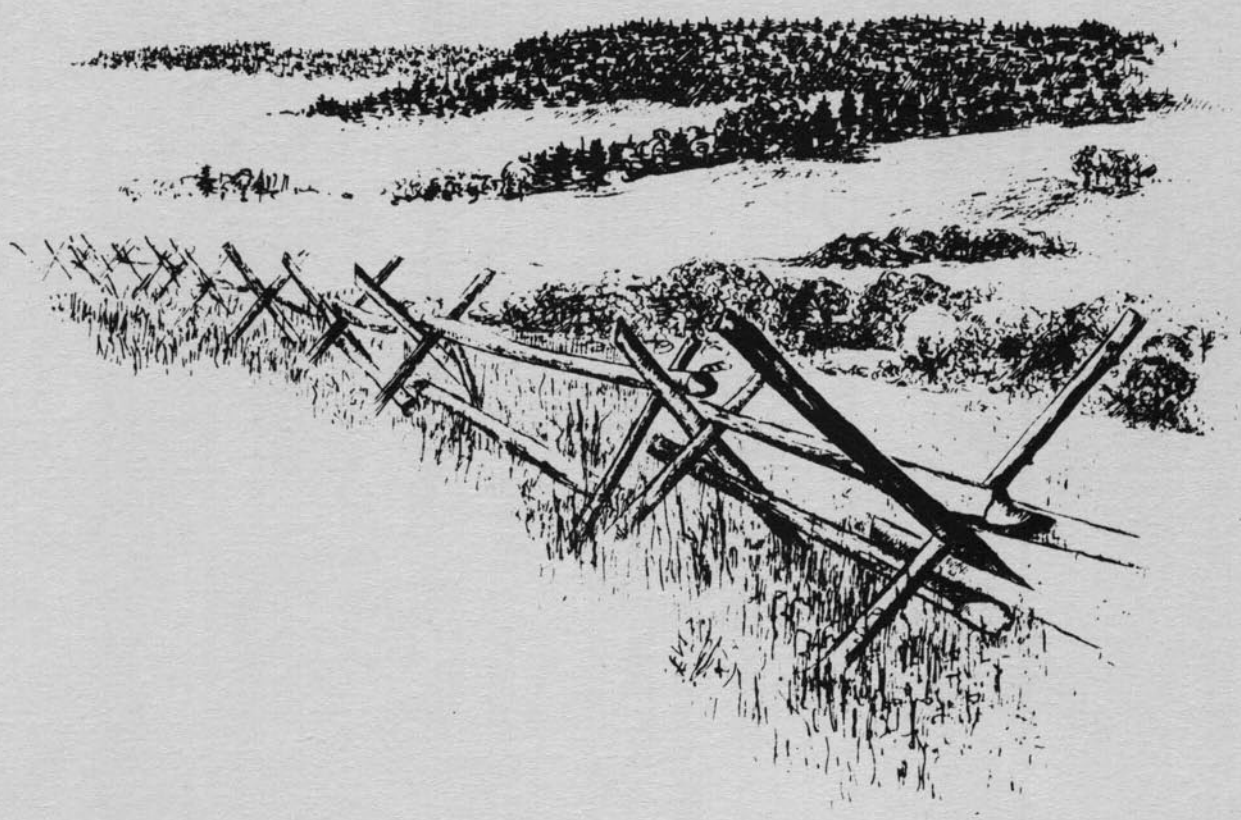
A Soil Resource and Land Use Survey of the

Williams Lake Indian Reserve

L.A. Leskiw, L. Farstad and T.M. Lord
Edited by: Dr. R.E. Carlyle



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A SOIL RESOURCE AND LAND USE SURVEY OF THE WILLIAMS LAKE INDIAN RESERVE

Summary

This report presents the results of a survey of the soil resources of the Williams Lake Indian Reserve. The survey revealed 13 soil units on the Reserve which are delineated on a map (Figure 3). The characteristics of each soil are given in the soil map legend.

The report includes descriptions of seven management areas (designated by letters and also mapped, Figure 4) based on soil groupings and agricultural utilization. Suitable crops, irrigation requirements and fertilizer use are indicated in the discussions. Expected yields and special problems are noted.

A fair sized area of bottom land is productive (forage) but only partially arable because of spring and early summer flooding. Significant amounts of native forage can be produced on these wet soils.

Another area (Management Area C) of fertile soils is naturally supplied with enough moisture to produce large amounts of forage, grasses or mixtures of grasses and legumes. Flooding prevents spring cultivation so cereals and vegetables are precluded.

Management Area D can be irrigated and is capable of producing high yields of forage, cereals for feed and cool weather vegetables.

The yield from all Areas recommended for forage production is estimated at 3,000 tons per year. The remainder of the Reserve is either pasture or range. Parts are forested but commercial logging is not advised.

In addition to the agricultural uses, the Reserve is capable of developing several other income producing activities as follows:

(1) The forested areas can be cut selectively for rail and fence post production. This can be handled on a small industry basis with the establishment of an advertised yard where good quality rails and posts are always available.

(2) The Reserve has several locations where Christmas trees could be cultured.

(3) Some tourist activities could be developed such as short trail rides or camp-outs. The Reserve, located close to the town of Williams Lake, is large enough to preserve some of the "back to nature" qualities that are attracting increasing numbers of tourists. This kind of development could generate some income on the range and forest lands.

To be successful these activities require careful planning and organization. Attention to details is a necessity. Also, prior training is an important prerequisite. They all represent a radical departure from the traditional Indian way of life and this report does not necessarily recommend implementation. Instead, these suggestions are offered as possible ways of further utilizing the Reserve's resources and increasing Indian income.

Considering the entire Reserve, a large portion is non-arable land and best used for grazing. At the same time, there is ample unused potential in the arable parts. These areas, if irrigated should produce considerable quantities of forage, cereal feed and cool weather vegetables. The forage and cereals can be sold or fed to livestock. Vegetable production except for home use, depends on an available market.

Introduction

This report is one of a group describing the soil resources of some of the Indian reserves in British Columbia. These surveys are carried out by the Soil Survey Section, Research Station, Canada Department of Agriculture, Vancouver, at the request of the Department of Indian Affairs and Northern Development.

The Williams Lake Reserve has a listed population of 226.

Ranching is the principal agricultural occupation but only a fraction of the band may be thus employed. A beef herd is maintained as well as some horses. Approximately 645 acres can be irrigated to grow forage or cereal feeds. Most of the remainder of the Reserve is non-arable land best used for grazing.

The objectives of this report are as follows;

(a) to assess the soil resources of the Reserve,

(b) to group the soils into management areas including practical management suggestions for each area,

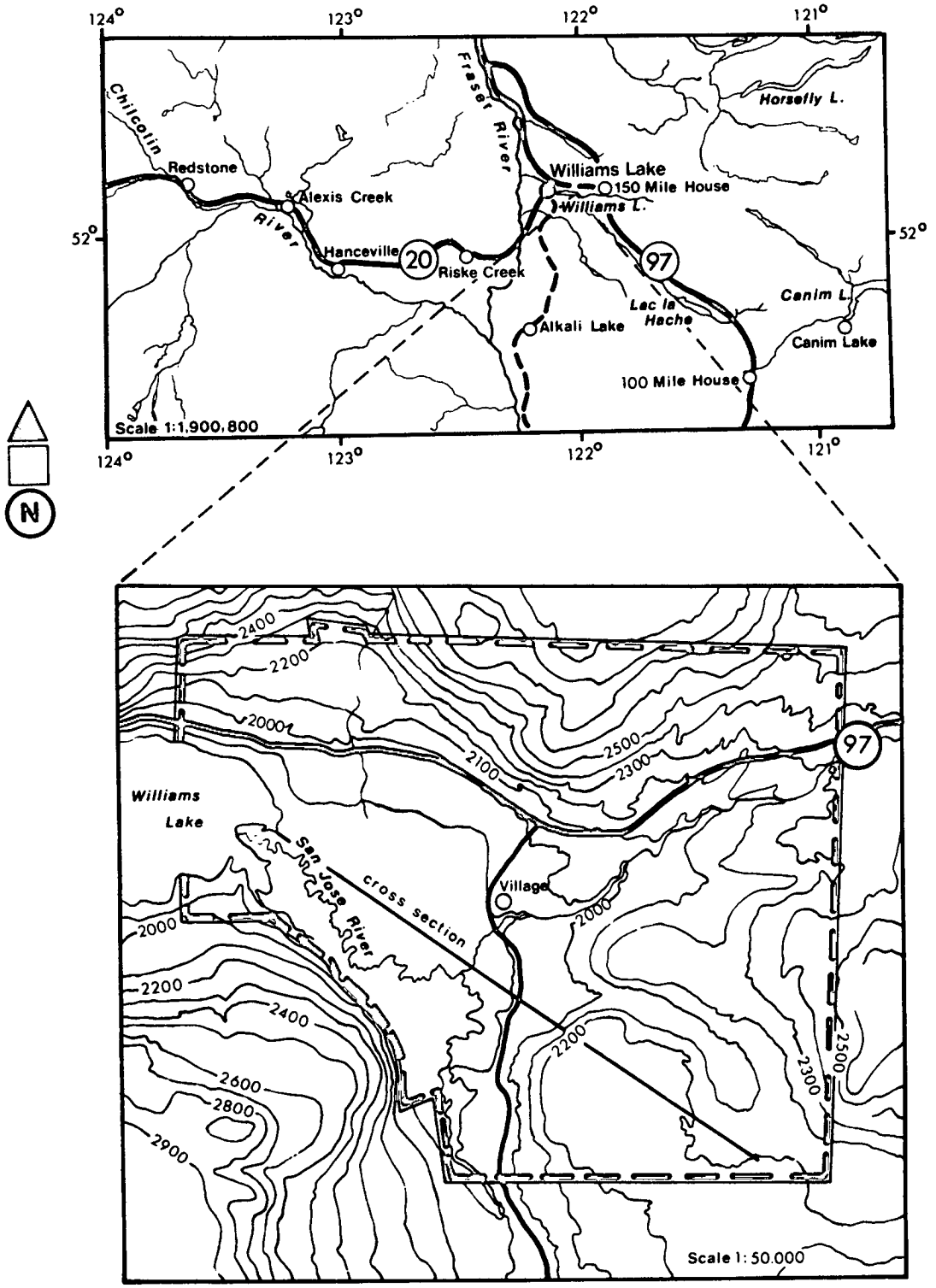

Figure 1. Location map of Williams Lake Indian Reserve.

Highway

Reserve boundary

Contour Line

Contour Interval 50 ft.

(c) to outline irrigation water and fertilizer requirements,

(d) to suggest crops adaptable to the soils and climate of the Reserve.

Economic assessments are not included in this survey but the economic soundness of all suggestions has been kept in mind.

To achieve the objectives, a preliminary discussion was held with some of the Reserve's residents including Council members. Next, the soils of the Reserve were systematically mapped and samples were collected for chemical analyses. Special attention was given to the present agricultural practices. Finally, the soils were grouped into management areas and their distribution was mapped.

Location and Size

The Williams Lake Indian Reserve (Figure 1) is located immediately east of Williams Lake, British Columbia. The eastern end of the Lake extends into the Reserve.

The Reserve lies within National Topographical Sheet No. 93 A/4 and 93 B/1.

The size of the Reserve is approximately 4200 acres[1] of which only 230 acres are arable. This same arable land can be irrigated. Another 450 acres are suitable for hay meadows. The remainder of the Reserve is limited to grazing management.

Highway 97 (Cariboo Highway) runs across the northern third of the Reserve.

[1] Acreages were determined from aerial photograph measurements.

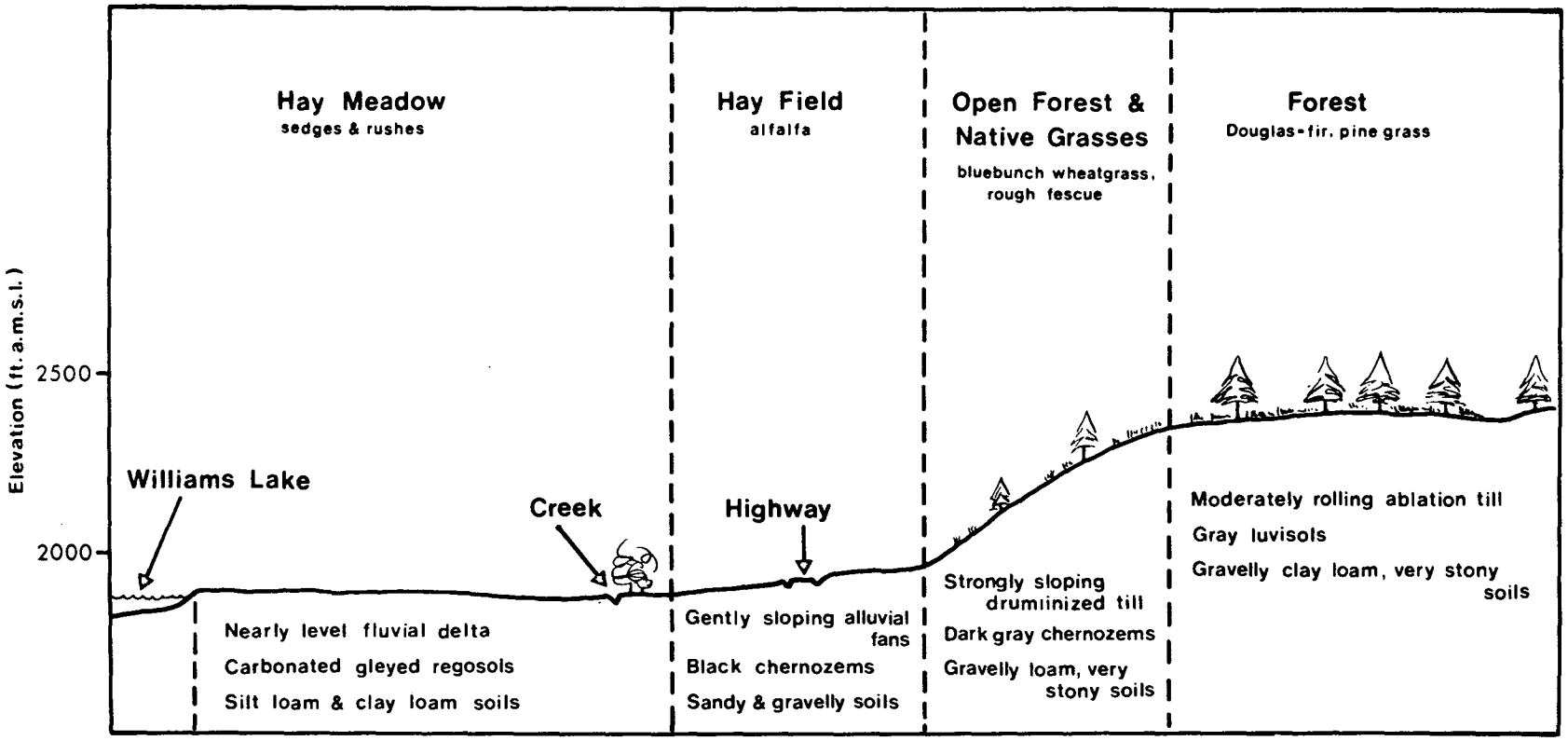

Figure 2. Idealized cross section of Williams Lake Indian Reserve indicating vegetation, landforms, soils, textures, and stoniness

Nature of the Landscape

A north central to southwest cross-section (Figure 2) illustrates the general topography of the Reserve. The San Jose river flows into the southeast tip of Williams Lake forming the main valley of the Reserve. The part of the Reserve adjoining the River is low bottom land, nearly level and occupies approximately 600 acres.

Four levels of land are prominent on the Reserve. Lowest is the bottom land adjoining the River. Next are gently sloping terraces containing most of the Reserve's arable land. Third are the steeply sloping valley walls too precipitous for cultivation. Highest, are the forested areas, non-arable and used mostly as range land.

A number of intermittent streams from minor valleys in the surrounding forested uplands flow across the Reserve to the San Jose River.

Climate

Annual precipitation	16.5 inches
May through September precipitation	8.7 inches
Annual snowfall	55 inches
Frost-free period	81 days
Growing degree days above $42^{\circ}F$	2150°

The Williams Lake Indian Reserve is in a region with a moderate temperate continental climate. Winters are cold and summers are hot and tend to be dry. Insufficient precipitation during the growing season severely limits crop production. With irrigation it is possible to grow a wide range of crops even though the frost-free period is 81 days. The last spring frost usually is not later than the first week of June and the first fall frost can be expected during the last week of August.

The Cariboo region occasionally suffers a difficult harvesting climate. Rainfall in September and October combined with lowering temperatures can hamper the curing of forage and harvesting of cereals.

Vegetation and Crops

The vegetation of the Williams Lake Reserve varies greatly because of the diverse soil conditions ranging from wet bottom land to a relatively high forested plateau.

Forested areas are dominated by Douglas-fir, lodgepole pine and aspen. Also present in varying intensity are juniper, kinnickinnick, shepherdia, Saskatoon and wild rose. The immediate ground cover is dominantly pine grass.

In the more open grass area native fescues and wheat grasses are prominent.

The moist bottom lands support heavy covers of sedges and willows. A rush (Scirpus species) is found here. It grows in patches on calcareous weakly saline soils and resembles sugar cane in appearance. This rush is restricted to a unique habitat in terms of climate, soils and moisture conditions. Its occurrence is relatively rare in the region but several extensive patches are found on the Reserve. Quite often the Reserve village is referred to as "Sugarcane".

With irrigation, a wide range of crops can be grown on this Reserve. Easiest to produce is forage consisting of alfalfa, red, alsike and sweet clovers, brome grass and timothy. Also, forage crops do not require an excessive expense for machinery.

Cereals, particularly for livestock feed are suited to the soils and climate. Cereals for grain sale, particularly wheat, encounter difficulties because of the relatively short frost-free period.

Many of the cool weather vegetables will flourish but a steady reliable market must be available. Also, Indians have not demonstrated much interest in the intensive farming methods that are required to produce vegetables.

Irrigation Water

The San Jose River is the source of irrigation water. The water quality at the east end of Williams Lake can be assumed to be the same as that of the River. Extended use of the San Jose water may produce some salt accumulation in the soil. The water contains 28.0 ppm of sodium, 25.4 ppm of calcium and 41.0 ppm of magnesium (2).

Water supply is not a problem and can be taken from both the Lake and the River. Both these sources require pumping but the heights and distances involved are reasonable.

In this report, water in the soil is expressed as inches of water per foot of soil. The total amount of water available to plants is known as the Available Water Storage Capacity (AWSC). Technically, it is the difference in soil moisture content between Field Capacity and Permanent Wilting Point.

Water is not uniformly available to plants over the entire range of the AWSC. For example, the first 35 percent of the range may be readily available to a given crop and then become increasingly difficult to take from the soil over the remaining 65 percent of the range. For this report it is assumed that 50 percent of the AWSC is readily available to plants. Evapotranspiration requirement for a forage crop is considered to be 0.20 inches per day for the growing season. In the recommended irrigation requirement for each management area, a limited contribution from precipitation is considered but application losses are excluded. If irrigation efficiency is 50 percent, application rates, in terms of irrigation system design, must be doubled (1).

When the AWSC has not been measured for a certain soil, it is possible to estimate it from soil textures and the depths of the layers making up the plant root zone.

Soil Management Areas

Soils of this Reserve could be grouped in many ways, depending on present and probable use. The present and probable future use of these lands is not intensive. The soils, therefore, have been grouped geographically for broad planning and land use purposes. These groups, called soil management areas, are shown on a map (Figure 4) at the back of this report. In preparing these groupings the kinds of soil, parent material, topography, and climate are considered. Each area consists of a single soil or a group of soils which, in a general way, lend themselves to similar systems of management or rotation and have the same potential ability to respond and produce the desired crop. However, within each management area some soils may be included that are markedly different. These are incorporated because the acreage is small or because they occur in small, isolated individual areas, making separate management impracticable.

In this report, each of the seven soil management areas is shown on the map by capital letters (Figure 4). The data used in discussing water requirements, fertilizer rates and crop yields are based on local experience, regional records and soil characteristics.

Management Area A (450 acres)

Management Area A occurs on the low-lying meadow within the valley bottom.

The topography is nearly level and is dissected in places by former stream channels. The soil varies from sandy loam to silt loam and is weakly calcareous. Being bottom land, it is imperfectly or poorly drained. During spring Area A has a high water table and is either flooded or too wet to be cultivated.

This Area is well suited to native forage production. Undisturbed, it supports a lush growth of sedges. If these sedges are harvested for forage, cutting and curing must be done before maturity to make palatable fodder. Replacing the sedges with tame grasses and legumes may not be justified because the yield would not be increased.

Area A should respond well to fertilizer applications. Because of spring flooding, fertilizers should be applied in early fall after the hay is cut. Spring application (after flooding) is preferable in parts that are accessible to fertilizer distributing machinery. Approximately 50 lb./acre for each of N, P_2O_5 and K_2O is recommended. However, field trials should determine the optimum applications.

Management Area B (135 acres)

Management Area B is made up of two parts, one located south of the San Jose River and a much larger tract in the north central part of the Reserve.

The soils are poorly drained silt loams and silty clay loams; those in the larger tract are calcareous and contain sufficient soluble salts in the rooting zone to adversely affect crop growth.

Improvement of Area B is not recommended. Drainage is impracticable and the calcareous and saline nature of the soils in the northern part creates many management problems. Where suitable hay is produced it should be cut. The remainder, either very wet or grown up to foxtail is best left untouched.

The part located south of the river is very poorly drained and remains waterlogged throughout the year. It is a suitable area for encouragement of waterfowl but not large enough to exploit in any other way.

Management Area C (195 acres)

This Management Area occurs on sandy loam and silt loam gently sloping, weakly calcareous deposits located at the upper end of the meadow area. The soils are imperfectly drained because of groundwater seepage and flooding.

Soil moisture in the Area is sufficient for good crop growth and irrigation is unnecessary. The cultivation of annual crops such as cereals is precluded because the soil is too wet in the spring for the operation of machinery. Spring flooding also eliminates alfalfa production. Clovers, timothy and reed canary grass are recommended. Proper management should permit fairly high yields of these crops.

These soils can be expected to respond to fertilizer treatments. Annual applications of 100 lb. N and 80 lb. of P_2O_5 per acre should be adequate for yields of 3-4 tons per acre. The P_2O_5 application is relatively high because of the calcareous nature of the soil. If legumes were grown less N is required. The fertilizer should be applied during the summer or early in the fall. The Area is too wet in the spring to use a fertilizer spreader. If applied late in the fall some of the phosphorous may become unavailable and some nitrogen could be leached away before the crop is able to utilize it the following year.

Management Area D (230 acres)

Management Area D is characterized by well drained, gravelly sandy loam and sandy loam soils. The Area is made up of five land parcels all located on the gently sloping terraces above the bottom land. The topsoil is dark gray or black and friable and the subsoil is calcareous at depths of 30 inches. Chemical analyses (Table 1) indicate a moderately fertile soil that should be productive if irrigation is provided.

Fertilizer applications can be expected to increase yields in this Area. About 300 lb. of N per acre is recommended for grasses. For grass-legume mixtures, the nitrogen can be reduced to 50 lb. per acre but 60 lb. of P_2O_5 and 50 lb. of K_2O per year should be included.

The available water storage capacity of these soils is approximately 3.50 inches in the top 3 feet. Assuming one half of this water to be readily available to crops, about 1.75 inches of water should be applied every twelve days. The soils are too permeable to allow uniform distribution of water by flood irrigation so a sprinkler system is recommended.

The soils are suitable for the growth of forages, cereals, and vegetables but varieties must be used which have been adapted to the climate.

In terms of ease of management, forages probably would be the easiest to produce. Also, the capital outlay for machinery would be the smallest. Yields of 5-6 tons per acre of forage could be expected under good management.

Management Area E (1820 acres)

Management Area E is grassland occurring on the moderately to strongly rolling slopes between the lowland meadows and the upland forest region.

The soils are generally well drained, gravelly loam and very stony. Depressions characterized by poorly drained, calcareous soils also occur.

The Area is classed as non-arable and should be retained as rangeland. Certain parts might be seeded with range grasses to increase the animal carrying capacity. Over-grazing would encourage erosion and this should be watched and prevented.

Management Area F (700 acres)

Management Area F consists of non-arable soils found in four locations on the Reserve. It is forest land and constitutes the highest parts of the Reserve. Although forested, the potential for forest growth is rather poor. If logged the timber yield would be limited and in a practical sense non-renewable.

The soils are well drained, gravelly loam or gravelly clay loam, and moderately stony. The topography is gently to moderately rolling.

Area F is unsuited for arable agriculture. If cleared it could not be irrigated. The main value is as grazing land integrating its management with Areas E and G.

Management Area G (700 acres)

Management Area G includes the steeply sloping valley wall along the northern part of the Reserve. It is non-arable principally because of the topography.

The soils are gravelly sandy loam or loam textured, moderately stony, and bedrock is commonly shallow or exposed.

Any disturbance of these slopes would result in serious erosion. They can be grazed but care must be exercised to prevent over-grazing.

Management Area	pH ($CaCl_2$)	Organic Matter %	Nitrogen %	Sulphur %	Potassium me/100g.	Phosphorous ppm
A	7.97	5.36	0.290	0.059	0.24	45
C	7.24	8.21	0.480	0.053	2.44	123
C	8.25	14.24	1.065	0.082	2.71	19
D	6.94	4.49	0.239	0.030	0.95	88
D	6.78	5.03	0.279	0.023	1.66	122
D	6.57	4.13	0.215	0.028	0.92	90
D	6.59	6.41	0.337	0.034	1.18	153

Table 1. Williams Lake Indian Reserve: Selected chemical analyses of topsoils of the important Management Areas.

Note:

1. Analyses procedures are those commonly used in the laboratory of the Soils Survey Section, Research Station, Canada Department of Agriculture, Vancouver.

2. Each topsoil sample is a composite of four subsamples.

References

1. British Columbia Irrigation Guide. Published by British Columbia Department of Agriculture, Victoria, British Columbia.

2. Suitability for irrigation of water from lakes and streams in the southern interior of British Columbia. Canada Department of Agriculture, Publication 1179, 1963.

3. The system of soil classification for Canada. Canada Department of Agriculture, Ottawa, Ontario, 1970.

Glossary

alkaline soil - Any soil that has a pH greater than 7.0. See also - reaction, soil.

alluvial fan - A fan-shaped deposit of alluvium laid down by a stream where it emerges from an upland into a less steeply sloping terrain.

alluvium - Material such as clay, silt, sand, and gravel deposited by modern rivers and streams.

available water storage capacity - The range in soil water between field capacity and permanent wilting point. Units: percentage of oven dry weight of soil, inches of water per foot of soil or per effective rooting depth.

calcareous soil - Soil containing sufficient calcium carbonate, often with magnesium carbonate, to effervesce visibly when treated with cold 0.1N hydrochloric acid.

colluvium - A heterogeneous mixture of material that as a result of gravitational action has moved down a slope and settled at its base.

drainage soil - Classes used on Soil Map are as follows:

1) Rapidly drained - The soil moisture content seldom exceeds field capacity in any horizon except immediately after water additions.
2) Well drained - The soil moisture content does not normally exceed field capacity in any horizon (except possibly the C) for a significant part of the year.
3) Moderately well drained - The soil moisture in excess of field capacity remains for a small but significant period of the year.
4) Imperfectly drained - The soil moisture in excess of field capacity remains in subsurface horizons for moderately long periods during the year.
5) Poorly drained - The soil moisture in excess of field capacity remains in all horizons for a large part of the year.
6) Very poorly drained - Free water remains at or within 12 inches of the surface most of the year.

dunes - Wind-built ridges and hills of sand formed in the same manner as snowdrifts.

evapotranspiration - Water transpired by plants, built into plant tissue, evaporated from the soil surface.

field capacity - Soil water content retained by the soil following an irrigation or heavy rain, after downward movement of water has materially decreased. It is the upper limit of soil water available for plant use.

flood irrigation - Application of water by flooding to soil for the purpose of supplying the moisture essential for plant growth.

frost-free period - Average number of days between last spring frost and first fall frost, based on $32^{\circ}F$.

glaciofluvial deposits - Material moved by glaciers and subsequently sorted and deposited by streams flowing from the melted ice.

growing degree days (also, degree-days, above $42^{\circ}F$) - The number of degrees above 42 accumulated for all days during the growing season. This expresses the length and warmth of the growing season in a single figure.

growing season - The dates in spring and fall corresponding to a mean temperature of $42^{\circ}F$ are used as the start and end of the growing season.

irrigation interval - The number of days between the start of an irrigation at any one spot and the start of the next irrigation at the same spot.

lacustrine deposit - Material deposited in lake water and later exposed either by lowering the water level or by uplifting of the land. These sediments range in texture from sands to clays.

leaching - The process of removing soluble material from the soil by passage of water through the soil.

outwash - Sediments washed out by flowing water beyond the glacier and laid down as stratified drift in thin forest beds. The particle size may vary from boulders to silt.

permanent wilting point - The water content of the soil when plants growing in it are wilted to the point where they will not recover when placed in the dark for 12 hours in an atmosphere of 100% relative humidity. It occurs at about 15 bars of soil moisture tension.

permeability, soil (1) - The ease with which gases, liquids or plant roots penetrate or pass through a bulk mass of soil or a layer of soil. In the absence of precise measurements, soils may be placed into relative permeability classes through studies of structure, texture, porosity and cracking in the soil profile in relation to local use experience. The relative classes presented in this report are estimated and are as follows:

	Possible rates in inches per hour
Slow	less than 0.20
Moderate	0.20 to 5.00
Rapid	over 5.00

pH - The negative logarithm of the hydrogen-ion activity of a soil. The degree of acidity or alkalinity of a soil as determined by means of a glass, quinhydrone, or other suitable electrode or indicator at a specified moisture content or soil-water ratio, and expressed in terms of the pH scale.

reaction, soil - The degree of acidity or alkalinity of a soil, usually expressed as a pH value. Descriptive terms, commonly associated with certain ranges in pH (H_2O) are: moderately acid, 5.6-6.0; slightly acid, 6.1-6.5; neutral, 6.6-7.3; slightly alkaline, 7.4-7.8; moderately alkaline, 7.9-8.4.

root zone - That part of the soil occupied by plant roots.

saline soil - A nonalkali soil that contains enough soluble salts to interfere with the growth of most crop plants. The conductivity of the saturation extract is greater than 4 mmhos/cm, the exchangeable-sodium percentage is less than 15, and the pH is usually less than 8.5.

soil - (i) The unconsolidated material on the immediate surface of the earth that serves as a natural medium for the growth of land plants.

(ii) The naturally occurring unconsolidated material on the surface of the earth that has been influenced by parent material, climate, macro- and microorganisms, and topography, all acting over a period of time to produce soil that may differ from the material from which it was derived in many physical, chemical, mineralogical, biological, and morphological properties.

soil classification - The systematic arrangement of soils into groups or categories on the basis of their characteristics. Broad groupings are made on the basis of general characteristics and subdivisions on the basis of more detailed difference in specific properties.

soil horizon - A layer of soil, approximately parallel to the soil surface, with distinct characteristics produced by soil forming processes.

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

soil series - This is the basic unit of soil classification, and consists of soils that are essentially alike in all major profile characteristics except the texture of the surface.

sprinkler irrigation system - For design purposes, this includes all equipment required to apply water to the design area from the source of water supplying the system to the revolving sprinklers, nozzles or perforated pipe.

stocking rates - The number of acres needed to graze a 1000-pound cow for 1 month (AUM). They are determined by calculating the amount of available forage, allowing for a 45 percent carryover to avoid damage to the range. About 660 pounds of available forage is needed per AUM.

stoniness - The classes of stoniness are defined as follows:

1) Slightly stony land - There are some stones, but they offer only slight to no hindrance to cultivation.
2) Moderately stony land - There are enough stones to cause some interference with cultivation.
3) Very stony land - There are enough stones to constitute a serious handicap to cultivation and some clearing is required.
4) Exceedingly stony land - There are enough stones to prevent cultivation until considerable clearing is done.
5) Excessively stony land - This land is too stony to permit any cultivation (boulder or stone pavement).

texture, soil - The percentages of sand (S), silt (Si), and clay (C) in a soil determine its texture. Size groups from 2 mm to 0.05 mm in diameter are called sand, those from 0.05 to 0.002 mm are called silt, and those less than 0.002 mm in diameter are called clay.

From: Toogood, J. A.—A Simplified Textural Classification Diagram. Can. J. Soil 38: 54-55. 1958

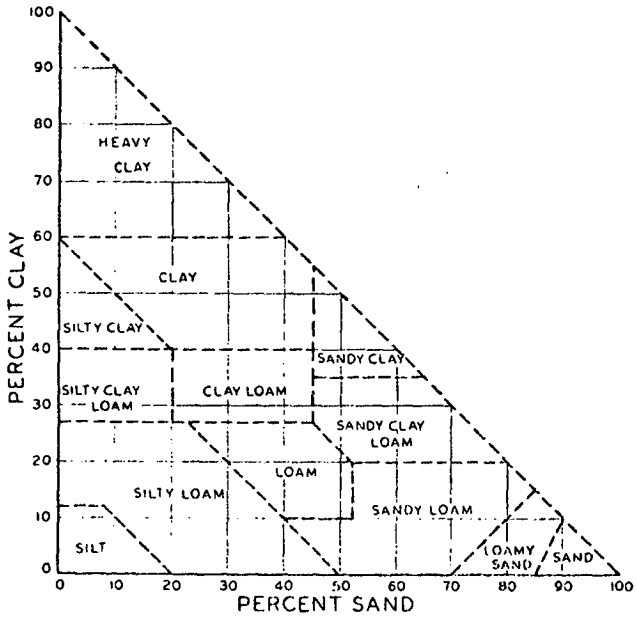

Chart showing proportions of soil separates.

topography - definition of classes used on Soil Map (Fig. 3):

Simple topography Single slopes (regular surface)	Complex topography Multiple slopes (irregular surface)	Slope %
A depressional to level	a nearly level	0 to 0.5
B very gently sloping	b gently undulating	0.5+ to 2
C gently sloping	c undulating	2+ to 5
D moderately sloping	d gently rolling	5+ to 9
E strongly sloping	e moderately rolling	9+ to 15
F steeply sloping	f strongly rolling	15+ to 30
G very steeply sloping	g hilly	30+ to 60
H extremely sloping	h very hilly	over 60

topsoil - The layer of soil moved in cultivation.

wilting point - See permanent wilting point.