29	0.24	1.62	0.77	0.74	0.08	0.38	27.0	8.09	4.10
1957	1.07	1.14	0.38	0.12	1.23	1.07	1.02	1.56	0.11	1.18	0.66	0.38	25.9	9.92	5.11
1958	0.75	0.91	1.71	0.63	0.22	1.78	0.80	0.07	1.02	0.53	0.45	0.89	25.5	9.76	4.52
1959	2.08	0.50	0.10	0.09	0.93	0.96	0.24	1.93	2.01	0.37	1.26	0.57	31.6	11.04	6.16
1960	0.76	0.19	0.30	0.63	0.36	0.45	0.04	0.73	0.10	0.35	0.84	0.91	17.3	5.66	2.31
1961	0.94	0.76	0.43	0.08	1.00	0.11	1.43	0.54	1.29	0.52	0.73	1.07	27.2	8.90	4.45
High	2.29	1.38	1.71	0.91	1.23	2.33	1.95	3.19	2.01	2.21	1.57	2.69		12.30	8.36
Low	0.27	0.19	0.00	0.01	0.06	0.11	0.00	0.07	0.00	0.01	0.08	0.28		5.66	2.31

GLOSSARY

Alluvium - All materials moved and deposited by running water.

Calcareous material - Material having a relatively high content of calcium carbonate. It effervesces when treated with acid.

Cobbles - Rounded and subangular rock fragments from three to 10 inches in diameter.

Colluvium - Heterogenous to poorly sorted material which accumulates at the base of steep slopes through the influence of gravity, including creep, frost action and local wash.

Concretions - Hard concentrations of soil cemented by certain chemical compounds into aggregates or nodules of various sizes and shapes. In this report the term refers to concretions formed by precipitated calcium carbonate.

Conductivity - A method of measuring the salt content of a soil which is based on the ease with which a solution extracted from a saturated soil paste conducts an electric current. The values are expressed as milli-mhos per centimeter at 25°C.

Eolian deposit - Wind deposited sediments such as loess and dune sands.

Glacial till - An unsorted, generally unconsolidated, heterogeneous mixture of stones, gravels, sand, silt, and clay deposited by glacier ice.

Glacio-fluvial deposits - Material carried, sorted and deposited by melt-water streams.

Glacio-lacustrine deposits - Material carried by melt-water and deposited in temporary glacial lakes.

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

Horizon - A layer of the soil profile approximately parallel to the land surface. It has more or less well defined characteristics derived from the soil-building process. Horizon boundaries are described as abrupt if less than one inch wide, clear if from one to 2½ inches, gradual if 2½ to five inches, and diffuse if more than five inches vertical width.

Horizon nomenclature - Definitions of capital and lower case letters used to designate horizons in this report are as follows:

Organic horizons:

L - A layer of organic matter in which the plant remains can be identified.

F - A layer of organic matter which is partly decomposed. The plant remains can be identified, but with difficulty. Fungi mycelia often present.

H - A layer of well decomposed organic matter. The plant remains cannot be recognized.

Master Mineral Soil Horizons:

A - A mineral soil horizon at or near the surface. The zone of maximum removal of materials in solution and suspension, and/or maximum accumulation of organic matter in the soil itself.

B - As used in this report, a mineral soil horizon characterized by loss of water soluble materials (magnesium and calcium carbonates and more soluble salts) accompanied by slight alteration by hydrolysis and/or oxidation and the formation of structure.

C - A mineral horizon comparatively unaffected by the pedogenic processes operating in the A and B horizons, excepting the formation of gley, the accumulation of carbonates and the more soluble salts.

Lithologic changes in the profile are identified by the Roman numerals II, III, etc.; I being assumed where the material is homogenous throughout.

Lower Case Letter Suffixes:

a - A layer disturbed by the activities of man, such as cultivation; used only with reference to the A horizon.

c - A cemented (irreversible) pedogenic horizon.

g - A horizon characterized by chemical reduction and gray colors; may be mottled (Gley).

h - A mineral soil horizon enriched by organic matter.

j - A horizon whose presence is weakly expressed (juvenile). If more than one lower case suffix is used, one only being a weak expression, the "j" is expressed with a bar (e.g. Ckg$\bar{j}$).

k - A horizon which has been enriched with carbonates.

m - A horizon characterized by the loss of water soluble materials only. Usually it is slightly altered by hydrolysis and/or oxidation.

p - A relic horizon or old buried surface (paleosol). Used as a prefix.

s - A horizon enriched with salts, including gypsum.

Kame - A more or less oval or irregular knoll, hummock, etc., usually of sand and/or gravel on valley sides, deposited in irregular channels along the margin of a valley glacier, or in irregular openings in the ice.

Loess - Silty and very fine sand material blown and deposited by wind.

Mottled - Irregular spots or streaks of different colors in soils. Indicates oxidation and reduction caused by a fluctuating water table.

Orthic - A term which identifies the normal or regional subgroup of any soil group.

Outwash - All material washed out of melting glacier ice and deposited by melt-water streams.

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

Polygonal - Having more than four sides and four angles. In this report, soil aggregates formed by surface cracking which extended to about three inches deep.

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

Saline soil - A soil which contains soluble salts in quantities sufficient to interfere with plant growth. The salts are generally sulphates and chlorides of calcium, magnesium and sodium.

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

Stratified - Composed of strata, or arranged in layers.

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

Platy - Thin, horizontal plates; the horizontal axis is longer than the vertical one.

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

Blocky - Block-like aggregates; the vertical and horizontal axes about the same length, usually with sharp edges.

Subangular blocky - Block-like aggregates with vertical and horizontal axes about the same length, usually with sub-rounded edges.

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

Massive - A cohesive soil mass having no observable aggregation.

Single-grained - A loose, incoherent mass of individual particles as in sand.

Terrace - A relatively flat, horizontal or gently inclined plain of variable size, step-shaped. In the soil map-area the term refers to river terraces.

Texture - Soil texture is based on the amount of sand, silt and clay a soil may have. Sand consists of particles which range in size from 2.0 to 0.5 mm; silt from .05 to .002 mm; while clay consists of all particles less than .002 mm.

Vesicular - A soil aggregate containing small cavities.

Water table - The upper limit in the soil or underlying material which is saturated with water.
