WR -18

MORICE BIOPHYSICAL STUDY 93 L/S.W.

Wildlife Capability and Habitat (Soils, Terrain, Climate and Vegetation)



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Ministry of Environment and Parks MORICE BIOPHYSICAL STUDY 93 L/S.W.

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> B. Fuhr M. Fenger L. Lacelle R. Marsh M. Rafiq

Ministry of Environment and Parks Wildlife Branch Victoria, B.C.

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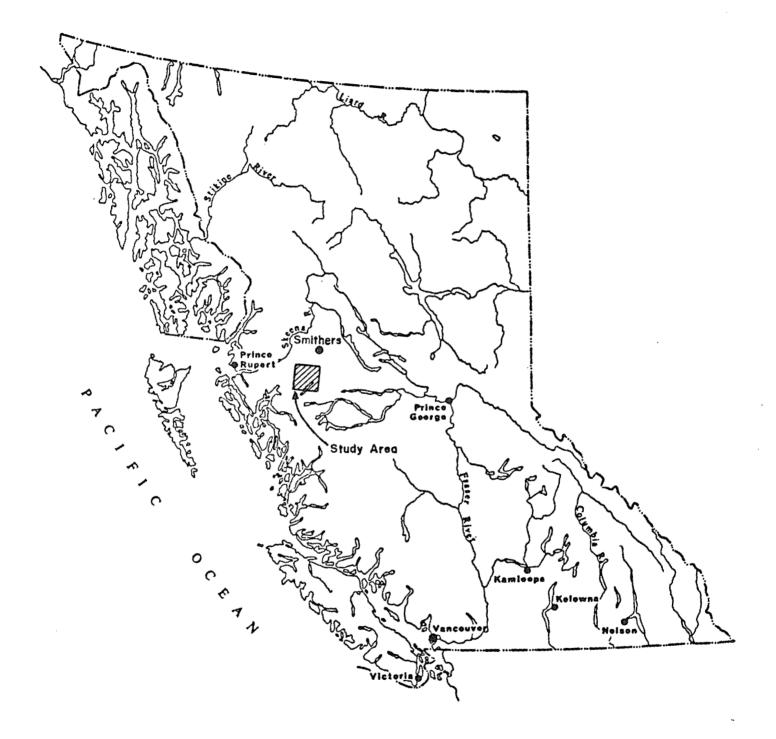
CHAPTER 1. INTRODUCTION

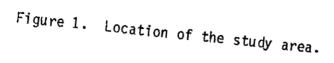
The Morice Biophysical Study was initiated by the Planning and Assessment Branch of the B.C. Ministry of Environment. It is intended to provide reconnaissance biophysical information for this largely remote area. The area (see Figure 1) comprises four 1:50 000 scale NTS map areas: Lamprey Creek (93L/3), Corona Peak (93L/4), Burnie Lake (93L/5) and Thautil River (93L/6), covering an area of 3,690 square kilometers. In addition to this report there are several map products:

- 1. Terrain (4 maps)
- 2. Biophysical Soil Landscapes (93L/3 only)
- Vegetation Landscapes of the Morice River Floodplain (portion of 93L/3 only)
- 4. Biophysical Ungulate Capability (4 maps)

The Lamprey Creek map area (93L/3) was studied in somewhat more detail as it contains areas of high capability moose winter habitat, it has considerable moose habitat/forestry interaction and has the greatest road access for sampling. Also, the proposed Kemano Completion hydroelectric development would potentially impact moose habitat along the Morice River floodplain, and was of particular concern while in the study area. The possible impacts of the Kemano Completion proposal are summarized by Ministry of Environment (1979), but do not include possible detrimental effects on moose habitat of the Morice River. Vegetation landscapes of the Morice River floodplain were done to help identify possible impacts within the study area. Areas downstream of this project were assessed for ungulate capability previously (Stewart, 1981).

The map products are of a reconnaissance nature, relying mainly on airphoto interpretation and a minimum of ground checking. They are applicable at the scale and level of survey at which they were produced. They provide a stratification of the materials, terrain hazards, soils and ungulate habitat capability at a scale of 1:50 000. Applications such as detailed road alignment or present habitat condition require further study.





The report follows the stepwise process of integrating the disciplines of climate, terrain, soils, vegetation and wildlife that is part of the biophysical method (Walmsley, et al., 1980). Each author provides details, background, methods and results.

CHAPTER 2. PHYSIOGRAPHY, BEDROCK GEOLOGY AND GEOLOGIC HISTORY

2.1 PHYSIOGRAPHY

The Lamprey Creek mapsheet (93L/3) and the southern portion of 93L/6 are described by Holland (1976) as being part of the Nechako Plateau physiographic region (Figure 2). This plateau area is characterized by relatively low relief and lack of dissection by major river systems. The majority of the study area is in the Bulkley Ranges of the Hazelton Mountains physiographic region. These mountains are characterized by ranges of relatively high relief, rugged, glacially sculptured peaks, separated by broad floored, U-shaped valleys. In the Hazelton Mountains, remnants of an older plateau surface are evident as relatively flat surfaced uplands surrounded by steep walled, glacially oversteepened U-shaped valleys. Plateau remnants east of the Burnie Lakes and Telkwa River provide rolling alpine terrain suitable for caribou range. The western margin of the study area is in the Coast Mountains physiographic region, an area of high relief, rugged, glacially sculptured peaks with large U-shaped, broad floored valleys between ranges.

2.2 BEDROCK GEOLOGY

Bedrock geology for this area was mapped by Carter and Kirkman (1969) and amalgamated into the geological atlas by Tipper et al., 1979.

The majority of the study area is underlain by Lower and possibly Middle Jurassic volcanic bedrocks including andesitic to rhyolitic tuffs, breccias and flows with lesser associated sedimentary rocks (Figure 3). These intermediate to acidic volcanic bedrocks tend to weather to form basic soils that are, in general, better soils for browse growth, than are acidic soils. Two relatively large belts of Upper Jurassic and lower Cretaceous sedimentary bedrocks (greywacke, siltstone, mudstone, conglomerate, with minor coal) occur in the McBride Lake and Holland Lake areas. These sedimentary bedrocks, being largely

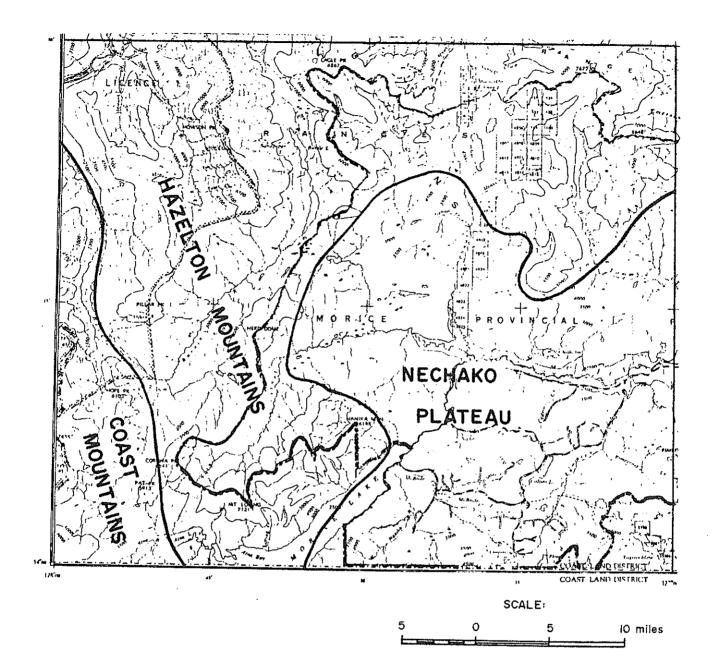


Figure 2. Physiographic regions.

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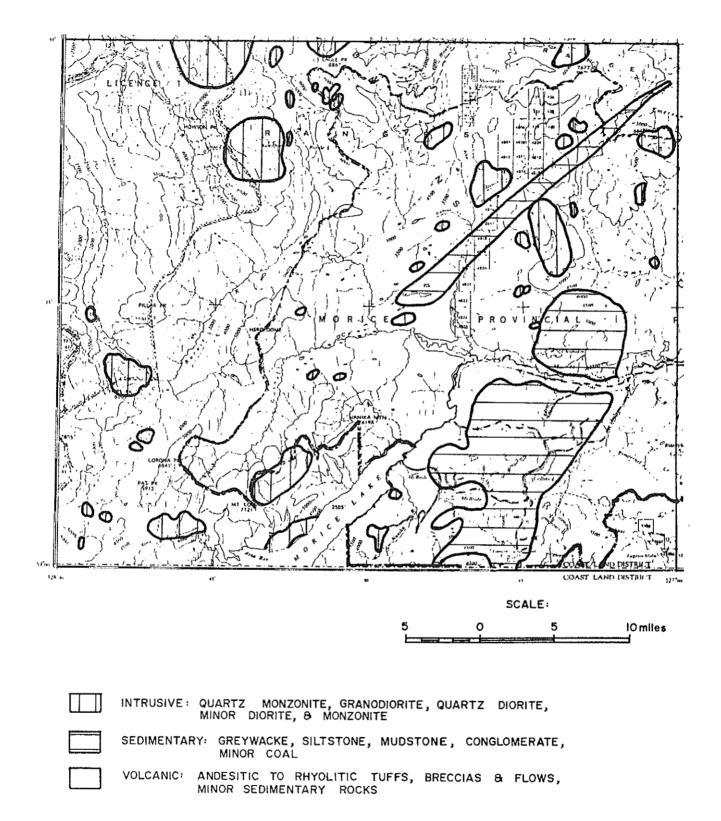


Figure 3. Bedrock geology (after Carter and Kirkham, 1969).

of volcanic origins, also tend to weather to produce basic soils. These older volcanic and sedimentary bedrocks and have been intruded by plutonic bedrocks (quartz monzonite, granodiorite, quartz diorite, with minor diorite and monzonite) in the Upper Cretaceous and early Tertiary. Subsequent erosion has exposed the plutons at a number of locations in the study area. These acidic to intermediate bedrocks tend to weather to produce acidic soils. At locations such as Howson Peak and Mount Loring, harder plutonic bedrocks often form steep cliff faces that provide good escape terrain for goats.

2.3 GEOLOGIC HISTORY

During the Tertiary geologic period a land surface of low relief was formed throughout the interior of the Province by a long period of erosion (Holland, 1976). A portion of this surface exists today as the portion of the Nechako Plateau in the study area (Figure 2). In the western and northern portions of the study area, the Tertiary land surface was re-elevated and deeply incised by stream and subsequent glacial erosion. Areas of high elevation, such as the Coast Mountains and the Howson Range have been sculptured by erosion to form a rugged mountainous topography lacking remnants of the ancient Tertiary plateau land surface. The Bulkley and Telkwa Ranges have been less severely eroded and consequently isolated segments of the ancient plateau surface occur at high elevations. The Nechako Plateau portion of the study area was not significantly uplifted, nor deeply dissected by stream nor glacial erosion, and has retained a land surface of comparatively low relief.

Quaternary deposits and landforms in the study area appear to have all been formed either during the most recent major glaciation, the Fraser Glaciation, or subsequent to it in the Recent Epoch. The initial ice accumulation of the Fraser Glaciation may have commenced in the Coastal Mountains and adjacent interior ranges as early as 29,000 years before present (Clague, 1981). However, for southern British Columbia at least, the interior plateau and plains appear to have remained largely ice-free until after 21,500 years B.P.

In the study area, the ice divide for east-west flow of Fraser Glaciation ice appears to have been along the ridge of the Howson Range and along a line from Pillar Mountain across the Clore Canyon to Dog's Ear Peaks (Figure 2). In the north-western portion of the study area, the orientation of major Coast Mountain and Bulkley Range valleys (Clore, Copper (Zymoetz) and Kitnayakwa), plus ample evidence of along valley glaciation (sculptured peaks and valley walls, as well as lineations) strongly suggest that as ice buildup increased in these ranges, flow was primarily westward out of the study area, and into the adjacent Kitimat-Terrace depression. Ice flowing south from source areas in the Howson Ranges eventually became sufficiently thick to override the adjacent highland plateau surfaces of the Nechako Plateau at Tom George Lakes and at Shea Lake and thus, to flow easterly. Ice moved out from the Coast Mountains on the western fringe of the study area and flowed in a north-easterly direction along the upper Clore and Atna valleys through the Bulkley Ranges and out into the lower elevation portions of the Nechako Plateau. Striae and lineations indicate that ice flow on the plateau was primarily to the east, as the Telkwa Ranges formed a barrier to the north. During this glacial period low relief plateau surfaces and portions of the floors and flanks of major mountain valleys were mantled by variable depths of basal till. Steep mountain slopes as well as hills and hummocks in major valley floors and on the plateau, were commonly glacially scoured and left either as barren rock, or as rock with interspersed pockets of till in depressions. The landform created by this glacial action is one of the factors contributing to the present distribution and guality of wildlife habitat in the study area.

During the late stages of the Fraser Glaciations, large quantities of fluvioglacial materials were deposited in front of and around stagnant ice, both on the plateau and in major mountain valleys. Ice downwasting appears to have been relatively rapid with no landforms suggestive of subsequent alpine/subalpine glacial activity being superimposed on Fraser Glaciation fluvioglacial landforms. However, alpine glaciation persists to the present in the highest ranges of the Howson and Coast Mountains.

In the Recent Epoch, rivers and stream in many valleys in the mountains have downcut into Fraser Glaciation drift, or bedrock, creating narrow inner valleys. However, on the plateau and in a number of major mountain valleys, stream gradients are low and extensive areas of fluvial sediments have accumulated. Recent Epoch mass wasting of glacially over steepened rock slopes, as well as till slopes, has left extensive lower slope areas buried under colluvium. The physical characteristics of glacial and post-glacial surficial materials, their landforms and present day geological processes are further discussed in Chapter 4.

CHAPTER 3. CLIMATE

3.1 CLIMATE

Physiographically the area is dominated by the southern Hazelton Mountains and parts of the Interior Plateau. Its location immediately east of the Coast Mountains has a great influence on the character of the climate of this area. Prevailing westerly winds flow over the region, most frequently bringing maritime Polar air over this part of the province. Much of the moisture is precipitated along the west facing slopes of the Coast Mountains as coastal air passes over the mountain barrier. Further drying occurs over the study area as the air subsides and warms while moving down the east facing slopes of the Coast Mountains. The result is a broad rainshadow over much of the Interior Plateau and a more discrete local rainshadow which exists as a 45 km wide band running parallel to the Coast Mountains and extending to a point 60 km east of the Coast Mountain Divide.

Precipitation is relatively light in this region. The rainshadow areas in the vicinity of Morice Lake (764 m) average 180 mm between May and September and 495 mm over the year (Air Studies Branch, 1980). The annual distribution of precipitation reflects the influence of coastal weather systems on the area since maximum monthly precipitation occurs in December and January. Despite this influence, the precipitation during these two months only accounts for 23% of the annual total. April is the driest month while precipitation is light and evenly distributed between June and November. About 45% of the annual precipitation occurs as snowfall.

Precipitation increases rapidly from east to west over the Hazelton Mountains, partially as a result of increasing elevation, but more the result of precipitation carry-over subsequent to the lifting of Pacific air masses over the Coast Mountains. The lower passes along the Coast Mountain Divide receive precipitation in excess of 1000 mm annually more than 52% occurring as snowfall - and this total increases with increasing elevation. Near to the western edge of the local rainshadow, snow depths reach an average maximum of 234 cm in April at an elevation of 1370 metres near Kidprice Lake. By June 1st, the snow depth averages 122 cm. Further east snow depths are considerably reduced and in the drier areas reach average maximum depths of an estimated 100 cm in April. Low elevation sites are snow free by mid-May.

The area is characterized by cool summers and moderately cold winters. July mean maximum temperatures average 20°C and mean minimums average 6°C. Temperatures and diurnal temperature range decrease with increasing elevation, although minimums are usually depressed in poorly drained sites. Winter temperatures are typified by January mean maximums of -12°C and mean minimums of -17°C. Throughout the winter and early spring, Arctic air frequently surges into the area from the east and stalls along the eastern slopes of the New Hazelton and Coast Mountains. This air mass is associated with clear skies and very low temperatures. Winter extremes in the area can exceed -40°C. The higher elevations of the New Hazelton mountains will be subjected to Arctic outbreaks less frequently. These data are from Meteorological Services, Waste Management Branch, Victoria, B.C.

CHAPTER 4. TERRAIN

4.1 INTRODUCTION

Of the four 1:50 000 scale mapsheets in the Morice study area, only the Lamprey Creek sheet (93L/3) has been surveyed for terrain at sampling intensity levels appropriate for conventional Terrestrial Studies Branch 1:50 000 scale reconnaissance mapping. The Corona Peak, Burnie Lake and Thautil River sheets (93L 4, 5, 6) which make up the more mountainous western and northern 3/4 of the study area have been surveyed at intensity level more appropriate for 1:100 000 or 1:250 000 scale terrain mapping, although the maps are presented at a 1:50 000 scale. These latter mapsheets have no road access and thus were surveyed less intensively.

4.2 PREVIOUS TERRAIN MAPPING

The surficial materials of the Morice area have been mapped by Gough (1974). However, for purposes of wildlife capability mapping, this earlier mapping was found to be deficient in characterization of geological processes (Section 4.5) and in the mapping of fluvial surficial materials. Thus, it was decided to update the 1974 mapping and to append soil drainage to the terrain map unit symbols (e.g. $\frac{Mvb}{(w)}$), to further aid wildlife capability mapping. Site and soil data from 17 Ministry of Forests research plots was also utilized in the re-mapping.

4.3 METHODS

The revised terrain mapping for this study area was carried out according to the 1983 revisions to the Terrain Classification System (unpublished, see Terrain Map Legend). This system identifies various types of surficial materials (unconsolidated deposits), provides data related to their texture and landforms, and describes geomorphic processes evident in the study area.

Initially the 1:63 360 scale black and white stereo air photographs used in the original terrain mapping were examined stereoscopically to

characterize surficial materials and geologic processes in terms of the 1983 Terrain Classification System. The map unit boundaries of the original mapping were retained, an exception being on floodplains where the original map units were often subdivided on the basis of fluvial process characterization.

The 1983 terrain and soil field survey program involved 5 1/2 days of helicopter traverses, 7 days of road traverses (93L/3), as well as 1 day of boat traverse along the Morice River. The objective of these traverses was to check designated terrain map units and symbols and to collect additional data on the physical characteristics of the surficial materials such as soil drainage and geological processes. Observations were recorded at 61 sites and 4 samples were collected for soil engineering analysis (grain size analysis, Atterberg Limits). Soils were also described at all sites and samples were collected for lab analysis at 48 sites in order to characterize major soil developments. Site, soil and lab analysis results are available from the British Columbia Soil Information System (Sondheim and Suttie, 1983).

Following the field survey and laboratory processing of samples, the terrain field and lab data, plus soil drainage data were compiled on 1:50 000 scale maps using the 1983 (unpublished) Terrain Classification System.

4.4 GENERAL CHARACTERISTICS OF SURFICIAL MATERIALS

This section describes the types of surficial materials found in the study area. It describes some of their significant physical properties, their local distribution and common landforms associated with each type of material.

4.4.1 Morainal Materials (Till)

Till is material transported beneath, beside, within and in front of a glacier. It is deposited directly from the glacier and not modified by any intermediate agent.

Till is the most common unconsolidated material on the Nechako Plateau portion of the Morice study area. Here it forms extensive mantles of varying thickness (e.g. Mvb, Mb, Mv), often over hummocky bedrock (e.g. $\frac{Mv}{Rh}$). In the major valleys of the Bulkley Mountains, such as the Kitnayakwa, relatively deep till deposits are also common on the valley floors with thinner tills on the slopes above. Some major mountain valleys such as the Burnie and upper Clore characteristically have extensive areas of blankets and veneers of till over hummocky to undulating bedrock surfaces (e.g. $\frac{Mvb}{Ruh}$). Relatively high elevation plateau and upland surfaces such as those north of Morice Lake, north of Dockrill Creek and northeast of Burnie Lakes are commonly also characterized by till mantles, ridges and aprons of Neoglacial till (primarily terminal and lateral moraine) (e.g. $\frac{XMwra}{Rh}$).

Basal tills predominate in the study area and generally consist of moderately compact to compact, non-sorted, non-stratified materials with a wide range of particle sizes (pebbles, cobbles, boulders) in a matrix of sand, silt and clay. Till textures and clast lithology appear to be closely related to the predominant local volcanic and associated sedimentary bedrocks (see Section 2.2). These tills commonly have a silty sand to sandy silt matrix texture (e.g. \$sM) (Table 1), with very variable percentages of coarse fragments (primarily pebble and cobble sized fragments of volcanic rock).

The basal tills generally consist of a weathered upper stratum that is relatively loose, non-compact and relatively permeable (rapid to moderately well soil drainage depending upon slope position). The unweathered (basal) portion of the till is compact, relatively impermeable and restricts drainage. On toe-slopes and in depressions, water accumulation above the basal till commonly results in localized wetter habitats that usually have an increased diversity and abundance of browse species. In comparison to coarse textured colluvial and fluvioglacial deposits, all study area tills examined have more favourable soil moisture retention properties and consequently are usually capable of supporting a greater diversity of browse species.

Unweathered basal till is relatively resistant to shear and deformation due to preconsolidation by glacial ice. However, the few samples of basal

SAMPLE NUMBER*	PERCENTAGE BY WEIGHT			ATTERBERG LIMITS		
	Coarse Fragments (>2 mm)**	Sand (2- .0625 mm)	Silt (.06254- .002 mm)	Clay (<.002 mm)	Liquid Limit	Plastic Limit
82-17752 82-17757 82-17782 82-17783	71 43 72 14	13 25 15 34	10 24 10 35	6 8 3 17	20.36 22.83 15.13 22.03	15.27 19.53 11.56 15.97

Table 1. Textural Analysis and Atterberg Limits for Morice Study Area Till Samples

* For locations see terrain map.

** % by wt. coarse fragments - visual estimate in field, % sand, by weight
of silt and clay - laboratory analysis.

tills suggest that they are generally weakly plastic (liquid limits of 15 to 23, Table 1). Thus when wetted they may be subject to deformation and shear failure, especially on large cut faces. They are not as suitable as fluvioglacial materials for road beds, nor for operation of heavy machinery during wet weather.

Tills with coarser textures may occur in areas dominated by coarse drained plutonic bedrock outcroppings, but were not observed during the very limited number of stops in such areas during the field survey. Such tills would have more favourable roadbuilding and machinery operation characteristics, but less favourable with regards to the maintenance of browse species, being more droughty and acidic.

Ablation till (till deposited as a result of downwasting of glaciers) was not observed in the mountainous portions of the study area. However, shallow mantles of relatively coarse textured ablation till commonly veneer finer textured basal tills on the Nechako Plateau. By hand texture and visual estimates ablation till has a sandy gravel texture and is loose and permeable (rapid to well drained). It resembles fluvioglacial gravels in physical characteristics and in ability to support browse species.

Neoglacial tills commonly consist primarily of angular coarse fragments (e.g. xM) (based on visual and hand texture estimates) with lesser and variable amounts of interstitial sand, silt and clay. These relatively young, coarser textured tills are commonly relatively loose, non-compact and permeable (rapid to well drained). They are commonly sparsely vegetated due to their location in and near high elevation cirques and their coarse textures.

4.4.2 Colluvial Materials

Colluvial materials are products of mass wastage, chiefly consisting of rubbly and blocky bedrock material. They are perhaps the second most common surficial material in the study area, especially in mountainous topography. Here, they are common as aprons and fans (e.g. rCa, rCf) at the bases of steep mountain slopes, as well as blanketing and veneering portions of valley walls (e.g. rCvb). On the hummocky or undulating bedrock controlled topography commonly seen on the Nechako Plateau and on the floors of major valleys in the mountains, colluvium forms extensive mantles of rubbly materials (e.g. $\frac{rCvb}{Rhru}$), weathered largely in situ. Here it is commonly mapped in association with veneers of weathered till (which it often closely resembles) and hummocks of rock. Higher elevation plateau/upland surfaces are also partially mantled by very rubbly colluvium weathered in situ, largely by frost shattering.

The colluvial materials of the study area were not analyzed for textural analysis nor for Atterberg Limits. However, hand texture and visual estimates suggest that a rubbly texture (dominantly <256 mm rubble, with lesser blocks as well as lesser interstitial sand, silt and clay) is appropriate, particularly in the mountains. The rubbly colluvial materials are relatively loose and permeable (generally rapid to well drained), creating droughty sites with a relatively sparse vegetative cover. However, the toes of colluvial fans and aprons are commonly moister and are more lushly vegetated. Also, morainally derived colluvium on the Nechako Plateau may have a finer texture and support better plant growth. Rubbly colluvium is not usually subject to plastic behavior and except for slope limitations, is suitable as road subgrade and as a bearing surface for heavy machinery operation.

Colluvium derived from failed tills has physical properties intermediate between colluvium and till and would generally be subject to plastic behaviour.

4.4.3 Fluvioglacial Materials

Fluvioglacial materials are fluvial materials deposited in contact with glacier ice. They commonly show evidence of ice melting such as irregular topography, irregular bedding or slump structures (e.g. $F^{G}hd$). In the study area, fluvial materials deposited in front of glaciers (outwash plains) have also been mapped as fluvioglacial deposits (e.g. F^{G}_{t}).

Fluvioglacial materials are common in major valleys in the mountains (e.g. the Howson - Thautil Creek Valley), due to large volumes of water from

active/stagnant mountain valley glaciers. These mountain valley deposits include kame terraces and fluvioglacial fans both deposited adjacent to, or partially on ice, as well as outwash plains on broad valley floors. These deposits have often been dissected by post glacial stream downcutting and today are evident as terraces above incised inner valleys, as in the Clore River Valley.

On the Nechako Plateau, downwasting of stagnant/dead ice masses resulted in development of extensive fluvioglacial outwash plains generally with associated kame terraces with kettles, eskers and hummocky ablation till. Plateau fluvioglacial deposits have not generally been deeply dissected by post glacial stream downcutting. Most glacial meltwater channels on the plateau are not deeply entrenched and have come to be occupied by small, irregular meandering misfit streams.

Fluvioglacial materials in the study area were not sampled for mechanical analysis. Based on visual estimates and hand texturing, they generally have a sandy gravel texture (usually >50% pebbles, cobbles and lesser boulders with <50% sand). In valleys such as Houston Tommy that are characterized by extensive outwash plains, sandy textured fluvioglacial deposits occur on the floors of some meltwater channels.

The fluvioglacial materials are non-plastic and non-consolidated and due to their coarse-textures have good bearing capacities. They are highly permeable (rapid to well drained) and consequently are dry sites with a relatively sparse browse cover. The terrestrial lichens commonly used by caribou may be abundant on these sites.

4.4.4 Fluvial Materials

Fluvial materials are those transported and deposited by streams and rivers (alluvial materials). In the Morice study area the most extensive deposits of fluvial materials are low gradient floodplains associated with irregular meandering creeks and rivers on the plateau and in major mountain valleys, such as the Atna and Clore - Burnie valleys (e.g. sgF_p^A -I). As previously mentioned, these water courses are usually misfit streams in larger meltwater channels. They are flanked by the escarpments of higher

fluvioglacial terraces and fans, and occasionally by the lower escarpments of younger fluvial terraces. Portions of these floodplains are often occupied by active fluvial fans and organic deposits. Smaller mountain valleys with steeper gradients generally have incised streams with very small floodplains.

Visual and hand texture estimates of fluvial materials indicate that they have a sandy gravel texture (>50% pebbles, cobbles and boulders, <50% sand and a few percent silt and clay) (e.g. $sgF^{A}P$, sgF^{A}_{f} , sgFt). On the plateau, floodplains tend to have an overlying silty or sandy surface strata that in turn may be partially capped by organic deposits (e.g. $0p=\$F^{A}p-I$).

The coarser textured fluvial materials are non-consolidated, loose, non-plastic and permeable. They have favourable characteristics for road building and heavy machinery operation except for seasonal limitations due to high water tables and flooding. Silty textured floodplains are somewhat plastic, much less permeable, and much less suited for road building materials and heavy equipment operation. Floodplains are commonly mapped as having imperfect soil drainage, but often have areas of poor to very poor soil drainage with organic cappings. Floodplain sites are highly productive of browse species. Associated inactive fluvial terraces and fans may, however, be well to rapidly drained and have engineering properties and vegetation characterisitics similar to those for droughty fluvioglacial materials.

4.4.5 Organic Materials

Organic materials result from the accumulation and partial decay of vegetative matter. The organic materials in the study area most commonly occur as flat surfaced deposits over 1 m in depth, along low gradient flood-plains (e.g. $Op = F^{A}_{p}$).

The organic materials most commonly consist of mesic textured (partially decomposed) sedges or mosses. They are very compressible and have very low bearing strengths and consequently are not suitable for road building nor

heavy equipment operations. The water table is generally near, at, or above the surface (very poor soil drainage).

4.4.6 Glaciolacustrine Materials

Glaciolacustrine materials are those deposited in direct contact with glacier ice, or those containing evidence of deposition in close proximity to glacier ice. Glaciolacustrine materials were seen only in sections on the Clore River where they are overlain by till (e.g. $\frac{Mb}{CSL}_{G}$) and in one small area downstream of the Lamprey Creek - Morice River confluence. Hand texture estimates indicate that these latter materials have a sandy silt texture (>50% silt, <50% sand with lesser clay). The glaciolacustrine materials were not sampled for mechanical analysis but appear to be non-consolidated, moderately compact, weakly plastic and relatively impermeable. They have significant limitations for road building or heavy equipment operation, especially when wet. They also have favourable moisture retention characteristics and depending upon topographic location and soil drainage, are similar to tills in ability to support browse species.

4.4.7 Ice

Ice includes areas of snow and ice where evidence of active glacier movement is present. The only extensive areas of ice in the study area are the glacier fields on the Howson Range and in the Coast Mountains on the western edge of the study area.

4.5 GEOLOGICAL PROCESSES

Geological processes are processes that are currently modifying, or have modified surficial materials and surface expressions. A number of hazardous geological processes are evident in the mountainous portions of the study area and include failures in: bedrock (rockfall, rockslide, bedrock slump), surficial materials (debris torrent), and in ice and snow (avalanches). High elevation peaks, uplands and plateau surfaces are also subject to a number of much less hazardous, but significant periglacial processes including cryoturbation, nivation and solifluction. Fluvial processes evident in the study area include development of irregular sinuous, meandering and braided watercourses. Gully erosion is a significant process on steep mountain slopes, on till slopes, on fluvial fans, and in canyons. These processes influence the type and quality of wildlife habitat.

4.5.1 Rockfall

Rockfall is the detachment of masses disintegrating bedrock from steep slopes and their descent mostly through the air by leaping, bouncing and rolling. In the Morice study area, it is also used to include small rockslides and rock avalanches that cont ibute to talus accumulation. It generally involves repeated falls of small amounts of debris resulting in fresh scars on rock faces (e.g. Rs-Rb) and fresh talus debris (e.g. rCaf-Rb). It is most common in steep, rocky mountain summit areas, but also occurs to a limited extent on steep rock faces at lower elevations. Very active areas are poorly vegetated and present a hazard to mountain goats traversing these areas.

4.5.2 Rockslide

Rockslides are the rapid downslope movement of masses of bedrock along well defined slip planes (e.g. Rs-Rr). The moving mass disintegrates or is severely deformed. This process was observed only in the Kitnayakwa River-Steward Creek valleys where numerous small, and one extensive, deep seated rockslide failures have occurred in volcanic bedrock.

4.5.3 Bedrock Slumps

Bedrock slumps are the sliding of internally cohesive masses of bedrock along a surface of rupture that is either concave upwards, planar or irregular. This process was observed only in the Kitnayakwa River and Steward Creek valleys where it is characterized by scarp slopes (slide scars) and tension cracks associated with displaced slump blocks in volcanic rock (e.g. Rs-Fm).

4.5.4 Debris Torrents

Debris torrents are the rapid flow of slurries containing rock fragments and vegetative debris down well defined, steep mountain side stream channels. In the Morice study area this process is identified by debris accumulation, sediment plugs and/or scattered large blocks in the channels carved in the mountain slopes (e.g. rCvb//Rs-Rt), and by coarse, non-sorted debris, large blocks, levees and wood debris on fans affected by debris torrents (e.g. rCf-Rt). This process is common on steep, gullied slopes in the Coast Mountains, but also occurs less frequently on similar topography in the Bulkley Ranges.

4.5.5 Avalanching

Avalanching is the rapid downslope movements of snow, ice and other incorporated debris on steep mountain slopes and in gullies (e.g. rCv/Mv-A), often extending out onto valley floors (e.g. rCa-A). It is prevalent throughout the mountainous portions of the study area. Frequent avalanches may preclude winter range use by mountain goat on otherwise suitable range and may be an important mortality factor.

4.5.6 Cryoturbation

Cryoturbation consists of heaving, churning and related movements that result from repeated freezing and thawing of moist unconsolidated sediments. In the Morice study area it is characterized by development of sorted circles, stone stripes, and earth hummocks on alpine/subalpine slopes above 1500 m and on all aspects (e.g. rCv-C). It also commonly occurs on plateau surfaces above 1500 m (e.g. $\frac{Mv}{Rhu}$ C).

4.5.7 Nivation

Nivation is the erosion and enlargement of hollows containing snow patches due to a combination of freeze-thaw processes, physical and chemical effects of meltwater, solifluction and soil creep. In the Morice study area it is characterized by circular to elongate "snow patch hollows" on alpine/

subalpine slopes (Rhs-N) and on plateau surfaces (e.g. Mv/Rhu-N). It is most common on "northerly" aspect slopes at elevations greater than 1500 m. Such areas are covered with deep snow until summer.

4.5.8 Solifluction

Solifluction is the slow downslope movement of moist or saturated, seasonally frozen unconsolidated material over a relatively impermeable substrate that may be bedrock or frozen ground. In the Morice study area it is characterized by lobes, sheets or terraces of soliflucted materials on alpine/subalpine slopes (e.g. rCvb-S). It generally occurs above 1500 m on all aspects.

4.5.9 Irregularily Sinuous Channel

The irregularily sinuous channel fluvial process is evident where the channels display irregular turns and bends without repetition of similar features (e.g. sgF^Apt-I). It is the typical fluvial process on relatively low gradient, laterally confined floodplains throughout the Morice study area. Floodplains subject to this process may be seasonally inundated by slow to rapidly flowing overbank flooding. Channel bank erosion and channel shifting may occur.

4.5.10 Meandering Channel

The meandering channel fluvial process occurs where a channel is characterized by a repeated pattern of bends with uniform amplitude and wave length (e.g. $sF^{A}p-M$). This process was mapped on low gradient reaches of the upper Clore River, Gosnell Creek and the Morice River. Areas subject to this process are generally seasonally inundated by slow moving overbank flooding. Gradual channel bank shifting and channel bank erosion occur. This is one of the most important processes in renewing seral progression on moose range in the area.

4.5.11 Braiding Channel

The braiding channel fluvial process occurs where the active channel zone is occupied by many diverging and converging channels separated by bars. Braiding channels are subject to seasonal flooding by rapidly moving water, channel and bar shifting, lateral instability and abrupt channel shifts (e.g. $sgF^{A}p$ -B). It is a typical process on fans and on the floodplains in large, relatively low gradient mountain valleys that are receiving excess sediment from steep tributary valleys and/or glaciers. Such areas provide some good summer moose range, but are often poorly vegetated.

4.5.12 Gullying

The gullying process is evident where surfaces have been eroded into long, narrow, steep sided depressions by running water, mass movement processes, or snow avalanches. In the Morice study area this process is commonly observed on steep rocky mountain slopes (e.g. Rs/rCv-V), on till slopes (e.g. Mvb-V) and in canyons (e.g. Us-V). Flooding, bank erosion, debris torrents and snow avalanching are typical hazards encountered in gullies. The complex topography created by this process often results in mosaic of feeding and secure resting sites for ungulates.

CHAPTER 5. BIOPHYSICAL SOIL LANDSCAPES OF THE LAMPREY CREEK AREA, 93L/3

5.1 INTRODUCTION

The Lamprey Creek 1:50 000 mapsheet 93L/3 is located between $54^{\circ}00'$ and $54^{\circ}15'$ north latitude and $127^{\circ}00'$ and $127^{\circ}30'$ west longitude. This map area covers 91,500 ha in the southeast quarter of the study area.

There are no settlements within the Lamprey Creek map area, however, considerable road access has been developed to access forest resources and one high elevation mining exploration area in the southwest corner of the study area. There are two B.C. Ministry of Forests low maintenance picnic sites, one on Morice Lake and another at the mouth of Lamprey Creek, as well as a cabin on McBride Lake. Major recreational opportunities for boating occur on McBride Lake, Lamprey Lake, and Tagetochlain Lakes as well as on the Morice River. Sport fishing has long been of major importance and the value of the Morice River, Nanika River and Morice Lake waters for salmon are detailed by Shepherd, 1979.

Most of the bedrock outcrops within the Lamprey Creek map area are fine grained and of volcanic and sedimentary origin. Coarse grained acid intrusive rock outcrops are limited to an area west of the Nanika River and south of McBride Lake. These two bedrock groups were recognized within the biophysical soil landscape legend. Table 2 shows how the bedrock geology maps have been generalized.

There are 3 biogeoclimatic zones present within the Lamprey Creek area; the Alpine-Tundra, Engelmann Spruce Subalpine Fir and Sub-boreal Spruce Zones (Ministry of Forests, 1984). Most of the area is within the Subalpine Fir Subzone of the Subboreal Spruce Zone. The Engelmann Spruce Subalpine Fir Zone is restricted to areas above 1070 m (3500') such as Pimpernel Mountain and the southwestern edges of the map area. The Alpine-Tundra zone only occurs northwest of Morice Lake. A very small area, the lowest elevation within the study area, 670 m to 730 m (2200' to 2400') along the Morice River is within the Spruce Subzone of the Subboreal Spruce Biogeoclimatic Zone. This area has the lowest snowfall and longest

Table 2. Generalized Bedrock Groupings for the Lamprey Creek Map Area* 93/L-3

1. Fine grained sedimentary and volcanic

0 KRR	Endako Group Red Rose	andesite, basalt, dacite shale, greywackie, conglomerate, coal
ЕТЬ		gabbro
KTOL	Oosta Lake Group	rhyolite, dacite, trachyte, sandstone, shale conglomerate
IJTN	Telkwa, Nilkitkwa Group	basalt, andensite, breccia, tuff, shale, siltstone
KBB	Brian Boru	andesite to rhyolitic tuff, breccia, flows

2. Coarse grained acidic intrusive

ETg	Early Ter ti ary	quartz monzonite, granodiorite,
EJg	Topley Intrusions	quartz diorite quartz mozonite, granodiorite

* after Tipper H.W., R.B. Campbell, G.C. Taylor and D.F. Scott, 1979, Parsnip River British Columbia. Sheet 93. 1:1 000 000 Geological Atlas. Geological Survey of Canada. Energy, Mines and Resources.

additional information on bedrock geology from:

Carter, N.C. and R.V. Kirkham, 1969. Geological Compilation Map of the Smithers, Hazelton and Terrace Areas. British Columbia Department of Mines and Petroleum Resources. Map 69-1. growing season. These zones and subzones provide a level of stratification of soils below physiographic region and bedrock type.

The summary of the ten short term climate stations within the Lamprey Creek map area appears in Chapter 3.

5.2 PREVIOUS SOIL AND TERRAIN WORK

Five site, soil and vegetation plots were collected by the B.C. Ministry of Forests in support of biogeoclimatic classification. Their locations are marked on the map.

The 1:50 000 scale landform map (93L/3) produced by N. Gough in 1974 was used as a base and revised to the unpublished Ministry of Environment Terrain Classification System. Process modifiers such as flooding, and surface expressions such as depth were the major additions to Gough's maps. The eight detailed soil profiles sampled during this earlier project supplemented the soil data collected during this study.

B.C. Ministry of Forests carried out detailed (1:20 000 scale) soils mapping in an area south of Pimpernel Creek and north of Bill Nye Lake (Lindebergh and Trowbridge, 1984). The general descriptions of their soil units were used to help extrapolate to the surrounding areas with similar materials and drainage conditions. No soil samples were analysed from this more detailed study area.

Soil samples collected by L. Lacelle in 1983 for this project were also used if they were collected within a biogeolclimatic subzone common to the Lamprey Creek map area.

There are published soil maps to the east of the study area (Runka, 1972). Although many of the soils recognized in the Lamprey Creek area have soil association names in the adjacent map area 93/L 2, no attempt was made to correlate with these association names.

5.3 METHODS

Prior to field work, aerial photographs were studied to gain familiarity with general tone, pattern and texture of the photographs so as to relate these to identification of drainage conditions and material types when in the area. The aerial photographs were taken at a 1:50 000 scale in 1979; flight line BC 79076 photo numbers; 154-170, and 242-249.

A total of eight days were spent in the Lamprey Creek map area, 93L/3, in July, 1983. Most roads were travelled by vehicle, supplemented with some short hikes to check map units. Boat access was used along the Morice River and 1 1/2 hours of helicopter time was used to access more remote areas.

Thirty-three plots including site, soil, vegetation and wildlife descriptions were collected in accordance with the standards set out in Walmsley et al., 1980. The site, soil and laboratory analysis is stored in the B.C. Soil Information System as described by Sondheim and Suttie, 1983. Additional information collected in the field was recorded on aerial photographs and incorporated into the terrain and biophysical soil landscape maps.

Appendix A shows how the field samples are located within the biophysical soil landscape legend. This is intended as a rough guide to the reliability of physical and chemical descriptions. Usually, landscape types with more described sample sites are better understood.

Laboratory analyses include: soil reaction (pH in calcium chloride), organic matter content (organic carbon), total nitrogen, cation exchange capacity, exchangeable cations, extractable iron and aluminum percentages. Some physical analyses were carried out to determine sand, silt and clay percentages for selected mineral horizons. Organic horizons were analysed for reaction, rubbed fiber content and pyrophosphate index.

Since the sampling was selective, the summary of the data relies on the experience of the surveyor. Some plots are considered to better represent the map units than others and have been judiciously selected. A statistically valid sampling program was not undertaken due to the cost and time involved relative to the benefits derived.

The biophysical soil landscape legend was developed with first level or broadest stratification based on physiographic regions and associated bedrock geology. The second level of stratification was based on biogeoclimatic zones and subzones. Within this framework the major material types are characterized for texture, drainage, topography, depth, perviousness and soil classification. Table 3 shows the matrix used to construct the biophysical soil landscape legend for the Nechako Plateau and the Bulkley Mountains physiographic regions.

Each biophysical soil landscape unit is a group of soils that have developed on similar parent materials and under broadly similar climatic conditions (in this case, as expressed by biogeoclimatic zones and subzones). These map units provide a sound ecological basis for land use planning and ratings for biological productivity such as ungulate capability ratings (Chapter 7).

A further level of detail can be added to each biophysical soil landscape unit by using map unit modifiers (see the soil map legend, box 4). Map unit modifiers are used to point out areas which differ from the majority of areas, for example areas of wetter soil or areas with steep south aspects.

5.4 BIOPHYSICAL SOIL LANDSCAPES

5.4.1 Introduction

This section summarizes the field observations and describes the character and distribution of the major materials and their associated bio-physical soil landscape units (Table 3). Four schematic cross sections show the major characteristics used to differentiate map units (Figures 4 to 7).

Range.
Bulkley
and
Plateau
Nechako
the
for
Units
Landscape
Soil
Biophysical
Table 3.

Physiographic Region				Nechako	Nechako Plateau (NE)	1 (NE)			Bulkley Range (BR)	ey (BR)
Bedrock Grouping	Non-E Spee	Non-Bedrock Specific		Fine Sedim and V	Fine grained Sedimentary and Volcanic		Coarse grained Acid	jrained I	Fine grained Sedimentary	ained entary
Biogeoclimatic Zone and Sub-Zone*	SBS(d)	SBS(e)	ESSF	SBS(d)	SBS(e)	ESSF	ESSF	AT	ESSF	AT
<u>Materials</u> Colluvial(deep) (shallow)				NEC2	NEC3 NEC4	NEC5 NEC6	NEC 7	NEC 8	BRC1 BRC1	BRC2 BRC2
Fluvioglacial		NEG2								
Floodplains (gravelly) (sands over gravels) (deep sands)	NEF1	NEF6 NEF3 NEF5								
Fluvial (terraces) (fans)		NEF4 NEF2								
Lacustrine	NEL1						<u> </u>			
Morainal (deep) (shallow)		NEM3 NEM4	NEM5 NEM6				₩₩			
Organic (deep) (shallow)		NE01 NE02								
Rock				NER1	NER2	NER3	NER4		BRR1	BRR2

* AT ESSF SBS(d) SBS(e)

= Alpine Tundra Zone
= Engelmann Spruce Subalpine Fir
= Sub-Boreal Spruce - Spruce Subzone
= Sub-Boreal Spruce - Subalpine Fir Subzone

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5.4.2 Colluvial Terrain and Soils

Shallow colluvial materials are widely distributed within the Lamprey Creek area. Eight biophysical map units were defined and three were sampled. The shallow colluvial areas, map units NEC2, NEC4, and NEC6 are well to rapidly drained. These areas are higher in angular coarse fragments than the deep colluvial areas and are directly derived from the physical weathering of fine grained volcanic and sedimentary bedrock outcrops. The single sample for shallow colluvium had a soil pH of 6.3 for the dark surface organically enriched surface horizon. This lithic south facing site supported a community of kinnikinnick (<u>Arctostaphylos</u>), common juniper (<u>Juniperus communis</u>) and grasses. The organic carbon content of the surface layer was 4.6%.

Map units NEC6, NEC7 and NEC8 were not sampled but are thought to be more deeply weathered and more acidic due to the coarse grained acid intrusive bedrock from which these soils are derived and the higher precipitation in the areas where they occur.

The deeper colluvial materials derived from morainal materials were imperfectly drained (Map Units NEC3 and NEC5). One site had a veneer consisting of 90% coarse fragments over colluviated till. Slope processes are considered active with material moving down the slope, obscuring distinct horizon boundaries. The surface soil pH ranged from 5.4 to 5.9 with relatively high organic carbon content (3 to 4.3 percent). These southerly aspect meadows supported a trembling aspen-saskatoon (<u>Populus</u> <u>tremuloides</u> - <u>Amelanchier alnifolia</u>) vegetation landscape (Chapter 6), explaining the high organic carbon percentages. These sites are considered highly productive and mapped as NEC3 (see Figure 4).

5.4.3 Fluvial Terrain and Soils

Fluvial materials have been deposited by flowing water and materials are often well sorted. The majority of fluvial materials are associated with the major active floodplains in the study area, the Morice, Nanika, Gosnell Rivers and Lamprey Creek. New materials are actively deposited

NEC8 SOMBRIC HUMO		+) + + 			DEEP	COLLUVIUM DERIVED FROM COARSE GRAINED ACID BEDROCK TYPES
NEC7					SHALLOW	COLLUVIUM COARSE G BEDRO
NECG	-	+			SHALLOW	
NEC5	PODZOL		+)+		DEEP	OM FINE VOLCANIC
NEC4					SHALLOW	COLLUVIUM DERIVED FROM FINE INED SEDIMENTARY AND VOLCANIC BEDROCK TYPES
NEC3				+	DEEP	COLLUVIUM GRAINED SEDI BED
NEC2	REGOSOLS			+++++++++++++++++++++++++++++++++++++++	SHALLOW	19
BIOGEOCLIMATIC ZONES AND SUBZONES	ALPINE TUNDRA	ENGELMANN SPRUCE SUBALPINE FIR- NORTHERN CONTINEN- TAL SUBZONE	SUB-BOREAL SPRUCE SUBALPINE FIR SUB- ZONE	SUB-BOREAL SPRUCE SPRUCE SUBZONE		BIOPHYSICAL SUIL LANDSCAPE UNIT CHARACTERISTICS

Schematic Cross-section of Biophysical soil Landscape units for colluvial materials of the Nechako Plateau. FIGURE 4.

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within these floodplains and channels continue to change. Low terraces not subject to to flooding are common along the margins of these floodplains as these watercourses continue to incise into the landscape.

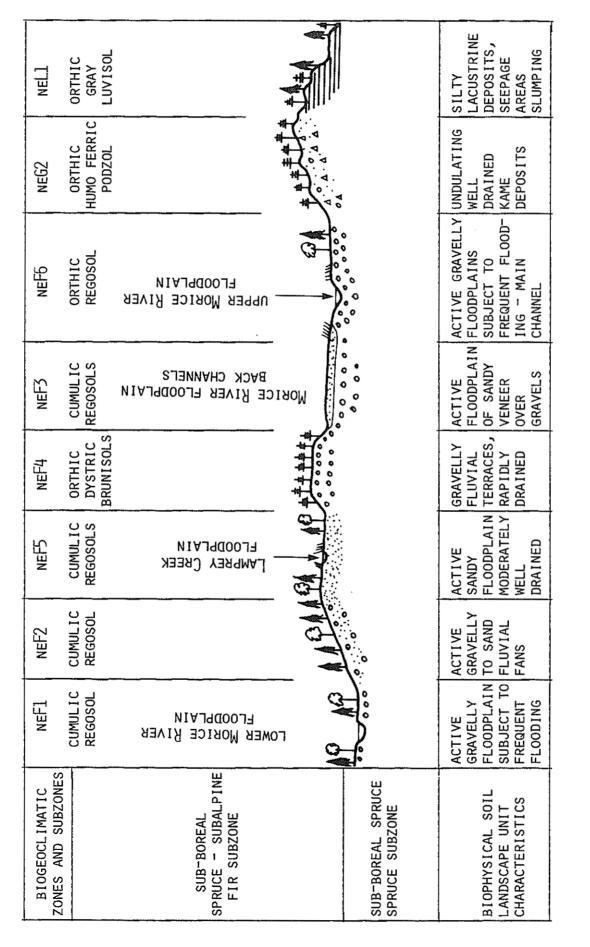
Six biophysical soil map units were defined for fluvial materials within the study area. These fluvial soils can be broadly grouped into 5 types; gravelly textured fluvial terraces (NEF4), sandy floodplains (NEF5), gravelly floodplains (NEF1 and NEF6), gravelly floodplains with a sandy veneer overlying the gravels (NEF3) and gravel fluvial fans (NEF2) (see Figure 5).

Fluvial terraces mapped NEF4 are rapidly drained areas which support xeric plant communities such as the lodgepole pine - lichens vegetation (Pinus contorta - Cladina) vegetation landscape (Chapter 6). Fluvioglacial terraces associated with long abandoned meltwater channels have been included with these soils as they have similar soil and plant communities. Coarse fragment contents of these areas are high, (70 to 80%). The three sites used to characterize these terraces had surface soil reaction from pH 4.8 to 5.0, organic carbon of 1.3 percent and extractable iron and aluminum of 1.5 to 2%. Soil matrix textures are coarse and consequently have a low moisture holding capacity.

Deep sandy floodplains NEF5 are associated with lower gradient streams such as the mid section of Lamprey Creek and portions of the Gosnell and Morice river floodplains. The six sites visited ranged from moderately well to imperfectly drained mottled soil indicating a seasonal water table within 0 to 70 cm of the soil surface (NEF5a). Some sandy floodplains were well drained and are mapped as NEF5.

Floodplains characterized by a sandy veneer over gravels are the most extensive (NEF3). The majority of the Morice River floodplain is included within this map unit. Five sites varied in texture from silty loam to loam with soil reaction varying from 3.8 to 6.9 pH.

Frequency of flooding of some portions of the valley floor was not clear and two sites, 82-07624 and 82-07629 had developed Podzolic soil



SCHEMATIC CROSS-SECTION OF BIOPHYSICAL SOIL LANDSCAPE UNITS FOR FLOODPLAINS, FLUVIAL TERRACES, KAME TERRACES AND LACUSTRINE DEPOSITS OF THE NECKAKO PLATEAU. FIGURE 5.

profiles with dark brown surface horizons. Podzolic profile development is traditionally believed to take in excess of 100 years and a steady state not reached until 500 years (Chandler, 1942). Only one surface horizon was sampled along the Morice River floodplain in areas which were frequently flooded (pH of 6.9). The two Podzolic profiles had surface pH values of 3.8 and 4.3, indicating a great deal of weathering. Such areas of the valley bottom may not have received deposition of new material for more than 200 years. This does not necessarily indicate that these sites were not seasonally submerged by seepage water, but that such water was not laiden with sediments as are the majority of the Cumulic Regosol soils associated with the main channel areas.

A historic look at channel changes has been undertaken by M. Miles (personal communication) through study of 5 sets of aerial photographs available from 1950 to the present. Deep gravelly floodplains (NEF6) are associated with the most active main channels of the Morice, Thautil and Nanika Rivers. These areas are frequently flooded and are sufficiently active that no soil weathering can take place before new material changes the profile.

The lower portions of the Morice River floodplain downstream from Lamprey Creek are climatically warmer, have lower snowfall and are in the Spruce Subzone of the Sub-Boreal Spruce Zone (NEF1).

5.4.4 Fluvioglacial Terrain and Soils

Fluvioglacial deposits are not extensive throughout the Lamprey Creek map area. A major glaciofluvial meltwater channel above the present upper Morice indicates that an abrupt and major change occurred in drainage at one point during deglaciation. This abrupt drainage change left a well established dry river bed some 20 to 30 m above the Gosnell River and along portions of the upper Morice River.

The eastern end of McBride Lake also has evidence of fluvioglacial materials; deep sands, possibly associated with discharge from the Nanika River. The Nanika River channel today dissects fluvioglacial material

along its lower reaches and as it empties into Morice Lake. Kame deposits and discontinuous eskers are also found along Nado Creek and Cedric Creek. Small meltwater channels are scattered within large, deep morainal areas near McBride and Collins lakes.

Soil map unit NEG2 have a wide range of soil matrix textures (<2 mm) ranging from loamy sand, to sand to silt loam and an equally wide range of coarse fragment contents. Most of these soils are well to rapidly drained with undulating to hummocky surface topography.

Two samples with surface pH of 4.2 and 4.7 were taken to characterize map unit NEG2. Both samples had enough extractable iron and aluminum for classification as Podzols.

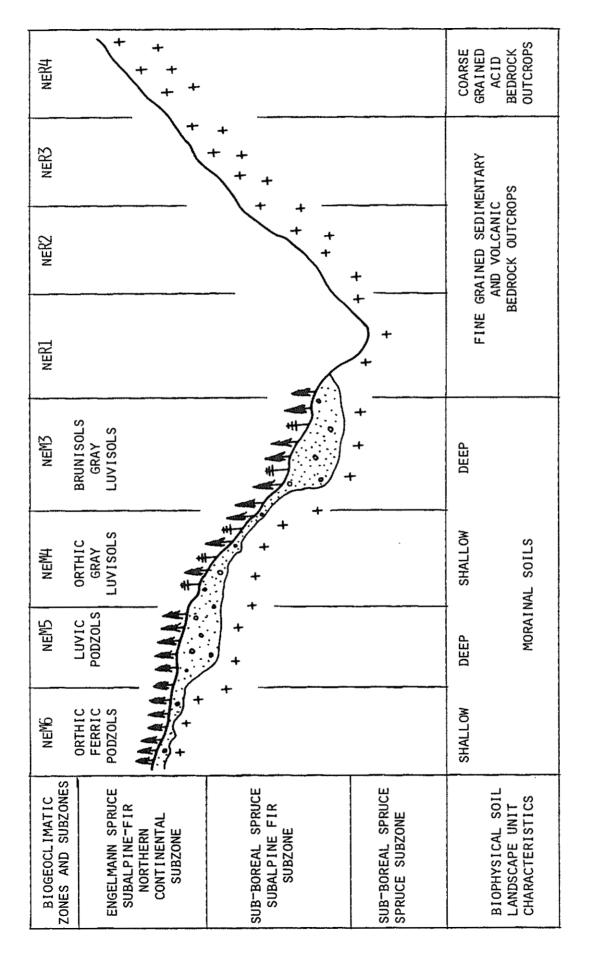
5.4.5 Glaciolacustrine Terrain and Soils

One small area downstream from the Lamprey Creek and Morice River confluence was identified as glaciolacustrine material (NEL1). A well defined delta, identified with foreset beds exposed in a gravel pit is located in 93L/2 just outside the study area. The glaciolacustrine materials are believed to be associated with this delta and represent the western extent of a much larger lake associated with deglaciation. Ice movment was believed to be from west to east across the map area. Glacial straie on recently exposed bedrock north of Lamprey Lake had an orientation of 90°.

5.4.6 Morainal Terrain and Soils

A majority of the morainal materials are deep and many areas may have a surface layer of less compacted material, believed to be ablation moraine. The matrix textures available for three samples below 2 m in depth were loam and sandy loam. Two other till samples adjacent to the area of Shea Lake and Gosnell Creek also had loam matrix textures.

Soil map units NEM1 and NEM2 occur at the lowest elevations along the Morice River and are associated with the Spruce subzone of the Sub-Boreal



Schematic Cross-section of biophysical soil landscape units for moraine and rock for the Nechako Plateau. FIGURE 6.

Spruce biogeoclimatic zone. These map units are an extension of much larger low elevational morainal soils east of the study area and characterized in greater detail by Runka, 1972 (see Deserters Soil Association). Map unit NEM2 is restricted to some south aspects along the lower Morice River valley.

Map unit NEM3 is most wide spread and has six sites available to characterize these areas. Soils mapping has been carried out in the Pimpernel area, mostly detailing drainage characters with NEM3 map units (Lindeburgh and Trowbridge, 1984). NEM3 soils range from 30 to 50% coarse fragments with soil pH from 4.5 to 5.3 for the dark brown podzolic surface horizons. There is evidence, such as clay skins and slightly finer textures, that clay accumulation has taken place below 50 cm in depth. Rooting is above 50 cm with mottles and gleying often associated with the zone of clay accumulation even on moderate slopes. Surface soil textures ranged from loam to clay loam to sandy loam. The medium to coarse soil matrix textures are considered to have been derived from less compact ablation moraine.

Map unit NEM4 is a shallow morainal soil (<1 m). These soils are not as extensive as the deep morainal soils (NEM3) and are commonly mapped as a minor component within a dominately deep morainal area or in association with shallow colluvial materials, (NEC4). The surface pH where sampled was 3.8 with 1.3% carbon and extractable iron and aluminum percentages of 1.6.

Map unit NEM5 is confined to the higher elevations and areas of higher rainfall in the Engelmann Spruce Subalpine Fir Zone. The two sites visited were well and moderately well drained. The upper soil horizons of these sites appeared glacially washed and could have been derived from a layer of ablation moraine overlying more compacted basal moraine. Soil matrix textures (<2 mm particles) were sandy loams, verified by laboratory analysis for both sites. Evidence for clay accumulation was supported by many moderately thick clay skins showing an increase in clay from 9 to 17%. This clay layer is situated from 90 to 120 cm in depth and acts as a layer in which an excess of moisture is present. Common distinct mottles were associated with this layer for the moderately well drained site.

The map unit NEM6 is found in association with deep moraine (NEM5) and shallow colluvial soil (NEC6), usually as a minor component. No sites were visited but soils are considered to have a podzolic development with no significant clay movement in the profile. These soils tend to be well drained on upper slopes, and have a lower moisture holding capacity than the deeper NEM5 soils (see Figure 6).

5.4.7 Organic Terrain and Soils

Organic materials are scattered in distribution and associated with active floodplains and fans. Two organic soil map units (NEO1 and NEO2) have been mapped within the study area. Three organic sites were visited, all were located in poorly drained depressional areas and were greater than 1 metre in depth (NEO1). Map unit NEO2 describes areas of organic deposition of between 40 cm and 1 m in depth (see Figure 7).

5.4.8 Bedrock Terrain and Soils

Two major bedrock groups were recognized: fine grained volcanic/sedimentary bedrock and coarse grained acid bedrock (see Table 2). The most extensive bedrock outcrops are fine grained volcanic and sedimentary. Rock dominated map units often include areas in which <10 cm of material occur over rock as well as bare rock outcrops. The volcanic and sedimentary rocks have weathered and fractured and support xeric vegetation communities (NER1, NER2, NER3).

The acid coarse grained bedrock map units are very limited in distribution within the study area. These areas are also xeric in character with less fracturing of bedrock. Thus, these areas tend to have fewer opportunities for plants to establish (NER4, NER5, and NER6) and tend to be less productive than the fine grained volcanic and sedimentary rock.

BRRI	ROCK OUTCROPS (INCLUDE VEGETATED AREAS WITH LESS THAN 10CM OF SURFACE MATERIAL)	+ + + + + + + + + +	+	CK OUTCROPS OF FINE ED SEDIMENTARY AND VOLCANIC ROCKS S
BRR2	ROCK + + + + + + + + + + + + + + + + + + +	+		VIAL BEDROCK OUTC NE GRAINED SEDI ND VOLCANI BULKLEY RANGES
BRC2	L FERRIC PODZOL FERRIC PODZOL	+++++++	AREAS HIGH IN ANGULAR COARSE FRAGMENTS	AND SHALLOW COLLUVIAL S DERIVED FROM FINE NED SEDIMENTARY AND VOLCANIC ROCKS BULKLE
	FERRIC PODZO	+++++++++++++++++++++++++++++++++++++++	+ + + + + + + + + + + + + + + + + + +	DEEP AND SHALLOW COLLUVI SOILS DERIVED FROM FINE GRAINED SEDIMENTARY AND VOLCANIC ROCKS BU
	TERRIC MESISOL		POORLY DRAINED	SHALLOW OILS PLATEAU
NEOI	TYPIC MESISOLS	-	POORLY	deep organic soi Nechako Pl
BIOGEOCLIMATIC ZONES AND SUBZONES	ALPINE TUNDRA	ENGELMANN SPRUCE SUBALPINE FIR - NORTHERN CONTINENTAL SUBZONE	SUB-BOREAL SPRUCE SUBALPINE FIR SUBZONE	BIOPHYSICAL SOIL LANDSCAPE UNIT CHARACTERISTICS

Schematic Cross-section of Biophysical soil Landscape units for organic areas of the Nechako Plateau and for rock and colluvium in the Bulkley Ranges. FIGURE 7.

CHAPTER 6. VEGETATION

6.1 VEGETATION ZONATION

The biogeoclimatic zonation of the area is largely described by Pojar. et al. (1984). A draft map at 1:250 000 scale from the Prince Rupert Regional office of Ministry of Forests Research Branch was used as a guide to zonal distribution. The vegetation zonation reflects the physiography and climate of the area. The Coastal Western Hemlock Zone occurs in the western, wetter portion of the study area, while the drier, colder Sub-Boreal Spruce Zone occurs in the rainshadow of the Coast Mountains to the east. Each area has corresponding subalpine and alpine zones also reflecting climatic drying from west to east. This is most notable in the Telkwa Ranges where snow pack is sufficiently reduced by a drier climate and windsweeping to provide good alpine winter range for mountain caribou and mountain goat. The relatively dry and mild climate of the White Spruce Subzone of the Sub-Boreal White Spruce Zone occurs near the lower Morice River. Moose winter range was found to generally be correlated with this subzone, with the exception of strongly edaphic areas.

6.2 VEGETATION LANDSCAPES OF THE MORICE RIVER FLOODPLAIN

The Morice River floodplain study area includes the area downstream of Gosnell Creek on map area 93L/3. It encompasses the transition of the milder White Spruce Subzone (SBSd) to the colder Subalpine Fir Subzone (SBSe) of the Sub-Boreal Spruce Zone (Pojar et al., 1984). This reference contains a detailed description of biogeoclimatic classification in the area.

Vegetation landscapes are areas of similar successional pattern and climax vegetation. The main factors creating these landscapes in the study area are climate, surficial materials, available soil moisture and frequency of flooding. The following is a description of how these factors influence vegetation landscapes in the study area.

a. <u>Climate</u>. The regional climate of the area (macroclimate) is reflected by limited moisture availability and a shortened growing

season, influencing species diversity and productivity. This regional climate is locally modified by slope, elevation, aspect and cold air drainage. Thus vegetation influenced by a somewhat colder climate occurs along the valley bottom and northerly aspects while a warmer climate prevails on southerly aspects. For example, the trembling aspen - saskatoon vegetation landscape¹ has high browse productivity and low snowdepth, largely attributable to its steeply sloping southern exposure.

- b. <u>Surficial Materials</u>. Surficial materials influence moisture and nutrient availability by their texture and chemical characteristics. For example, relatively dry, nutrient poor ecosystems such as the lodgepole pine - lichens dry forest may develop on coarse textured surficial materials.
- c. <u>Available Soil Moisture</u>. The availability of water to plants can be influenced by soil texture, drainage, soil chemistry and height of water table. Water table height is important in determining the abundance of willows and red-osier dogwood along the Morice River floodplain.
- d. <u>Flooding Frequency</u>. The active floodplain area has had frequent disturbance resulting in a diverse vegetation pattern. This disturbance in addition to water table movement largely contribute to the vegetation landscapes present. These processes along with other biophysical parameters have provided a rich blend of the vital needs of wildlife, i.e. food, shelter and water. This makes the floodplain one of the important wildlife habitats in the area.

The vegetation landscapes of the study area can be grouped into the following landscape systems. They are summarized in Table 4.

a. <u>Wetland Landscapes</u>. Most wetlands have developed either in depressional upland areas or from a high water table. The former

¹ See vegetation map legend for a further description of these landscapes.

type tend to be organic bogs and fens with lower browse production for moose. The latter type commonly occur at the toe of slopes and near low gradient floodplains. Groundwater movement in these areas usually is a major contributor to their high browse productivity.

- b. <u>Riparian Landscapes</u>. These landscapes are dominantly influenced by the hydrology and erosional cycles of the river. Evidence of flooding in soil profiles was found on most areas of the valley bottom. Primary succession (pioneer) is the dominant successional process.
- c. <u>Fluvial Terrace Landscapes</u>. These areas are no longer influenced by flooding. Parent materials have a strong influence on moisture holding capacity and nutrient availability. Some sandy gravelly terraces can be very dry and nutrient poor, as in the lodgepole pine lichens vegetation landscape.
- d. <u>Upland Landscapes</u>. These areas may develop climatic climax forests through a series of seral stages (secondary succession). These stages may include either lodgepole pine or trembling aspen forests. Browse productivity is usually higher on the latter type, being more common on steeper south aspects.
- e. <u>Rock Outcrop Landscapes</u>. These areas have low vegetative productivity because of their dryness and thin soil. Steep south aspects usually provide some mule deer range.

Landscape System	Map Symbol	Vegetation Landscape Description
Wetland Landscapes	SB	Sedge - bog birch - sphagnum wetlands on organic soils.
Methanu Lanuscapes	WS	Wetland willow - spiraea shrub on gleysols.
	AW	Fluvial alder - willow shrub.
	CW	Black cottonwood - willow deciduous forest.
Riparian Landscapes	SS1	Black cottonwood - red-osier dogwood deciduous forest.
	SS2	Black cottonwood - white spruce mixed forest.
	SS	White spruce coniferous forest.
Fluvial Terrace Landscapes	LL	Lodgepole pine - lichens dry forest.
	AS	Trempling aspen - saskatoon.
	BS1	Trembling aspen - white spruce seral forest.
Upland Landscapes	BS2	Lodgepole pine - white spruce seral forest.
	BS	White spruce - alpine fir coniferous forest.
Rock Outcrop Landscapes	R	Rock Outcrops.

Table 4. A Summary of the Vegetation Landscapes of the Morice Floodplain Study Area*.

 \star See the vegetation landscape map for a full description of these types.

CHAPTER 7. WILDLIFE CAPABILITY

7.1 INTRODUCTION

The four wildlife maps depict capability for moose, mountain goat, woodland caribou and mule deer. Capability is largely reflected by present use, mainly because access to much of the area is limited. Exceptions to this include the caribou of the Telkwa Range, which have been recovering from overhunting of the 1940's and 1960's (Hodson, 1977); and moose in the Lamprey Creek map area which appear to have not yet responded to the increase in forage created by logging. Despite these exceptions the maps should provide a good basis for survey stratification, planning and habitat protection.

Greater survey effort was directed towards areas of higher ungulate capability. These include portions of the Telkwa Ranges with high capability for goat and caribou, and the lower Morice area with high moose capability. The possible detrimental effects of the proposed Kemano Completion hydroelectric development on moose habitat along the Morice River increased our survey effort in this area. The mountainous western half of the study area was surveyed with the least intensity because of its remoteness and frequent poor weather. Survey reliability is expected to vary accordingly.

7.2 BACKGROUND WILDLIFE SURVEYS

The limited background information pertaining to wildlife in the study area is listed here for reference:

- "A fisheries and wildlife survey of the Burnie Lakes park proposal", an unpublished Parks Branch document, dated 1975.
- 2. "Snowmobile conflict with the Telkwa caribou herd," an unpublished B.C. Fish and Wildlife Branch document, dated 1980.

- "A winter population and habitat survey in the Telkwa Mountains of mountain caribou, January - April/77," an unpublished B.C. Fish and Wildlife document.
- 4. "Gosnell resource plan," an unpublished document by Northwood Pulp and Timber Limited, undated.
- 5. B.C. Fish and Wildife Branch regional files, Smithers.
- Canada Land Inventory winter flights of 1968 and 1974, and 1:250,000 scale capability map.

7.3 METHODS

Background data pertaining to wildlife and biophysical themes were used in combination with aerial photographs to prestratify the sampling prior to field work. Summer field work (1983) was done concurrently with the soils, terrain and vegetation sampling. Fifteen days of summer field work and 16 hours of helicopter time were expended, mainly to gain ground access to selected sites, although one flight focused on mountain goat habitat use in the Telkwa Ranges (September 19, 1983). Data from ground stops was recorded using the procedures described in Walmsley et al., 1980. The data from all reconnaisance plots (site, soil, vegetation and wildlife forms) has been entered into the B.C. Soil Information System. Ministry of Forests Research Branch personnel provided valuable field and office assistance.

Winter field work was mainly by helicopter to confirm ungulate use and habitat conditions of suspected winter ranges. Four days and twelve hours of helicopter time were expended between January 31 and February 6, 1984. The flight lines and observations were recorded using the methods described in Demarchi et al., 1983. These and the flight records of the summer field work are available from the Habitat Management and Inventory Section of the Wildlife Branch, Ministry of Environment, Victoria, B.C. Wildlife Branch personnel from Smithers assisted with the winter flights. The mapping procedure follows the methods outlined in "Wildlife Capability Classification for British Columbia: An Ecological (Biophysical) Approach for Ungulates." Briefly, the biophysical data or maps of terrain, soils, climate and vegetation are grouped or subdivided into units of similar ecological significance to ungulates. These units are separated into either summer or winter range and ranked according to their perceived importance. This ranking is then placed in the context of provincially based carrying capacities described by Demarchi et al., 1983. Census information is used to support these carrying capacity estimates where available.

7.4 CAPABILITY ASSESSMENT

7.4.1 Moose

Moose are the most abundant and widespread of the ungulates present in the area during the summer. Important summer areas identified include the floodplains and associated wetlands of the major watercourses in the area, notably the Morice, Thautil, Burnie, upper Clore and Atna Rivers, as well as Gosnell and Lamprey Creeks. These areas provide calving and rutting areas in addition to acting as corridors for movement. The lower Clore River appeared to be geographically isolated from moose populations east of the Coast Mountains.

Winter habitat use by moose is low in most of the study area because of deep snow. High winter use occurs along the Morice River floodplain from the area of the Lamprey Creek confluence and downstream. The most heavily used habitats appear to be the alder-willow river bars and adjacent forest. These habitats are maintained by flooding and provide abundant forage combined with some snow interception. The forage productivity and lower snow depth of this area largely corresponds with the limit of the SBS(d) subzone (Pojar et al., 1984). Moose habitat along the Morice floodplain is discussed in greater detail in Section 7.5. The Lamprey Creek floodplain also provides high capability winter range downstream of Pimpernel Creek. The extensive logging in the Lamprey Creek map area has resulted in abundant willow regeneration on upland areas. Willow appears to be more abundant at lower elevations (below 1,000 m elevation or slightly higher on south aspects). Such areas may provide good early winter range, but are considered to have excessive snow depths on average winters. An area of moderate capability winter range was identified along the south aspects of Tagetochlain Lake. This area has high present forage production but relatively deep snow, although snow depth is somewhat reduced on southern exposures.

7.4.2 Mountain Goat

Mountain goat is the most abundant ungulate species in the study area during the winter months. Their winter range is limited to areas where wind-sweeping and insolation expose forage and alter snow condition to allow movement. Such areas are usually convex in shape to be windswept and reduce avalanche hazard. Areas which were exposed to avalanche hazard from above but which otherwise appeared suitable were seldom observed to be used. With the exception of the Telkwa Ranges, all winter range was mapped at or below krummholz elevation, mainly because of the lack of vegetation at higher elevations as a result of extreme climate and persistent snow cover. The occurrance and extent of good winter range is therefore mainly the fortuitous occurance of favourable landform at the appropriate aspect and elevation in combination with climate. Such areas are more restricted in area and less common in the western half of the study area because of deeper and more persistent snow cover. Goat winter range was mapped at lower elevations here (below 1525 m) because the upper elevations of krummholz are lower, and subalpine fir (suspected to be a major winter forage species) is more common in the subalpine forest than in the mountain hemlock dominated Goats were observed in steep rock-bluff subalpine forest in krummholz. several locations especially on the Howson Range and west of the Clore and Burnie Rivers. Areas of high capability were identified here, but they tended to be smaller than areas east of the Bulkley Ranges. In addition, the alpine zone tends to have more vegetation than areas to the west. Goats were commonly seen in the alpine between 1800 and 2000 meters.

Goat ranges which appeared transitional between the ecotype found in the Telkwa Range and that of the high snowfall areas, occur in the area north-

east of Mt. Loring and on Herd Dome. There appears to be some rainshadow effect here, although not as great as in the Telkwa Range.

The spectacular canyon of the Clore River immediately downstream of its confluence with the Burnie River appeared to provide good year-round goat habitat. Difficulty in spotting goats because of forested cover, no helicopter landing sites and probable movement between there and the adjacent Hope and Pillar Peaks all combined to make a capability assessment of the canyon difficult.

During the summer months goats range widely throughout the mountainous portions of the study area, often to higher elevations and on aspects not used during the winter. Little specific is known about important summer habitat in the Bulkley Ranges.

7.4.3 Woodland Caribou

Caribou appear widespread during the summer months, with records from the Burnie Lakes area, Herd Dome and the Mt. Loring area. Both valley bottom and rolling alpine habitat were identified as summer range in this area, although this was not confirmed by observation of present use. Old antlers and historical records occur throughout these areas. Caribou capability was not mapped west of the Burnie/Clore confluence, as caribou are seldom reported from coastal forest, and steep slopes often form a barrier to movement. The rolling kummholz and subalpine areas to the east of Burnie Lakes appears to be more frequently used summer range, probably because of its landform and proximity to the Telkwa Range wintering area.

The winter range distribution of caribou appear to focus on the rolling alpine areas of the Telkwa Range. These areas have the convex landform, lower snow depth, windsweeping and available vegetation necessary to support caribou during the winter. Several plots recorded an abundance of terrestrial lichens, grasses and sedges during both summer and winter. Such alpine habitat surround the rugged portion of the Telkwa Range, with some areas occurring to the north of the study area. Large areas occur in the upper Houston Tommy and Emerson Creek drainages. These more extensive areas are suspected to be important in providing a variety of areas with available forage, depending on snow condition and windsweeping. Disturbance of caribou on these areas by snowmobiles or other activity (snowmobile tracks were observed throughout the Emerson/Houston Tommy areas on February 4, 1984) could shift use to less suitable areas or cause excessive use of less disturbed areas. The detrimental effects of such activity would be difficult to measure, other than by a long-term decline in herd numbers.

Use of winter habitat other than alpine probably occurs during early winter or during periods when alpine forage is unavailable. These areas are not well known and have largely not been identified on the capability maps. Mature subalpine forest with a high arboreal lichen density may provide winter range at some times. Such areas typically have a southerly aspect and are seldom steeply sloping. Forested areas with high terrestrial lichen ground cover are also commonly used by caribou during the winter, although this was unconfirmed in the study area. This would likely be an early winter activity as snow depths in most of the area are excessive for such foraging by mid-winter. Some of these areas were identified and include fluvioglacial deposits near Mooseskin Johnny Lake, along the Thautil and upper Morice Rivers, and along lower Houston Tommy Creek.

7.4.4 Mule deer

Mule deer range widely throughout the lower elevations of the eastern half of the study area during the summer months. They appear to occur infrequently in the western half of the study area, presumably because of its distance from winter range. Steep south aspects and clearcuts appeared to be most frequently used.

Winter range is very restricted in the study area because of deep snow. Deer were observed on February 6, 1984 on the south aspects of the Morice River near Lamprey Creek, although snow depths were below normal at low elevation. Two other areas of low to moderate capability deer habitat occur on the south aspects of lower Houston Tommy Creek and Tagetochlain Lake, although both areas usually have an excessive snow depth for deer and were not considered to be winter range.

7.4.5 Other species

While habitat for other species are not mapped, some habitat generalizations can be made.

Grizzly bear frequent most of the mountainous portion of the study area. Some of the more important areas of habitat can be identified using the environmental condition parameters on the ungulate maps. Some of these include: rolling alpine or krummholz areas (EaLr or EkLr), avalanche areas (La), subalpine meadows (Em), seepage areas (Eh), organic areas (Eo) and floodplains (Lf). Important spring ranges likely occur on main floodplains and south-facing avalanche tracks.

Black bear use was most commonly noted (July, 1983) in the clearcut logging of the 93L/3 map area and along major floodplains throughout the study area. Numerous black bears appeared to be foraging on crowberry (<u>Empetrum nigrum</u>) at krummholz elevation during the mid-September field survey.

Four trumpeter swans were noted on the Burnie River near the outlet of Burnie Lake on February 4, 1984. The river was unfrozen in this area and may provide a common wintering area.

7.5 IMPLICATIONS OF FLOW REDUCTION ON MORICE RIVER MOOSE HABITAT

The Kemano Completion Project would result in an average flow reduction of 20% at Owen Creek with summer flows reduced 30-40% (Department of Fisheries and Oceans, 1984). The degree to which this affects moose habitat along the Morice River floodplain depends on the amount of flow reduction, the degree of freshet flooding and the extent of habitats dependent on disturbance and/or a high water table. The probable effects are discussed here in the context of the vegetation landscapes described in Chapter 6. This discussion includes only the portion of the Morice River floodplain in the study area and does not include winter range downstream. Larger areas of winter range floodplain occur downstream (Stewart, 1981) and would be similarly affected. The fluvial alder-willow (AW), black cottonwood-red osier dogwood deciduous forest (SS₁), and black cottonwood-willow deciduous forest (CW) vegetation landscapes have high forage production. They constitute the recently disturbed portions of the floodplain. The black cottonwood - white spruce mixed forest (SS₂) and white spruce coniferous forest (SS) vegetation landscapes are seral to SS₁ and produce progressively less forage with time as the cover of spruce forest increases. These older stands have moderate to high snow interception potential and function mainly as cover. Flooding, resulting in overbank deposition, channel erosion and aggradation, functions to maintain a dynamic balance of the forage and cover producing landscapes. Elevation and movement of subsurface water in these stands contributes to the growth of red osier dogwood and willow, probably the most important browse species on the floodplain.

A reduction of flow would likely have several affects on succession. The AW vegetation landscape would succeed to CW, CW would succeed to SS_1 and the SS_1 or SS_2 landscapes would succeed to their SS spruce climax more rapidly. The areas of habitat affected were not calculated because the mapping scale (1:50 000) does not show sufficient detail and most winter range lies downstream. However, considerable long term (50 years plus) loss of forage production and associated carrying capacity would likely occur. Coniferous landscapes (SS) with lower forage production would become more abundant. There would be initial increase or maintenance of the present area of winter range while pioneer vegetation establishes on exposed river bars. However, it is likely that the quality of much of this range will decline even in the short term because of the reduced elevation and movement of subsurface water.

Summer use could also be affected. Moose commonly use islands and floodplain areas for calving. A reduction in island security and dense back channel vegetation would reduce the suitability of the area for calving and summer use.

CHAPTER 8. SUMMARY

The Morice Biophysical Study provides reconnaissance level terrain and ungulate capability maps for four 1:50 000 scale map areas (93L/3-6). In addition, soil landscapes are provided for the Lamprey Creek area (93L/3) and vegetation landscapes for the Morice River floodplain (portion of 93L/3). The maps and report provide a stratification of these resources and themes for resource planning and management.

The physiography of the area includes the rugged Coast Mountains along the western margin of the study area, the central Hazelton Mountains and the subdued Nechako Plateau to the southeast. The climate of the area is strongly affected by this physiography. The westerly prevailing winds lose much of their moisture in the Coast Range. Areas to the east, notably the Telkwa Range and lower Morice River valley have high capability wildife habitats largely attributable to this combination of physiography and lower snow depth.

The terrain of the area largely reflects its glacial history and is one of the dominant features affecting ungulate habitat. Glacial till is common on lower valley slopes and on the Nechako Plateau. It provides some of the better upland moose habitat because of its higher moisture and nutrient status, such as in the Lamprey Creek map area. Colluvial materials dominate the slopes of mountainous areas. Their higher elevation usually results in deep winter snow cover, except where windsweeping occurs. Glaciofluvial materials are common in major valley bottoms. Their very coarse texture, dryness and low nutrient status all contribute to low vegetative However, such sites may have abundant terrestrial lichen productivity. cover suitable for woodland caribou forage such as along Houston Tommy Creek and the Thautil River. Active fluvial materials are most common along larger, lower gradient watercourses such as the Morice and Clore Rivers. The seasonally high soil moisture content and frequent flooding of these areas contributes the high forage production of to this habitat. Organic materials are common in the depressions of the hummocky mantle of till on the Nechako Plateau. Many of these areas provide important summer range for moose.

The biophysical soil landscapes for the Lamprey Creek map area are based on a stratification of physiographic regions, bedrock geology, biogeoclimatic zonation, topography, terrain and soil properties. Each soil landscape type so derived has similar ecological properties and provides much of the basis for the ungulate capability assessment of this area. In all 40 soil landscapes were described in two physiographic regions and four biogeoclimatic subzones.

The Morice River floodplain was studied in greater detail to investigate the potential impact of flow reduction on moose habitat by the Kemano Completion Project. Thirteen vegetation landscapes describe areas of similar vegetation and succession in this area. A reduction in flow would likely reduce the creation of riparian habitat on floodplain, and reduce the productivity of existing habitat over the long term.

Ungulate capability is strongly influenced by the physiography and climate of the area. Deep snow results in most of the area being limited to summer range use however, very high capability for moose, woodland caribou and mountain goat exists where this deep snow is reduced by local factors. The restricted extent of such areas emphasizes the importance of this habitat. In the western portion of the area, only mountain goats have adequate habitat to remain in the area through the winter. Moose winter range occurs along the Morice River floodplain and other nearby areas of combined reduced snow depth and high forage abundance. The Telkwa Range provides areas of very high capability mountain goat and woodland caribou winter habitat as a result of its reduced snowfall and favourable topography. This area of spectacular rolling alpine in combination with rugged cliffs makes it an area of provincial significance for wildlife habitat.

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APPENDIX A

Distribution of Plots in the Biophysical Soil Landscapes of the Lamprey Creek Map Area, 93/L 3

Soil Landscape Map Unit	93/L 3 Data Form Numbers	Adjacent Map Areas 93/L 4 & 6
NEC2 NEC3 NEC4 NEC5 NEC6 NEC7 NEC8	82-07620, 82-07608, 78-1628 82-07607 82-07615	
NEF1	82-07634	
NEF2 NEF3	82-07622, 82-07624, 82-07625, 82-07626 82-07629	82-17745
NEF4 NEF5	82-07610, 78-1636, 78-1626, 78-1618 82-07601, 82-07612, 82-07613, 82-07621	82-17750, 81-17760
NEF6	82-07623, 82-07630, 82-07631, 82-07627 82-07628	82-17744
NEG2	82-07619, 8207632	82-07635, 82-07636
NEL1		
NEM3	82-07603, 82-07605, 82-7614, 82-07616 82-07616, 82-07618, 78-1629	82-17752, 82-17754 82-17783
NEM4 NEM5 NEM6	82-07606 82-07617, 82-07611, 82-07604	82-17756
NEO1 NEO2	82-07617, 82-07611, 82-07604	82-17751
NER1 NER2 NER3 NER4		
BRC1 BRC2 BRR1 BRR2		

APPENDIX B

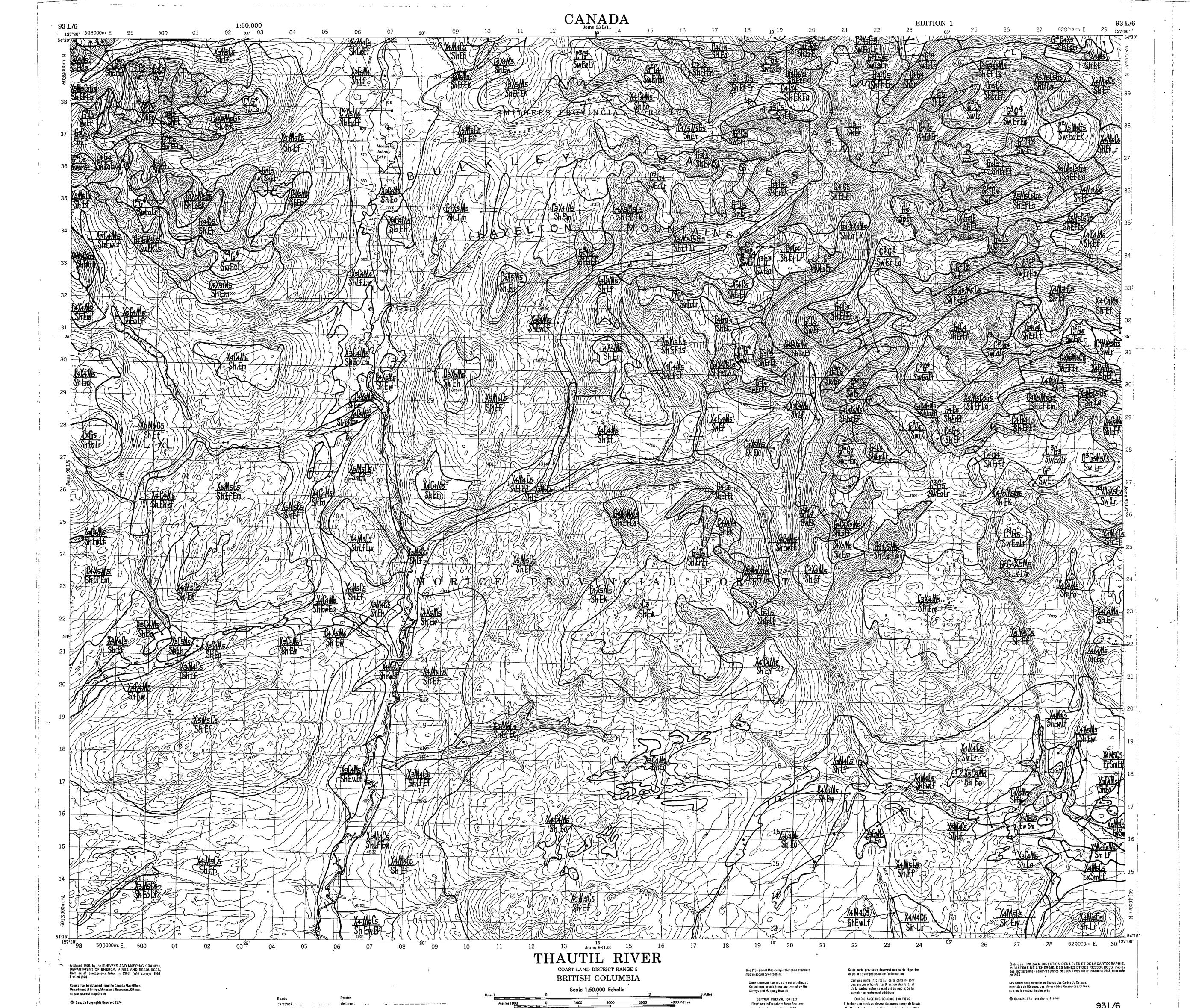
Sources of further information

- 1. Data collected during field studies is available by contacting the authors. This includes:
 - plot data including site, soil, terrain, vegetation and wildlife forms (Walmsley et al., 1980). - laboratory analyses of soil samples.

 - ungulate habitat aerial survey flight lines and transcripts.
 - background biophysical information.
- 2. Ungulate capability maps (1:50 000 scale) bordering this study area on 93L only, their accompanying report: A Moose Habitat Assessment of the Bulkley - Endako Area (Fuhr and Pendergast, 1983), and copies of this report are available from:

Maps B.C. Surveys and Resource Mapping Branch 553 Superior Street Victoria, B.C. V8V 1X5

Queen's Printer for British Columbia® Victoria, 1987



BIOPHYSICAL CLASSIFICATION FOR WILDLIFE CAPABILITY

This map represents a biophysical classification for wildlife (ungulate) capability. It is general in nature and is presented at a scale of 1.250 000 Like capability maps for forestry and agriculture, ungulate capability maps are based on landforms, surficial materials, soils, climate and vegetation that are considered to form "ecologically significant" units of land. For wildlife, biophysical base maps may be supplemented by animal censuses to gain an insight into ungulate distribution and abundance. The biophysical mapping approach used here is a step wise process beginning with the two most fundamental needs of wildlife - food and cover. These attributes are assessed using terrain and soils as mapped by other services in the Terrestrial Studies Branch. Areas of land judged to have differences significant to ungulate management are designated as map units. Subsequent steps in the assigning of capability values are the assessment of a number of environmental conditions influencing the expression of ungulate capability of the land to support a given ungulate species is based on the long term ability of that land to meet the total needs of the species. In terms of food and cover requirements, the ratings are based on the optimum vegetational (successional) stage that can be maintained. Hanagement prescriptions are limited to prescribed burning or grazing, prescribed longing or slashing, or, protection from any land use practice that is detrimental to the wildlife species.

- SUPERSCRIPT RATING INDICATES WINTER RANGE

W...White-tailed Deer

X...Hoose

2. Example of Map Symbol

CAPABILTY RATING -(see Boxes 4 & 5)

1. Explanatory Notes

UNCULATE SPECIES LF SM (see Box 3) ENVIRONMENTAL CONDITIONS (see Box 6)

Note . An asterisk (*) following a capability rating indicates a rutting area. This example would be interpreted as follows

A floodplain unit of moderate winter snow accumulation which is a very high capability winter range for moose (also a rutting area), a moderate capability winter range for elk and a low capability summer range for mule deer and white-tailed deer

3. Ungulate Species Symbols

B...Black-tailed Deer E...Elk H...Hule Deer C...Caribou G...Mountain Goat S...Hountain Sheep

4. Capability Classes
 CLASS 1 Lands in this class have very high capability to support the assigned ungulate species. When required, this class may be subdivided on the basis of productivity into classes 1a, 1b and 1c.
 CLASS 2 Lands in this class have high capability to support the assigned ungulate species.
 CLASS 3 Lands in this class have moderate capability to support the assigned ungulate species.
 CLASS 4 Lands in this class have low capability to support the assigned ungulate species.
 CLASS 5 Lands in this class have low capability to support the assigned ungulate species.

CLASS 5 Lands in this class have very low capability to support the assigned ungulate species. CLASS 6 Lands in this class have no or virtually no capability to support ungulates.

		ANIMALS ,	/ SQUARE KILOMET	FRE / YEAR			
Species Classes	Elack-tailed Boor	Hule Deer and White-tailed Deer	Nountain Sheep	Elk	Caribou	Hountain Goat	Moose
1c	34-41	26-32	20-24	16-20	13-15	10-12	8-9
16	27-34	21-26	16-20	13-16	10-13	8-10	6-8
1a	20-27	16-21	12-16	10-13	8-10	6- 6	5-6
2	14-20	11-16	8-12	7-10	5-8	4-6	3-5
3	7-14	5-11	4-8	3-7	3-5	2-4	2-3
4	3- 7	2- 5	2-4	1- 3	1- 3	1- 2	1-2
5	<3	<2	<2	<1	<1	a	<1
6	o	0	0	0	Đ	D	D

6. Environmental Conditions

The most significant environmental conditions influencing the production of the species and thus determining the capability class, are indicated on the map by symbols. The environmental conditions affect the ability of the land to meet the needs of the species in terms of food, cover and other requirements. For convenience, the environmental condition symbols are placed in three main categories: those relating to climate (such as snowfall or temperature), those relating to the inherent characteristics of the land (such as landforms, soils or vegetation potential), and those relating to permanent anthropogenic (man made) changes to the land base.

CLIMATE Pa - RAIH SHADOW - unit in which more xeric tolerant plants become established due to climatic factors than occurs in adjacent areas

- Sh HIGH SHOW unit in which snow accumulation is greater than approximately one meter Sh - LOW SHOW - unit in which snow accumulation is less than approximately one half meter in depth
- Sm HODERATE SHOW unit in which show accumulation is approximately one half to one meter in depth Sp SHOWFIELDS AND GLACIERS unit of permanent ice or show
- Ss INTENSIFIED SOLAR RADIATION unit in which snow accumulation is significantly reduced through exposure to solar radiation on southerly aspects

SW - WINDSWEPT SHOW - unit in which snow accumulation is considerably reduced by wind erosion Ta - ALPINE ARIDITY - unit at high elevations that is subject to aridity in summer from extreme evapotranspiration and wind action Tc - CDLD AIR LAYER - extreme and persistent freezing temperatures below temperature inversions

TC - COLD AIR LAYER - extreme and persistent freezing temperatures below temperature inversions TF - FROST POCKETS - unit that is subject to increased occurance of freezing temperatures relative to the surrounding terrain

Th - HIGH HEAT - unit that is subject to high heat causing extreme evapotranspiration Tw - WARM AIR LAYER - relatively warm air, occuring over tomperature inversions We - EXPOSURE - unit that is greatly exposed to local winds throughout the year

ANTHROPOGENIC

116 - RESEPVOIR DRÅW-DOKH ZOKE - the area between full pool and low pool in reservoirs 111 - INDUSTRIAL DEVELOPHENT - unit of industrial development such as mills, mines, tailings or spoil areas Nr - TRANSPORTATION CORRIDORS - unit that has a significant proportion of transportation development such as

roads or railroads Hu - UPEN: DEVELOPMENT - unit that has permanent urban development

Hc - CULTIVATED LAND - unit in which native forage production has been altered by cultivation

SOILS AND LANDFORMS

Ea - ALPINE TUNDRA SOILS - unit of virtually treeless high elevation mountains or plateaus Eb - ALLALINE SOILS - unit of strongly alkaline soil

Ed - OPEN FOREST SOILS - unit where an open forest or a transition forest/grassland becomes established

Ef - UPLAND FOREST SOILS - unit where dense conifer forests become established Eg - GRASSLAND SOILS - unit where a grassland becomes established

Eh - HOIST SOIL - area of moist mineral soil Ek - KRUMHOLZ FOREST SOILS - unit that has an interrupted forest cover of stunted subalpine tree species

EX - RRUMULE FORCES SOLES - unit that is dominated by soils developed from deep, inactive lacustrine

deposits Em - SUBALPINE NEADON - unit where a subalpine meadow becomes established

Eo - ORGANIC SOILS - unit with poor drainage that is dominanted by organic soils Er - DEDROCF - unit that is dominated by bedrock

Es - SALINE SOILS - unit of strongly saline soil

Et - TALUS - unit that is dominated by talus $E_{V} = DEEP$ FLUVIAL DEPOSITS - unit that is dominated by well to rapidly drained soils developed from deep,

inactive fluvial deposits Ex - DRY SOIL - unit that is dominated by well to rapidly drained soils of coarse textured morainal or

colluvial materials La - AVALANCHE TRACTS - unit that has avalanche chutes

Le - SOIL EROSION - unit that has erosion or potential erosion ranging from sheet erosion through to minor guileying

LF - ACTIVE FLOODPLAIN - unit of flat land bordering a river and subjuct to periodic flooding Li - FRESH WATER INUNDATION - unit that is subject to long periods of natural flooding resulting in marshy

vegetation L1 - LEVEL LAND - unit that is flat with slopes less than 2°

LI - LEVEL LAND - unit that is that with stopes less than 2 Lr - ROLLING OR HILLY LAND - unit with complex slopes of butween 5 and 30° in a generally low relief area Ls - STEEP SLOPES - unit with slopes greater than 25°

Lt - TIDAL INUNDATION - unit that is flooded frequently by tidal activity Lw - FALLING SLOPES - unit of extensive slope movement

7. On-Site Symbols

D Identifies the location of known mineral licks

8. References

For a more detailed description of the classification system the reader should refer to the guidelines which outline the Biophysical capability classification for ungulates in British Columbia. These guidelines are available from: the Map Library, Surveys and Resource Mapping Branch, Ministry of Environment, Parliament Buildings, Victoria, British Columbia

9. Credits

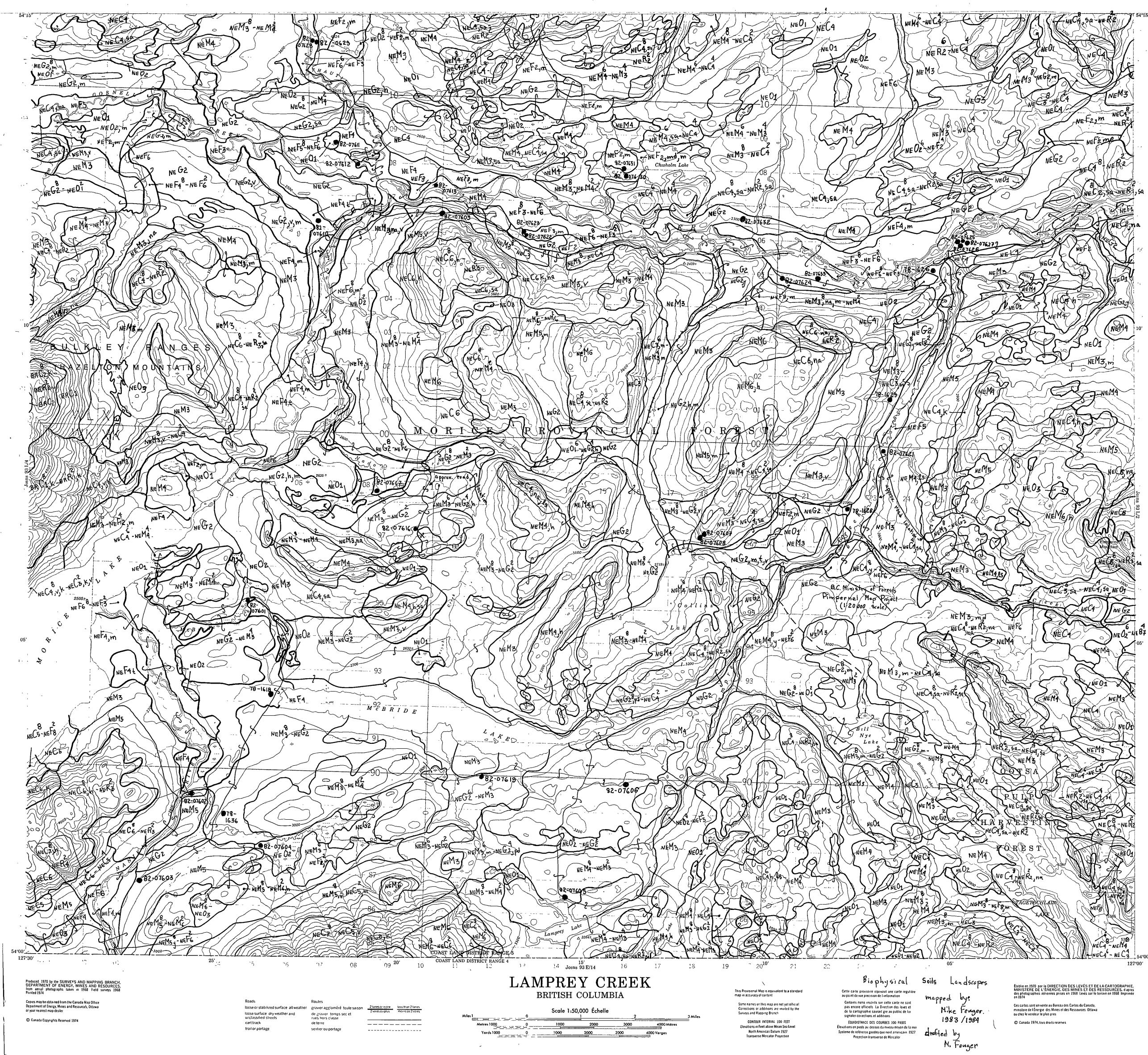
Happed by, **B.Fuhr** Date Happed · **1964** Date and scale of photography, **1979** [**/60 000 1968** [**/60 000**

Date of base mapping by Surficial Geology 1984 , Soils 1984 , Vegetation 1984 , Date drafted 1984

Revision dates. Drafted by Cartography Unit, Surveys and Resource Mapping Branch, Ministry of Environment, Victoria, B.C Base Map provided by: Surveys and Resource Mapping Branch, Ministry of Environment, Victoria, B.C

1983 Edition

BIOPHYSICAL SOIL LANDSCAPES FOR THE LAMPREY CREEK MAP AREA



BIOPHYSICAL SOIL LANDSCAPE LEGEND FOR THE LAMPREY CREEK MAP AREA N.T.S. 93L/3 EXPLANATORY NOTES BIOGEOCLIMATIC ZONES The information in the following boxes explains the important characteristics of the Lamprey Creek map area, 93L/3, which covers 91,500 ha in north central British Columbia. This legend describes the landscape at a reconnaissance level of survey. More details on the soils their environment and chemical properties, and the terrain, vegetation zones and ungulate capability maos for this area is contained in the complimentary reported entitled, "Morice Biophysical Study", Ministry of Environment. DESCRIPTION Alpine Tundra Zone Engelmann Spruce Zone-Subalpine Fir Subzone Sub-Boreal Spruce Zone-Spruce Subzone Sub-Boreal Spruce Zone-Subalpine fir Subzone AT ESSF SBS d SBS e *after B.C. Ministry of Forests Research Section, Smithers. Pojar et al. 1984. 2. EXAMPLE OF A MAP UNIT SYMBOL. -----Unit Number (box 5 TEXTURE* Biophysical Soil Landscape Map Unit (box 5) NEM3a —— Hap Unit Hodifier (box 4) COARSE FRAGMENTS (>2mm) FINE FRACTION (>2mm) CLASS DESCRIPTION CLASS DESCRIPTION This map unit is on the Nechako Plateau (NE) and is composed of morainal material (M). It is the third morainal map unit described on the Nechako Plateau and it is described in box 5 as deep well drained soils the sub boreal Spruce Zone (d sub zone). High >50% of soil volume Coarse Moderate 20 to 49% of soil volume Kedium Low <20% of soil volume Fine Sandy soils Loamy soils Clayey soils *Canadian System of Soil Classification, 1978. COMPOSITE MAP SYMBOLS. SOURCES OF FURTHER INFORMATION. Composite map symbols are used where two soils are intermixed or accupy such small areas that they cannot be separated at the scale of mapping. NEM35 - NEM4* signifies that approximately 60% of the soil map unit is occupied by NEM3 and 40% by NEM4. . Ministry of Environment aerial photographs. BC79076, 154-161, 164-170, and 239-244. Hinistry of Environment, Soil Information System. 60 site and soil descriptions available. Terrestrial Studies Section Surveys and Resource Mapping. , B., H.A. Fenger, L. Lacelle, R. Marsh and H. Rafiq. Morice Biophysical Study, 93-L-SW Morking Report, Wildlife Branch, B.C Ministry of Environment. Warking Report No. WR-18. . SOIL MAP UNIT MODIFIERS. These indicate that a minor portion of the map unit varies from the scription in Box 5. r, J., R. Trowbridge and D. Coates, 1984. Ecosystem Classificatio and Interpretation of the Sub-Boreal Spruce Zone, Prince Rupert Forest Region, British Columbia. Land Management Report No. 17. Ministry of Forests, Bag 5000 Smithers, B.C. Symbol Name Description indicates entire unit is affected, cannot be used alone.
 steep sided hillocks that are irregular or rounded in plan.
 snow avalanche tract sites. e extensive h hummocky k avalanching lithic - soils less than 50cm in depth. ping by : M. Fenger, Terrestrial Studies Section, Survey Mapping Branch, Ministry of Environment, Victo areas receiving additional soil moisture fr m seepage upslope sources. soil moisture in excess of field capacity a small but significant part of the year. otography used for mapping: Date 1979 : Scale 1 60,000 ps drafted by: Surveys and Resource Mapping Branch slopes greater than 30% with orientation fo 300° to 45°; sites receiving less insolation map provided by: Surveys and Resource Mapping Branch, Ministry soil moisture in excess of field capacity i all horizons for a large part of the year. poorly drained Reports available from: slopes greater than 30% with orientation fm 45° to 300°; sites receiving more sa south aspects

step-like topography, consisting of scarps and horizontal surfaces

parallel v-shaped ravines formed by water erosion

- areas with erosional scarps

t terraced

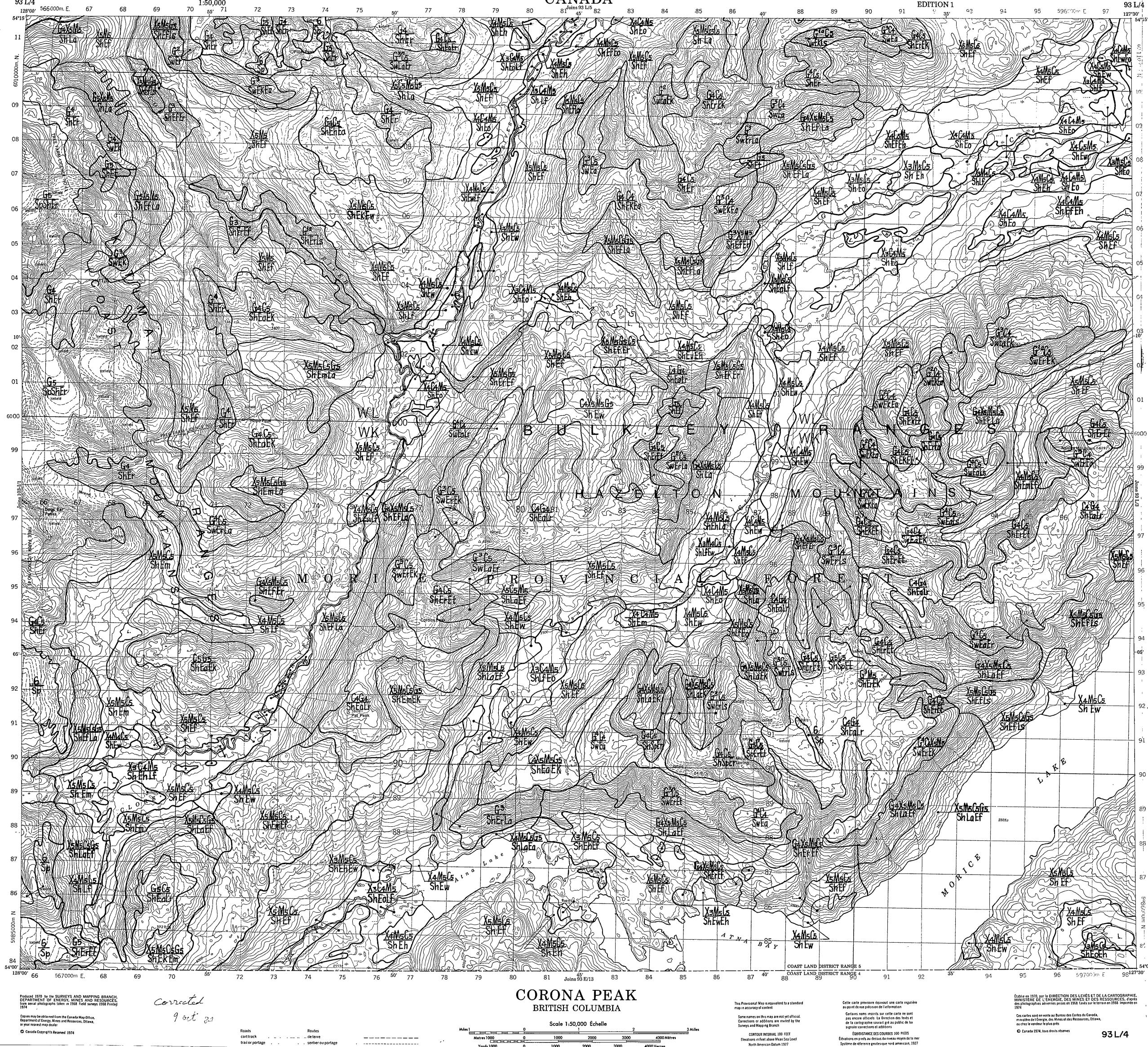
y steeply sloping

v guilied

Maps B.C. B.C. Ministry of Environment 557 Superior Street Victoria, B.C. VaV 1X5 _____

Soils 93 L/3

	BULKLEY RANGES MAP UNITS (BI	Blogeg-	Soil Parent				rainage	Rodensk T	Innth - al	toll Taxonor
tap /#bol	General Description & Distribution Pattern	subzone (See	Text	ture Fine Fraction		Dominant Drainage P	Uominant erviousness	Bedrock Types ((see report) H	lepth of Naterial	Soil Taxonomy
	deep & shallow colluvial soils on steep slopes north of Morice Lake, one unit	ESSF	high	medium	colluvial	well	moderate	fine-grained sedimentary & volcanic	>1m	Orthic Humo Ferric Podzol
RC2	only deep & shallow colluvial alpine soils on steep slopes north of Morice Lk., these soils are subject to frost action, solifluction	ESSF	high	medium	colluvial	well	moderate	fine-grained sedimentary & volcanic	<in and >im</in 	Sombric Humo Ferric Podzol
RR1	& nivation hollows present subalpine rock outcrops of fine grained sedimentary & volcanic rocks morth of	ESSF	N/A	H/A	rock	N/A	K/A \	fine-grained sedimentary & volcanic	N/A	N/A, minor lithic soils
RR2	Morice Lk., one unit only alpine rocks outcrops of fine grained sedimentary & volcanic rocks north of	AT	R/A	H/A	rock	N/A	H/A	fine-grained sedimentary & volcanic	N/A	N/A, minor lithic soils
CHAX	Horice Lake) PLATEAU MAP UNITS (NE) shallow colluvial slopes on	585 d	high 1	medium	colluvial	rapid	moderate	fine grained	<1m	Orthic Dystric
	south aspects along the lower Morice River reaches, one map unit only.				colluvial	well	moderate	volcanics	>1m	Brunisol-lithic phase Humic Regosols Orthic Humo Ferric
EC3	deep steeply sloping colluyial soils high in angular coarse fragments, limited distribution north- eastern portion of map area some lower slopes on Pimpernel Mtn. & south of Tagetachlain Lake	SBS e	high	wedium				volcanics and sedimentary		Podzol Orthic Humo Ferric
EC4	shallow steeply sloping areas high in angular coarse fragments, widely distributed on the steeper shallow rolling hills throughout the map area, often mapped with NEM7 shallow morainal soils	SBS e	high	medium	icolluvial	rapid	rapid	fine grained volcanics and sedimentary	<1m	Podzo1
EC5	deep steeply sloping collu- vial soils, very limited distribution along the south shores of Morice Lake	ESSF	high	coarse	colluvial	rapid	rapid	fine grained volcanics & sedimentary	<1m	Orthic Humo Ferric Podzols
IEC6	shallow steeply sloping materials high in angular coarse fragments, higher elevation areas between Nado Creek & Morice River, Pimpernel Mtn. and south of Morice Lake, limited distribution	ESSF	high	coarse	colluvial	rapid	rapid	fine grained volcanics å sedimentary	<1m	Orthic Humo Ferri Podzols
NEC7	shallow steeply sloping colluvial soils derived from acid coarse grained bedrock, limited distribu- tion south of McBride Lake only	ESSF	h1gh	coarse	colluvial	rapid	rapid	coarse grained acid	<1m	Orthic Humo Ferri Podzol
NEC8	steep to moderately sloping alpine soils subject to frost action, solifluction and nivation hollows present, one map unit only south of McBride Lake	Υ.	high	coarse	colluvial	rapid	rapid	coarse, grained acid	>1m and <1m	Sombric Humo Ferric Podzol
NEFI	plain sandy capping over gravels and some frequently flooded gravel bars, one	SBS d	low over high	COATSE	floodplair	well	rapid	N/A	>1m	Cumulic Regosol Orthic Regosol
NEF2	map unit only fluvial fans of variable texture, seepage often present, Chisholm Lake most	SBS d	high	coarse	fluvial terrace	rapid	rapid	N/A	>1m	Orthic Humo Ferri Podzols, Cumulic Regosols Humic Regosols
NEF3	extensive floodplains with a sandy capping over veneers, major portion of the Morice River flood plain away from the most actively flooded channel areas which are	SB5 d	low over high	coarse	floodplain	n well	rapid	N/A	>1m	Cumulic Regosols
NEF4	mapped as NEF6 gravelly and sandy terraces rapidly drained distributed above the present day flood plains along the Kanika and Morice Rivers, also a sandy area west of McBride Lake		high	coarse	terraces, fluvial & fluvio- glacial	rapid	rapid	N/A	>1m	Dystric Brunisol
NEF5		SBS d	low	coarse	floodplai	n moderate - well	moderate	N/A	>1m	Cumulic Regosols
NEF6	gravelly floodplains, main active channels, frequently flooded areas Horice,	SBS d	high	coarse	floodplai	n rapid	rapid	N/A	>1m	Orthic Regosol
NEG2	Nanika and Thautil Rivers. kame deposits and other washed materials of variable texture widely distributed at lower elevations along Cedric, Nado and Gosnel Creeks as well as undulating terrace	SBS e	high to low	fine to coarse	fluvio- glacial	well	moderate	¥/A	>1m	Orthic Humo Ferr Podzol
NELI	above the Morice River	SBS d	10₩	fine	lacustrin	ie well	moderate	N/A	>1m	Orthic Gray Luvisol
NEMS		SBS d	moderate	medium	morainal	well to mod.well	moderate	N/A	>1m	Brunisolic Gray Luvisols
NEK		SBS d	moderate	wedtum.	moraina	well	moderate	N/A	<1m	Orthic Gray Luvisols include some Lithic soit
NEM	5 deep morainal soils at higher elevations;Pimperne Mtn., south of McBride Lak and lower elevations of th	e	moderate	medium	moraina	Well to mod.well	moderati	N/A	>1m	Luvic Podzols
NEM	Bulkley Ranges	ESSF	noderate	medium	moraina	l well to mod.wel		9 N/A	<1m	Orthic Humo Fer Podzols
NEO		585 e		mesic	organic		rapid	N/A	>1m <1m	Typic Hesisol
NEO	2 shallow organic deposits moderately decomposed, associated with minor low gradient streams			mesic	organic		rapid N/A	N/A fine-grained		N/A minor lithi
NER		585 d	i h/A	N/A	Rock	N/A		sedimentary volcanic	8	sof1s
' NEF	22 outcrops of fine grained sedimentary and volcanic rock, mid-elevations; a minor inclusion often mapped with NEC4, occurs north of Tageochlain Lake as a pure unit	SBS 6	N/A	N/A	Rock	N/A	R/A	fine-graine sedimentary volcanic	8	soils
NEI		ESSI	N/A	N/A	Rock	N/A	H/A	fine-graine sedimentary volcanic	A	soils
NEI	R4 outcrops of coarse-graine acid intrusive rock; high elevation forested areas; north of Nanika River onl	d ESS Ier	F N/A	N/A	Rock	N/A	N/A	acid, coars grained	e N/A	N/A, minor lit solls



Yards 1000

2000

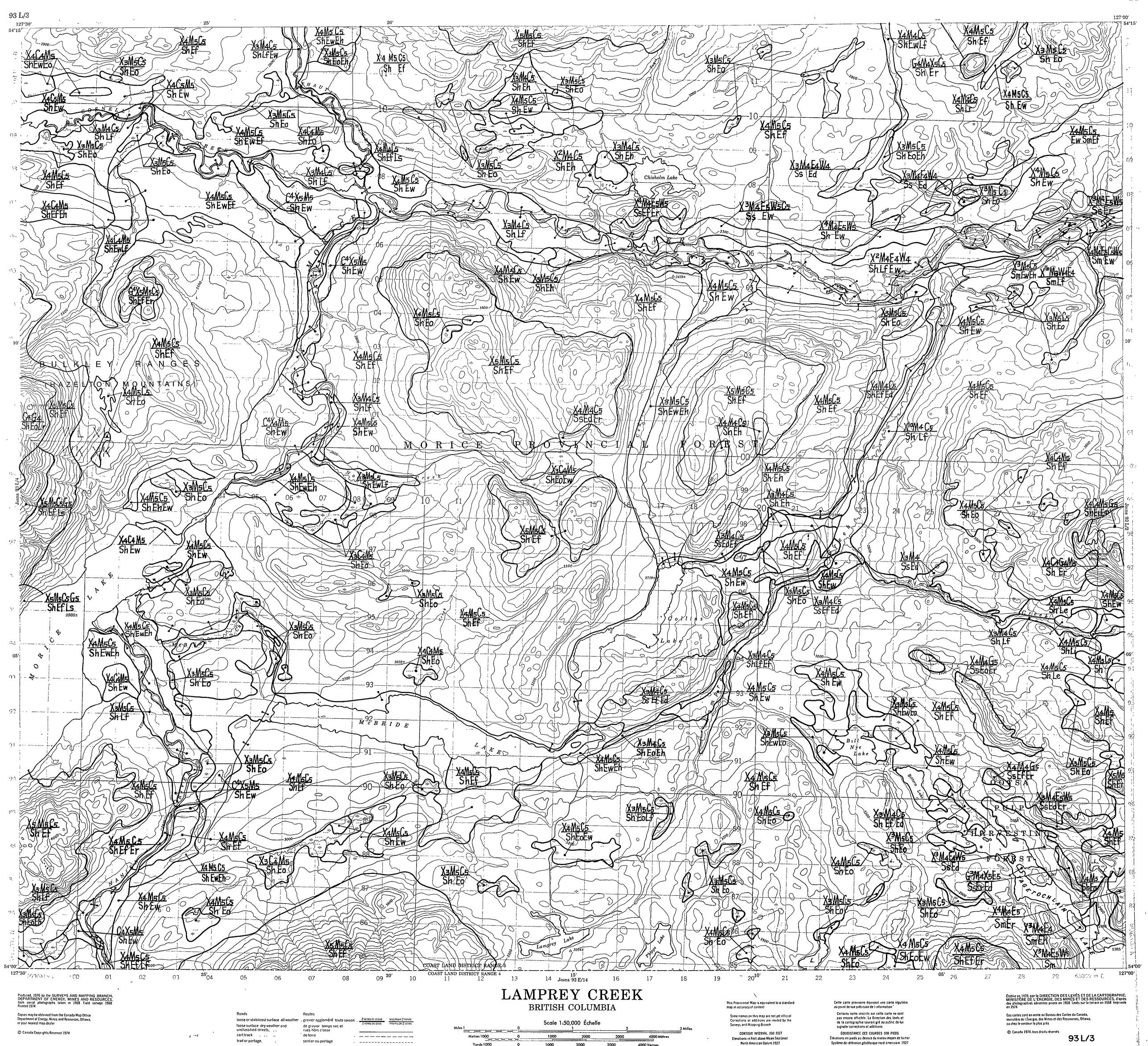
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BIOPHYSICAL CLASSIFICATION FOR WILDLIFE CAPABILITY

1. Explanatory Notes This map represents a biophysical classification for wildlife (ungulate) capability. It is general in nature and is presented at a scale of 1.250 000. Like capability maps for forestry and agriculture, ungulate capability maps are based on landforms, surficial materials, soils, climate and vegetation that are considered to form "ecologically significant" units of land. For wildlife, biophysical base maps may be supplemented by animal censuses to gain an insight into ungulate distribution and abundance. The biophysical mapping approach used here is a step wise process beginning with the two most fundamental needs of wildlife - food and cover. These attributes are assessed using terrain and soils as mapped by other services in the Terrestrial Studies Branch. Areas of land judged to have differences significant to ungulate management are designated as map units. Subsequent steps in the assigning of capability values are the assessment of a number of environmental conditions influencing the expression of ungulate capability. The capability of the land to support a given ungulate species is based on the long term ability of that land to neet the total needs of the species. In terms of food and cover requirements, the ratings are based on the optimum vegetational (successional) stage that can be maintained. Hanagement prescriptions are limited to prescribed burning or grazing, prescribed logging or slashing, or, protection from any land use practice that is detrimental to the wildlife species. Carrying capacity estimates are expressed as animals/square kilometer/year which can be supported on a sustained basis and are represented on the map by a capability class rating from 1 (highest) to 6 (lowest). Each unit is assessed for its ability to sustain the assigned ungulate species during winter or summer (non-winter) periods. This capability classification reflects only the biological and physical parameters of the environment and does not take into account social and economic factors. Also, the classification does not reflect present land use (except where the inherent capability has been permanently altered), ownership, degree of access, current wildlife management practices, nor hunting pressure. For the purposes of this map, wildlife are considered to be wild, cloven-hooved, herbivores or wild ungulates of the Cervidae and Bovidae families. 2. Example of Map Symbol CAPABILTY RATING -(see Boxes 4 & 5) SUPERSCRIPT RATING INDICATES WINTER RANGE SUBSCRIPT RATING INDICATES SUMMER RANGE ENVIRONMENTAL CONDITIONS (see Box 6) Note An asterisk (*) following a capability rating indicates a rutting area. This example would be interpreted as follows. A floodplain unit of moderate winter snow accumulation which is a very high capability winter range for moose (also a rutting area), a moderate capability winter range for elk and a low capability summer range for mule deer and white-tailed deer. 3. Ungulate Species Symbols E...Elk H...Hule Deer G...Hountain Goat S...Hountain Sheep B...Black-tailed Deer W...White-tailed Deer C...Carlbou X...Hoose 4. Capability Classes CLASS 1 Lands in this class have very high capability to support the assigned ungulate species. When required, this class may be subdivided on the basis of productivity into classes la, 1b and 1c. CLASS 2 Lands in this class have high capability to support the assigned ungulate species. CLASS 3 Lands in this class have roderate capability to support the assigned ungulate species. CLASS 4 Lands in this class have low capability to support the assigned ungulate species. Lands in this class have very low capability to support the assigned ungulate species. CLASS 5 CLASS 6 Lands in this class have no or virtually no capability to support ungulates. 5. Biophysical Ungulate Capability Class Carrying Capacity Estimates ANIMALS / SQUARE KILOMETRE / YEAR 6. Environmental Conditions The most significant environmental conditions influencing the production of the species and thus determining the capability class, are indicated on the map by symbols. The environmental conditions affect the ability of the land to meet the needs of the species in terms of food, cover and other requirements. For convenience, the environmental condition symbols are placed in three main categories - those relating to climate (such as snowfall or temperature), those relating to the inherent characteristics of the land (such as landforms, soils or vegetation potential), and those relating to permanent anthropogenic (man made) changes to the land base. Pa - RAIN SHADOW - unit in which more xeric tolerant plants become established due to climatic factors than occurs in adjacent areas Sh - HIGH SHOW - unit in which snow accumulation is greater than approximately one meter S1 - LOW SHOW - unit in which snow accumulation is less than approximately one half meter in depth Sm - NODERATE SNOW - unit in which snow accumulation is approximately one half to one meter in depth Sp - SHORFIELDS AND GLACIERS - unit of permanent ice or snow Ss - INTENSIFIED SCLAR RADIATION - unit in which snow accumulation is significantly reduced through exposure to solar radiation on southerly aspects Sw - WINDSWEPT SNOW - unit in which snow accumulation is considerably reduced by wind erosion Ta - ALPHNE ARIDITY - unit at high elevations that is subject to aridity in summer from extreme evapotranspiration and wind action Tc - COLD AIR LAYER - extreme and persistent freezing temperatures below temperature inversions Tf - FROST FOCHETS - unit that is subject to increased occurance of freezing temperatures relative to the surrounding terrain Th - HIGH HEAT - unit that is subject to high heat causing extreme evapotranspiration Tw - WARM AIR LAYER - relatively want air, occuring over temperature inversions We - EXPOSURE - unit that is greatly exposed to local winds throughout the year ANTHROPOGENIC Ith - PESEPVOIR DRÄW-DOWN ZONE - the area between full pool and low pool in reservoirs HI - INDUSTRIAL DEVELOPHENT - unit of industrial development such as mills, mines, tailings or spoil areas Hr - TRANSPOPTATION CORRIDORS - unit that has a significant proportion of transportation development such as roads or railroads Hu - UPBAN DEVELOPMENT - unit that has permanent urban development Hc - CULTIVATED LAND - unit in which native forage production has been altered by cultivation SOILS AND LANDFORMS Ea - ALPINE TUNDRA SOILS - unit of virtually treeless high elevation mountains or plateaus Eb - ALFALINE SOILS - unit of strongly alkaline soil Ed - OPEN FOREST SOILS - unit where an open forest or a transition forest/grassland becomes established Ef - UPLAND FOREST SOILS - unit where dense conifer forests become established Eg = GRASSLAND SOILS = unit where a grassland becures established Eh - HOIST SOIL - area of moist mineral soil Ek - KRUMHOLZ FOREST SOILS - unit that has an interrupted forest cover of stunted subalpine tree species El - DEEP LACUSTRINE DEPOSITS - unit that is dominated by soils developed from deep, inactive lacustrine deposits Em - SUBALPINE MEADOW - unit where a subalpine meadow becomes established Eo - ORGANIC SOILS - unit with poor drainage that is dominanted by organic soils Er - BEDROCH - unit that is dominated by bedrock Es - SALINE SOILS - unit of strongly saline soil Et - TALUS - unit that is dominated by talus Ew - DEEP FLUVIAL DEPOSITS - unit that is dominated by well to rapidly drained soils developed from deep, inactive fluvial deposits Ex - DRY SOIL - unit that is dominated by well to rapidly drained soils of coarse textured morainal or colluvial materials La - AVALANCIE TPACTS - unit that has avalanche chutes Le - SOIL EROSION - unit that has erosion or potential erosion ranging from sheet erosion through to minor guileying Lf - ACTIVE FLOODPLANN - unit of flat land bordering a river and subject to periodic flooding 1.1 - FRESH WATER INUMIDATION - unit that is subject to long periods of natural flooding resulting in marshy vegetation L1 - LEVEL LAND - unit that is flat with slopes less than 2* Lr - ROLLING OR HILLY LAND - unit with complex slopes of between 5 and 30° in a generally low relief area Ls - STEEP SLOPES - unit with slopes greater than 25° Lt - TIDAL INUNDATION - unit that is flooded frequently by tidal activity Lw - FAILING SLOPES - unit of extensive slope novement 7. On-Site Symbols Identifies the location of known mineral licks (\Box) dentifies important known or suspected seasonal movement corridors 8. References For a more detailed description of the classification system the reader should refer to the guidelines which outline the Biophysical capability classification for ungulates in British Columbia. These guidelines are available from: the Map Library, Surveys and Resource Mapping Branch, Ministry of Environment, Parliament Buildings, Victoria, British Columbia. 9. Credits Mapped by: B. Fuhr Date Mapped· 1984 Date and scale of photography: 1979 i:60 000 , 1968 I-50 000 Date of base mapping by Surficial Geology 1984 . Soils 1984 . Vegetation 1984 Date drafted. 1984 Revision dates:

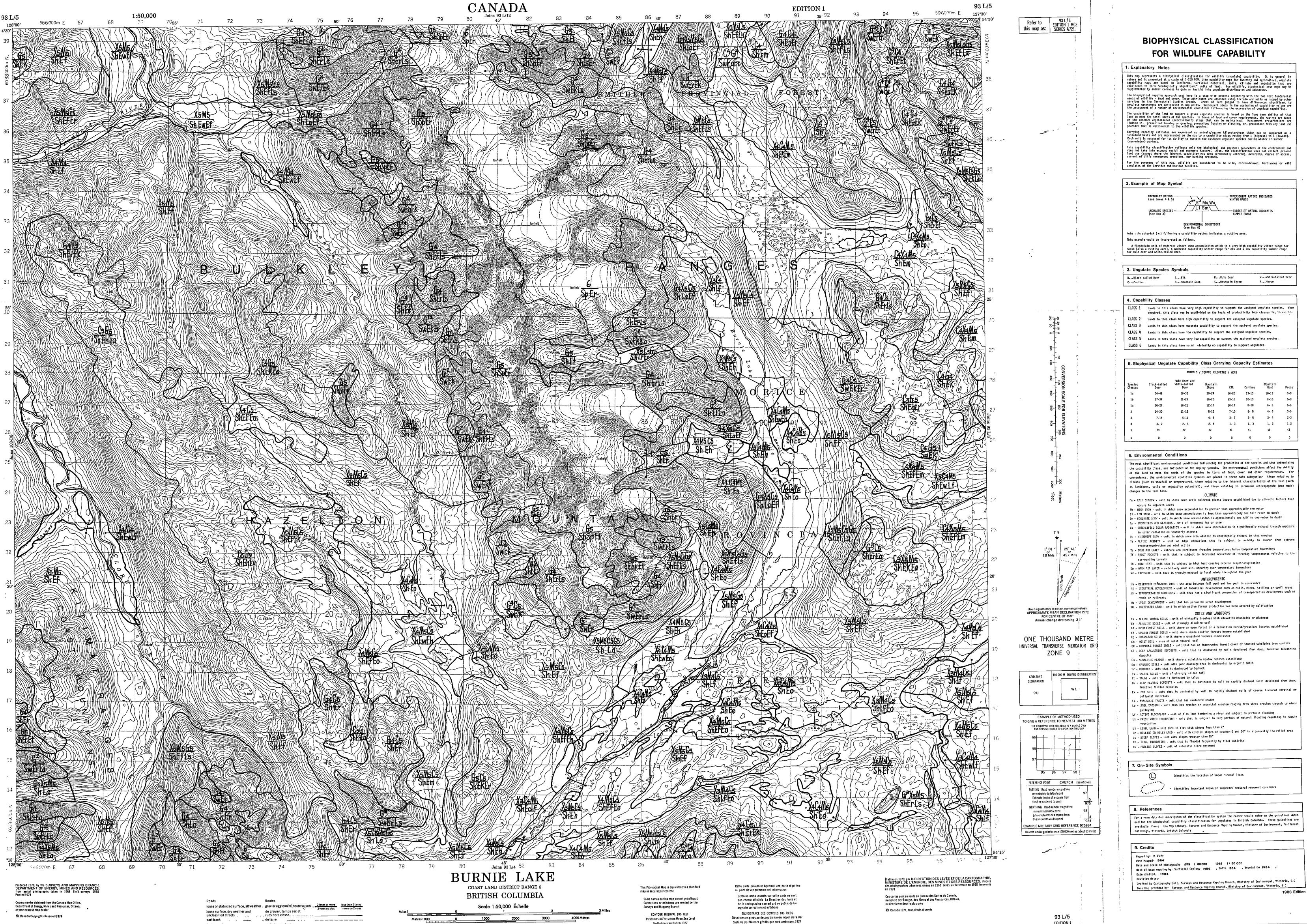
Drafted by Cartography Unit, Surveys and Resource Mapping Branch, Hinistry of Environment, Victoria, B C Base Map provided by Surveys and Resource Mapping Branch, Ministry of Environment, Victoria, B C 1983 Edition



BIOPHYSICAL CLASSIFICATION FOR WILDLIFE CAPABILITY

Carrying of sustained Each unit (non-winte This capab does not t land use { current wi For the p	ility of the land i set the total needs the the total needs the the total needs the the total needs prescribed burnt that is detrimental capacity estimates basis and are repre- tis assessed for its provide the total capacity classification take into account si (except where the in Idlife management p burposes of this m of the Cervidae and	to support a giv of the species. (successional) ing or grazing, p to the wildlife are expressed a sented on the ma s ability to sust on reflects only ocial and econom inherent capabili inactices, nor hu	en ungulate spec In terms of foc stage that can prescribed loggin species. As animals/squarn pib y a capabilit tain the assigned the biological ic factors. Als ity has been per inting pressure. The considered to	ofes is based of and cover be maintain g or slashin e kilometer/ ty class ration d ungulate sp and physical so, the class manently alte	on the long requirements, ed. Hanagem g, or, protec year which c ng from 1 (hi ecfes during parameters iffcation dor red), ownersi	term ability the ratings rent prescript tion from any an be suppor ghest) to 6 (winter or sum of the environ treflect hip, degree of	y of tha are base tions an land us ted on lowest). mer ment an t presen f access
2. Exam	ple of Map S	ymbol ,					
	CAPABILTY RATIN (see Boxes 4 &	5) <u>Xib*</u>	E ³ M4 W4 Lf Sm	SUPERS WINTER	CRIPT RATING RANGE	INDICATES	
	UNGULATE SPECIE (see Box 3)			Summ	CRIPT RATING ER RANGE	INDICATES	
This exampl A floodp moose (also	asterisk (#) follow le would be interpre plain unit of moders o a rutting area, a ger and white-tailed	(see Box wing a capability eted as follows ate winter snow a a moderate capabi	y rating indicate	es a rutting ch is a verv	high capabili	ity winter ran Sility summer	nge for range
881ack-	late Species	EElk		Pule Deer		WWhite-tai	tled Dec
CCar ibo	u ~	GHountain G	oat SI	Hountain Shee	ρ	XHoose	
CLASS 2 CLASS 3 CLASS 4 CLASS 5 CLASS 6	Lands in this cl - Lands in this cl Lands in this cl Lands in this cl	ass have roderat ass have low cap ass have very lo ass have no or	pability to supp e capability to ability to suppo w capability to virtually no cap	ort the assig support the a rt the assign support the a nability to su	ned ungulate ssigned ungu ed ungulate issigned ungu upport ungula	species. Nate species. species. Nate species. tøs.	
5. Biopi			J SQUARE KILOME		acity Est	inates	
Species Classes	Elack-tailed Ocer	Hule Deer and White-tailed Deer	flountain Sheep	Elk	Caribou	Mountain Goat	Moos
1c 1b	34-41 27-34	26-32 21-26	20-24	16-20 13-16	13-15 10-13	10-12 8-10	8-9 6-8
1a 2	20-27 14-20	16-21 11-16	12-16 8-12	10-13 7-10	8-10 5- 8	6- 8 4- 6	5-6 3-5
3 4	7-14 3- 7	5-11 2- 5	4- 8 2- 4	3- 7 1- 3	3- 5 1- 3	2- 4 1- 2	2-3
5 6	<3 0	<2 0	<2 0	<1 0	<1 0	<1 0	<1 0
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The most s the capabil of the la conventenc climate (s as landfo changes to Pa - RAIH occur Sh - HIGH SI - LOW S Si - HIGH SI - LOW S Si - HIGH to SI - LOW S Si - HIGH to SI Si - HIGH to SI Si - HIGH To - COLD Tf - FROS SI - HIGH TW - WARM We - EXPO Hh - RESE HI - HIGH HI - HIGH HI - RESE HI - HIGH HI - RESE HI - HIGH HI - RESE HI - HIGH SI - COLD SI - COLD SI - COLT Ea - ALPI Eb - ALL A Ed - OPER Eh - NOIS Ek - KRUH El - DEEF depp En - SUB/ Eo - CRG/ En - SUB/ Eo - CRG/	And to neet the main of the neet the main to neet the main of the neet t	dicated on the meeds of the spi al condition syn temperature), the etation potentia hich more xeric s ch snow accumula h snow accumula h snow accumula is shich snow accumula is shich snow accumula is shich snow accumula is shich snow accumula in which snow accumula in which snow accumula is subject of perma tion of perma subject is now accumula is subject to high vely warm air, c is greatly exposed is - the area bet - unit of indust is subject to high vely warm air, c is greatly exposed is - the area bet - unit of indust is - unit that has t that has perma in which native Simit of virtually of strongly alkal it where a subalp is the poor drainaged dominated by bee strongly saline	hap by symbols. ectes in terms mbols are placed hose relating to 1), and those r CLIMATE tolerant plants tion is greater : ion is less than nulation is appri- nent ice or snow hich snow accuru unulation is con at fons that is freezing teaper to increased occ: at local winds ANTHROPOEEN is a significant inclusion devel forage production OILS AND LANDIF y treeless high con to confer forests ad become stable in interrupted for is dominated by ine meadow become	The environme of food, cou- i in three may the inherent relating to p become estab- than approxima approximatel, oxinately one lation is sig siderably red subject to atures below urance of from extreme evapot throughout til IC ind low pool i such as mill proportion of lopment on has been a EORMS elevation mou- nsition forces become estab- lished prest cover o soils deval	ental conditi ver and other in categorie characteris mermanent ant lished due to ately one rol y one half ro- half to one nificantly ri- uced by wind artidity in temperature seeing temper- tering temper- temper- temper-temper- temper-temper-temper- temper-temper-temper-temper-temper-temper- temper-temper-temper-temper-temper-temper-temper-temper-temper-temper-temper-temper- temper-temper-temper-temper-temper-temper-temper-	ons affect the r requirement s. those rel- tics of the 1. hropogenic (s c climatic fac- ter ter in depth meter in depth erosion surmer from inversions atures relati flings or spo- fon development tivation ateaus becomes estable malpine tree s	e abilit ts. Fo lating t and (suc man made tors that tors that tors that n extreme live to t il areas nt such
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The most s the capabil of the la conventenc climate (s as landfo changes to Pa - RAIH occurs Sh - HIGH Sh - LOW S Sh - HIGH Sh - LOW S Sh - HIGH Sh - HIGH Sh - HIGH The LOW S Sh - HIGH The COLD The - COLD Cold Cold Cold Cold Cold Cold Cold Cold	Ility class, are in and to neet the m re, the environment such as snowfall or rms, solis or vego o the land base. SIMDOW - unit in viron rs in adjacent area SIGW - unit in which RATE SIGW - unit in this SIGW - unit in which RATE SIGW - unit in this SIGW - unit in which RATE SIGW - unit in this SIGW - unit in which RATE SIGW - unit in this SIGW - unit in which RATE SIGW - unit in this SIGW - unit in which RATE SIGW - unit in this SIGW - unit in which RATE SIGW - unit in TFIELDS AND GLACIERS SHEPT SUCH - unit is ART ARDITY - unit otranspiration and AIR LAYER - extrem T FOCHETS - unit that is SIGM - unit that is INC AND - unit that is INC FOREST SOLLS - unit CALLINE SOLLS - unit OF FOREST SOLLS - unit SIGM - unit that is SIGM - unit that is INC SOLLS - unit of US - unit that is INC SOLLS - unit that INC SOLES - unit which INC SOLES - unit which I	dicated on the meeds of the spi al condition syn temperature), the east of the spi al condition syn temperature), the east on potential hich more xeric s chanow accurulat which snow accurulat which snow accurulat is snow accurulat is snow accurulat is shift of perma TIOI - unit in wo outherly aspects in which snow accu- cated of perma tion - unit in wo outherly aspects in which snow accu- cated of perma tion - unit in wo outherly aspects in which snow accu- cated of the spi well warm air, co- g greatly exposed at - the area bet - unit of findust is subject to hig welly warm air, co- g greatly exposed at - unit of findust is subject to hig welly warm air, co- g greatly exposed at - unit of findust is subject to hig welly warm air, co- g greatly exposed at - unit of findust is strongly alkal it where a subalp it hoor drainage dominated by tel- well that is subject its dominated by t that has avalat hat has erosion it of filat land it of filat land it of filat with slopes greated it that is filowde	hap by symbols. ectes in terms mbols are placed hose relating to 1), and those r CLIMATE tolerant plants tion is greater i ion is less than roulation is appri- nent ice or snow hich snow accuru unulation is con at fons that is freezing teaper to increased occo where the causing e ice curing over term i to local winds ANTHROPOEEN ween full pool a rial development is a significant increased occor outils AND LANDF y treeless high e line soil forest or a trar conifer forests ad become setable in interrupted for is daninated by well to rapidl nene cutes or potential ero bordering a rive subject to long opes less than 2 lex shopes of hear r than 25° ed frequently by ope inversent	The environmo of food, could in three may the inherent relating to p become establish approximately one lation is sig siderably red subject to atures below urance of from atures below urance of from extreme evapot uperature invection throughout til IC and low pool if such as cillip proportion of lopment an has been a FORMS elevation mou maition fores become established orest cover o soils devel es established openies cover o soils devel es establishes cover o soils devel es establishes cover o soils dev	ental conditi ver and other in categorie characteris bermanent ant lished due to ately onu rol y one half ro- half to one nificantly ri- uced by sind aridity in temperature ering temper teranspiration ersions he year in reservoirs is, mines, ta f transportat litered by cul ntains or pla t/grassland t lished f stunted sub oped from de d ic soils drained soi sils of coar from sheet of to periodic natural flood s0° in a gene ty	ons affect the r requirement s. those rel- tics of the 1. horopogenic (n e climatic fac- ier etur in depth meter in depth erosion summer from inversions atures relati- iings or spo- ion development tivation iteaus becomes establ balpine tree s ep, inactive is developed se textured m erosion throug flooding ing resulting maily low rel-	e abilit ts. Fo lating t and (suc man made stors that it exposus in extre live to t il areas nt such isshed species lacustri from de prain man

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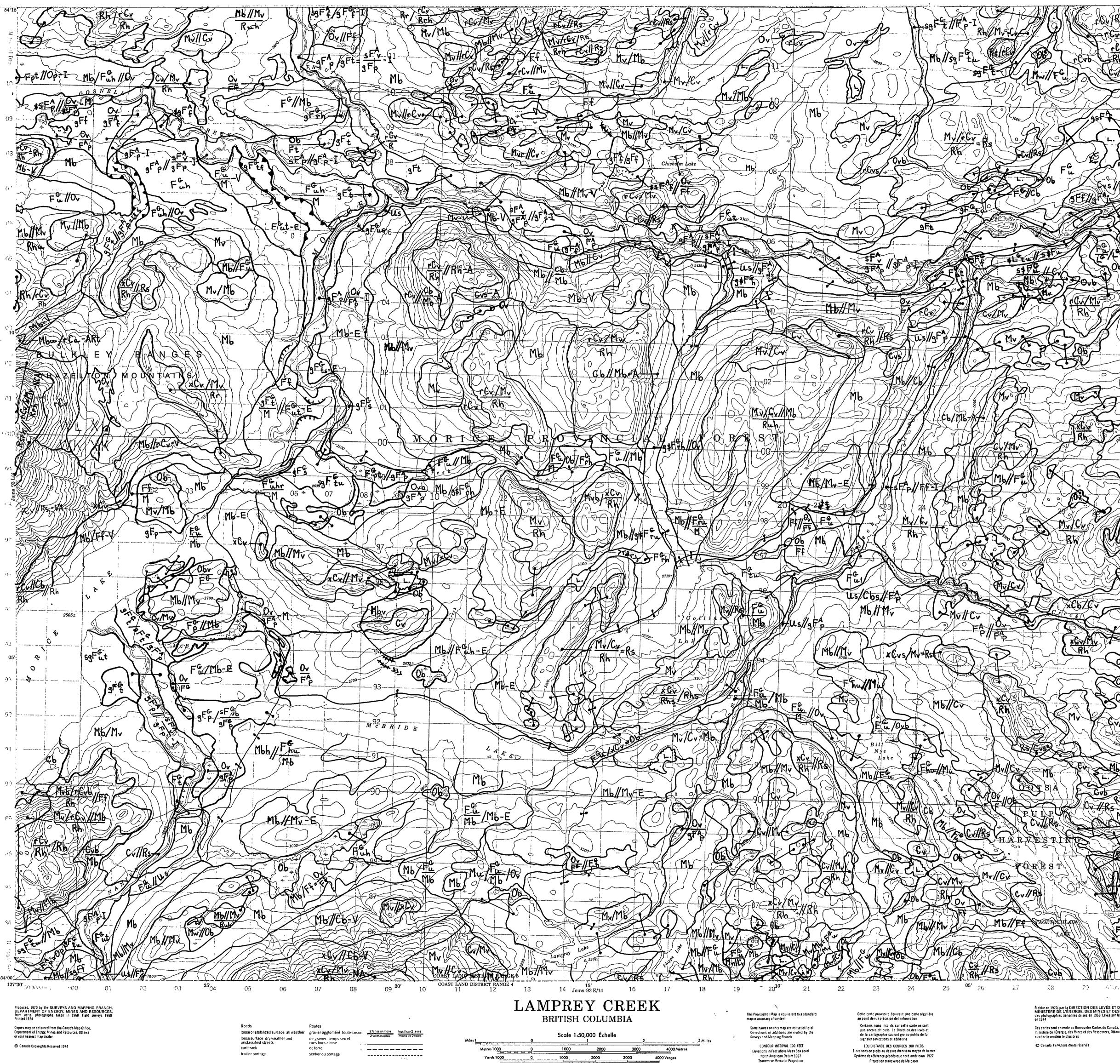
trail or portage sentier ou portage

Elevations in Feet above Mean Sea Level North American Datum 1927

Élévations en pieds au dessus du niveau moyen de la mer Système de référence géodésique nord américain, 1927

Projection transverse de Mercator

EDITION 1



MORICE STUDY AREA TERRAIN



REST	54°15'	-,, -, -, -, -, -, -, -, -, -, -, -,	MORICE STUDY AREA TERHAIN LEGEND (N.T.S. 93-L, 3 LAMPREY CREEK)	,
			1. INTRODUCTION 3. TEXTURE The information in the following boxes explains the important Texture refers to the size, roundness and sorting o	of particl
clu .		•	terrain characteristics of the Morice Biophysical Study area, Mational Clastic sediments. Topographic Series 93-L,3, which covers an area of 91,500 ha in north Central British Columbia. The Morice Study area also includes Map Mational Topographic Series maps 93-L 4, 5 and 6 which cover an Symbol Name Size (mm) Other Ch	haracteris
翻儿		; ·	terrain legend. Hore details on the terrain, bedrock geology, g gravel >2 mm rounded vegetation and wildlife (ungulate capability) for the entire study p pebble 2 - 64 mm rounded area is contained in the report entitled "Horice Biophysical Study" by x angular fragments >2 mm	particles particles includes
	31	 	r rubble 2 – 256 mm angular	particles particles
ET MB			2. EXPLANATION OF LETTER NOTATION Explanatory Notes:	to rounde
A FORMES	:0		A combination of letters is used to designate each terrain map unit. The relative position of letters within the symbol indicates the characteristic that they represent.	in a man
the state of the s			Qualifying Descriptor (see box 5) Surface Expression (see box 7) symbol, the texture given for the first indic material applies to both (e.g. rCv//Cb, sgrAp- other cases, the absence of a textural term fro symbol indicates that the texture of the mate observed in the field and cannot be reliably interp	erial was proted fro
L. 5	os		Texture	i) descrip
		1	 Units consisting of two or more types of terrain are designated by two or more groups of letters separated by slashes and/or equal signs e.g. Cvb = Hvb (Box 5). Where two textural terms are written together, the in order of increasing importance (e.g. \$s is si >50% sands and lesser silts). 	ey are wr ilty sand
			 Materials underlying the surface unit are shown by a symbol that is written beneath the surface unit symbol and separated from it by a horizontal line e.g. <u>\$\$KFb</u>. Rh 	
S / RS	08,		4. SURFICIAL MATERIALS	
			Surficial materials are classified according to their mode of formation or deposition. This influences their physical charact as texture, structure and compaction, which in turn control conditions of drainage and slope stability.	teristics
2 th Cr	07		Nap Description Symbol Name C colluvial Products of mass wastage. Commonly occurs as a mantle of variable thickness (e.g. rCv, rCb) that overline	ies rock a
		;	derived from local bedrock. Also includes often extensive areas of talus comes, fans or aprons (e.g. resulting from rockfall from units mapped as Rsh-Rb. All colluvium is indicated as having r (rubble) to fact, generally includes variable amounts of block coarse fragments, plus, sand, silt and clay interstiti F fluvial Materials transported and deposited by streams and rivers. Fluvial materials in the Morice study area	texture, b ial materi
Xell	05		nave sandy gravel texture (based on visual and hand texture estimates, e.g. sgFt). However, sandy a textured fluvial materials also occur on low gradient reaches of rivers (e.g. \$sFAp) as do cappin materials (e.g. Op/FAp).	and silty and silty and of or
100			FG Fluwioglacial Fluwial materials deposited in contact with glacier ice. Includes poorly sorted sandy gravel kame terra exposed along incised creeks (e.g. sg ^{FG}). Generally shows evidence of ice melting such as irregula irregular bedding, or slump structures (e.g. sg ^{FG} hd). Most commonly has sandy gravel textures (ba estimates and hand texturing), although sand textured outwash occurs locally (e.g. sF ^G p).	ar topogr
	05	i	I ice Areas of permanent snow and ice. L ^G glaciolacustrine Lacustrine materials that have been deposited in contact with glacier ice, or contain evidence of deposit	
3 Juis	y .	n ,	proximity to glacier ice. Mapped only in one area on the Morice River (e.g. gl ^G tu//sfFu. M Morainal Material deposited directly by glaciers (till). Generally consists of moderately compact to compact, m non-stratified material that contains a wide range of particle sizes in a matrix (<cmm) ar<br="" of="" sand,="" silt="">textures in the Morice study area appear to be closely related in texture and clast lithology to the pre-</cmm)>	nd clav.
	04	,	textures in the Morice study area appear to be closely related in texture and clast lithology to the pre- volcanic and associated sedimentary bedrocks. These tills most commonly have a slity sand to sandy slit (e.g. £sM) (82-17752, 17757, 17782, 17783 - Table 1). Tills with sandy matrix textures might occur coarse grained plutonic bedrocks but were not observed during the very limited number of stops in such ar field survey. Neoglacial tills (terminal and latera) moraines near glaciers) are indicated as havi	eas durin
Mutterc.	-10'		fragment) textures based on visual and hand texture estimates (e.g. xHrw). Variable amounts of interstit: and clay may also be present in neoglacial tills. O organic Material resulting from the decay and accumulation of vegetative matter (e.g. Op). Host commonly cons	ial sand,
			R bedrock Outcrops and rock covered by less than 10 cm of unconsolidated material (e.g. Rsh). Common voicanic bed R bedrock Outcrops and rock covered by less than 10 cm of unconsolidated material (e.g. Rsh). Common voicanic bed	drock type anodiorite
	1 03		quartz diorite plutonic bedrocks outcrop locally. U undifferentiated A sequence of more than three types of surficial materials cropping out on a steep erosional scarp or slop material be separated at the scale of mapping (e.g. Us-V).	
Mb	-			
	02		5. QUALIFYING DESCRIPTORS These descriptions qualify either surficial material or modifying process terms and are used to supply additional information about the are intermaixed or occupy such small areas that the	hev canno
Z		:	mode of formation, or modification of terrain map units. Hap Symbol Name Description Description designated as separate units at the scale of mapping (defined below) are used to indicate the relative and the components are always written order or importance.	ing. Syn mounts of
3	01		G glacial Used to modify non-glacial surficial materials = The components on either side of this symbol are where there is evidence that glacier ice equal. affected the mode of deposition of materials (e.g. FG). / The component in front of this symbol is more e	
160		1	A active Used to qualify surficial materials by indicating that a modifying process is either // The component in front of this symbol is cons operating continuously, or is of a recurrent extensive than the one that follows.	
	/ 150001	L A	nature at the present time, or that there is evidence that the formation of a surficial material is operative at the present time $\{e.g. Hb/R//Cv\}$ R is less extensive that Hb; Cv considerably less than R. $\{e.g. F^{A}p\}$.	is
		:	I inactive Used to qualify surficial materials by indicating that a modifying process is not continuing or recurrent, or the process of formation of a cualified material between the second	
	99	:	formation of a surficial material has ceased.	
	Joins	÷	7. SURFACE EXPRESSION	
	93 L/2		Surface expression is the topography or form of the land surface. In general, the terms listed here are used to describe feat not adequately shown on the topographic map. Hap	iures that
Way -	98 -		Symbol Mame Description p plain A flat or gently sloping unidirectional surface with a gradient of 0 to 2° (0-3%). (e.g. Fp). j gentle slope A unidirectional (planar) surface with a gradient of 2 to 10° (3-18%). (e.g. Hj).	•
Rinnemer () Mountain			a moderate slope A unidirectional (planar) surface with a gradient of 10 to 35° (18-70%). (e.g. Ca). s steep slope A steep erosional slope with a gradient commonly exceeding 35° (70%). (e.g. Rs).	
Con Ra	97	, , ,	u undulating Gently sloping, irregular rises and depressions. Slopes are generally between 2 and 10° (3-18%). (e.g. M h hummocky Steep sided, irregular hillocks and hollows. Slopes may range from 10 to 35° (18-70%) on unconsolidated	
D			to 35° (18 to 70%) on rock. (e.g. F ^G h). m rolling Elongate or linear, parailel or subparallel hills or ridges with slopes generally 2 to 10° (4-18%) and more than 1 m. (e.g. Mm).	i local re
00	96	, , ,	r ridged Elongate and steep sided rises and depressions. Slopes may range from 10 to 35° (18-701) on unconsolidat Bedrock slopes may be steeper. (e.g. Rr). t gerraced Stepped or benched topography consisting of well defined scarps separating horizontal or gently inclu	
Fue	, 		 (e.g. Ft). f fan A fan shaped surface that is a sector of a low angle cone. Slopes are generally between 2 and (e.g. Ff). 	
KING	1 95		 v veneer A surface layer of material that is of relatively uniform thickness and less than one metre deep. (e.g. C b blanket A mantle of surficial material which derives its general surface expression from the topography of the material formation of the surface expression from the topography of the surface expression from topography of the surface expression from topography of to	
	-05'	2 1 1	overlies. It is more than one metre thick. (e.g. Hb). w mantle A layer of discontinuous layer of surficial material of variable thickness that fills or partially fill <u>Explanatory Notes</u> : in an irregular substrate. Thickness ranges from 0 to 3 m. (e.g. Hw).	s depress
Qu Fr-	9:		 The use of two or more surface expression symbols together implies that there is a mixing of discrete forms, not a set of forms. Where more than one surface expression symbol is used, no significance is attached to the order in which the symbols are writed and the symbol is used. 	
Zevimk.		í	does not imply that v is more common than b).	ten (e.g.
Ch Mb	92	ł	8. GEOLOGICAL PROCESSES	
C.Ho.		`	These are terms which indicate processes that are currently modifying, or have modified, surficial materials and surface express Hap <u>Symbol</u> <u>Name</u> <u>Description</u>	
The second			Y gullying Surfaces eroded into long, narrow, steep sided depressions by running water, mass movement processes, or sno (assumed process status - active). In the Morice study area it is mapped extensively on steep, rocky mou (e.g. Rs/rCv-VA), on till slopes (e.g. Hvb-V, and in canyons (e.g. Rs/rCv-VAbRs).	untain sle
Ver Ob	92		A avalanching Rapid downslope movements of snow, ice and other incorporated debris on steep mountain slopes (e.g. rCv/Hv-A onto valley floors (e.g. rCa-A). B braiding channel Active channel zone is occupied by many diverging and conveying channels separated by bars. Subject to chashifting, lateral instability and channel avulsions (e.g. sgFAp-B). Typical process in large, low gradi	
MUTER			I irregularily Channel displays irregular turns and bends without repetition of similar features (e.g. sofAnt-1). Typica	
	91		sincus relatively low gradient, laterally confined floodplains throughout the Morice study area. Channels M meandering A channel characterized by a repeated pattern of bends with uniform amplitude and wave length (e.g. sFAp-H	
RSIL C			N nivation Erosion and enlargement of hollows containing snow patches due to a combination of freeze-thaw processes, chemical effects of meltwater, solifiuction and soil creep. In the Morice studyarea characterized by elongate "snow patch hollows" on alpine/subalpine slopes (Rhs-H) and on plateau surfaces (e.g. HV/Rhu-H).	physical circular
ML//FF	90	2 1	S solifluction Slow downslope movement of moist or saturated, seasonally frozen unconsolidated material over a relatively substrate that may be bedrock or frozen ground. In the Morice study area characterized by lobes, sheets or soliflucted material on alpine/subalpine slopes (e.g. rCvb-S).	/ impermea r terraces
			Z periglacial Used where cryoturbation, nivation and solifluction processes are all evident (e.g. <u>Hv</u> -Z).	· ·
J.S.F.	: 8)			1
			9. ON-SITE SYMBOLS 10. REFERENCES AND SOURCES OF FURTHER INFORMATION	
	58	1 1 2	82-17750 sample site G gravel pit	matfon sys
ter ins			G gravel pit F fossil locality Side scar; large, small F gravel pit F fossil locality F fossil locality	tish Colum
			C since scar; large, small C cirque B.C. Hinistry of Environment. 1983. Terrain Cl System Revision unpublished.	iassificat
	, 87	і • •	esker; direction known, unknown	
State (51.35		-t) - debris torrent avalanche track	
CALLER 5385		ľ	ridged lateral or terminal moraine Tritterit escarpment	
- CV/Cb	0		11. CREDITS	
$\frac{1}{2} \frac{1}{2} \frac{1}$	27°00 <u>′</u>	9 9 9 1 1	11. CREDEIS Mapped by: M. Fenger Surveys and Resource Mapping Branch, British Columbia Ministry of Environment, Victoria, British Columbia.	
ÉS ET DE LA CARTOGRAPHI	, IE,		Date of fieldwork: September 13-19, 1983 Date and scale of aerial photos. 1951, 1957 1:63 360	

s photographies aériennes prises en 1968 Levés sur le terrain en 1968 Imprimée

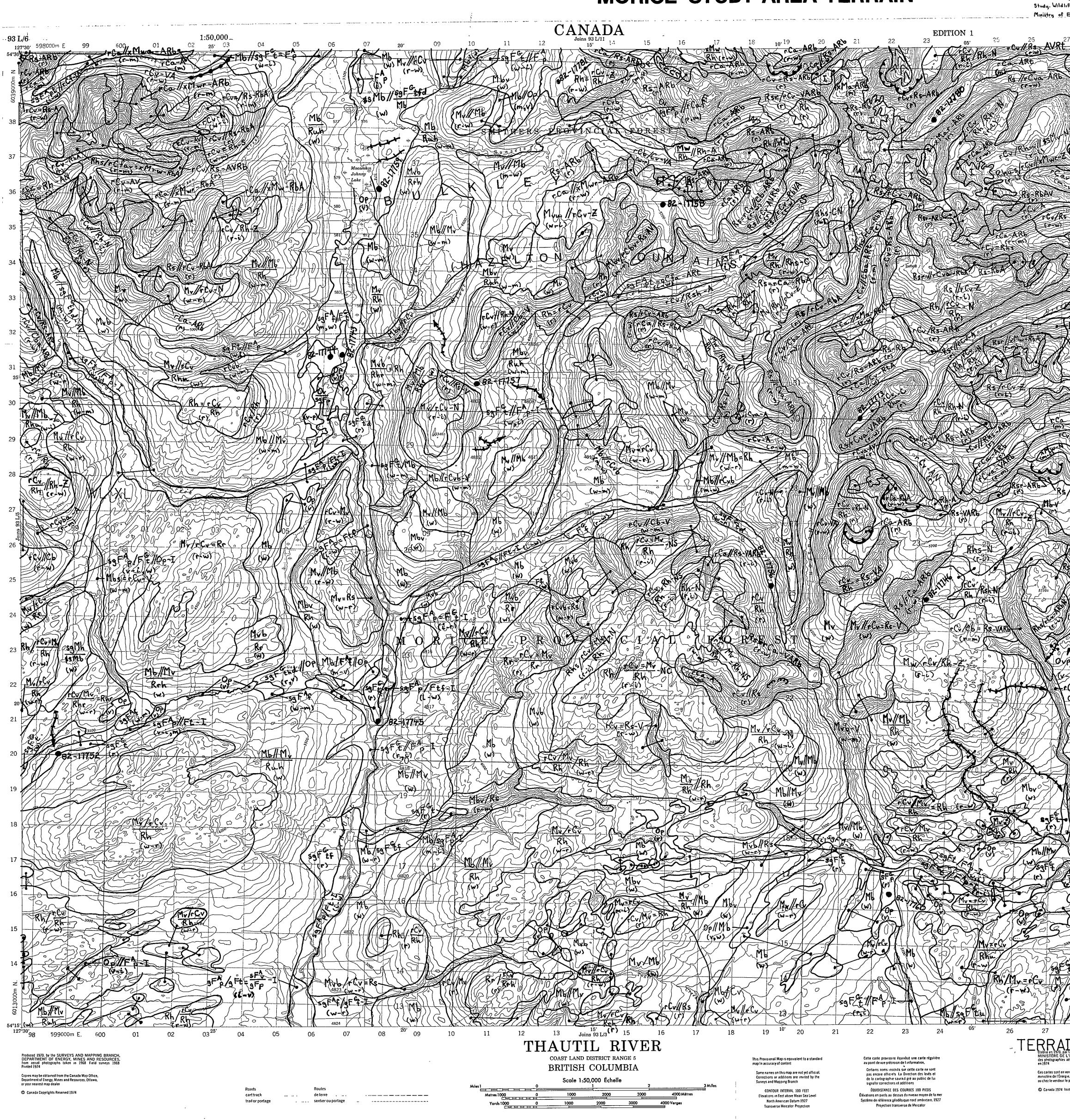
22

CV/M.

ase drafted by: Cartography Unit, Surveys and Resource Mappin Branch, British Columbia Ministry of Environment Victoria. Map drafted by: L. Lacelle

: Maps B.C. B.C. Ministry of Environment 557 Superior Street Victoria, B.C. V8V 1X5 Maps and Report available from:

lication date: 1985



MORICE STUDY AREA TERRAIN

. EXPLANATION OF LETTER NOTATION To accompany report: A combination of letters is used to designate each terrain map unit, Texture refer is relative position of letters within the symbol indicates the character- clastic sediments. Texture refers to the size, roundness and sorting of particles in Fuhr, B., M. Fenger, L. Lacelle, R. Marsh, and M. Rafig. 1986. Morice Biophysical istic that they represent Surface Expression Study. Wildlife Working Report No WR-18. Qualifying Descriptor Size (mm) Other Characteristics Symbol Name Surficial Materials Ministry of Environment, Wildlife Branch. gravel pebble angular fragments blocky rubble sand >2 ±04 2 - 64 ±03 >2 ±04 rounded particles includes intersti s, f and c Texture Soil Drainage Class >256 mm. 2 -- 256 mm. 0.0625 -- 2 mm. angular particle -93 L/6 angular particles angular to round 29 127°00' 529600m E .002 mm - 0.0625 mm <.002 mm Mbr Explanatory Notes: Explanatory Notes When the same surficial material (same texture but different landform or process status) is indicated twice in a map unit symbol, the texture given for the first indication of the material applies to both (e.g. rCv//Cb, sgPapert). In all other cases, the absence of a textural term from a map unit symbol indicates that the texture of the material was not observed in the field and cannot be reliably interpreted from sir photography or from a knowledge of bedrock geology (e.g. Myb). The reader is referred to the surficial material descriptions (Box 3) for general textural information. Units consisting of two or more types of terrain are designated by two or more groups of letters separated by slashes and/or equal signs e.g. Cvb = Hvb (Box 5). 2. Materials underlying the surface unit are shown by a symbol that is written beneath the surface unit symbol and separated from it by a horozontal line e.g. $\frac{d + h r r}{Bh}$ Soil drainage classes are shown in brackets beneath the terrain unit symbol (Box 8). Where two textural terms are written together, they are written in order of increasing importance (e.g. is silty sand with >50% sands and lesser silts). 3. Textural symbols applied to morsine (till) (e.g. \$M) refers to the matrix texture (<2 mm size fraction) only. Coarse fragment content is variable in tills (ranging from 14 to 722 by weight for 4 samples analyzed). Consequently, it is not indicated in the may symbol. The textural designation for all other surficial materials includes the</p> coarse fraction (e.g. sgFt) 3. SURFICIAL MATERIALS 402-177740 Surficial materials are classified according to their mode of formation or deposition. This influences their physical characteristics such as texture, structure and compaction, which in turn control conditions of drainage and slope stability. NH JEE Map <u>Symbol Name</u> Description Products of mass wastage. Commonly occurs as a mantle of variable thickness (e.g. rGv, rGb) that overlies rock and is de-rived from local bedrock. Also includes often extensive areas of talus cunta, fans or aprons (e.g. rGa, rGG, rCa) resulting from rockfall from units mapped as Rah-Rb. All colluvium is indicated as having r (rubble) texture, but in fact, generally includes variable amounts of blocky coarse fragments, plus, sand, silt and clay interstitial material. С colluvial Haterials transported and deposited by streams and rivers. Fluvial materials in the Morice study area most commonly have sandy gravel texture (based on visual and hand texture estimates) (e.g. sgFt). However, sandy and silty sand textured fluvial materials also occur on low gradient reaches of rivers (e.g. \$sF^{*}p) as do cappings of organic materials (e.g. 0/f^{*}p). fluvial Fluvial materials deposited in contact with glacier ice. Includes poorly sorted sandy graval kame terraces and fans exposed along incised creeks (e.g. sgy f). Cenerally shows evidence of ice melting such as irregular topography, irregular bed-ding, or slump structures (e.g. sgf hd). Host commonly has sandy gravel textures (based on visual estimates and hand texturing), although sand textured outwash occurs locally (e.g. sf p). p^G fluvioglacial Areas of snow and ice where evidence of active glacier movement is present. Lacustrine materials that have been deposited in contact with glacier ice, or contain evidence of deposition in close proximity to glacier ice. Mapped only in section on the Clore River (a.g. $\frac{Hb}{r+1,G}$). glaciolacustrine Material deposited directly by glaciers (till). Generally consists of moderately compact to compact, non-morted, and non-stratified material that contains a wide range of particle sizes in a matrix ((2 mm) of mond, mill and clay. Till textures in the Morice study area appear to be closely related in texture and clast lithology to the predominant local voleanic and associated wedimentary bedrocks. These tills most commonly have a silty sand to many silt matrix texture (e.g. \$mM) (82-17752, 17757, 17782, 17783 - Table 1). Tills with sandy matrix textures might occur in areas of coarse grained plutonic bedrocks but were not observed during the very limited number of stops in such areas during the field survey. Neoglacial tills (terminal and lateral mortaines near glaciers) are indicated as having x (angular fragment) textures (based on visual and hand texture estimates) (e.g. xHrw). Variable amounts of interstitial sand, silt and clay may also be present in Neoglacial tills. Material resulting from the decay and accumulation of vegetative matter (e.g. Op). Most commonly consists of me (partially decomposed) sedges or mosses. organic Outcrops and rock covered by less than 10 cm of unconsolidated material (e.g. Rsh). Common volcanic bedrock types in Morice study ares include andesite to rhyolite tuffs, breccias and flows. Quartz monzonite, granodiorite and quartz bedrock forice study area include plutonic bedrocks outcrop locally. A sequence of more than three types of surficial materials cropping out on a steep erosional scarp or slope, and canno separated at the scale of mapping (e.g. Um-V). undifferentiated REA naterial Table l Textural Analysis and Atterberg Limits Morice Study Area Till Samples SAMPLE NUMBER | SURFICIAL MATERIAL Liquid Limit Plastic Limi Sand (2-.0625 mm) Silt (.0625-.002 mm) Clay (<.002 mm) Coarse Fragments (>2 mm) RSP/ Cu=xMW-RHA7 15.27 19.53 11.56 15.97 20.36 22.83 15.13 22.03 till till till till 82-17752 82-17757 82-17782 82-17783 . COMPOSITE UNITS 4. OUALIFYING DESCRIPTORS Composite units are employed where two or three types of terrain are intermixed or occupy such small areas that they cannot be designated as separate units at the scale of mapping. Symbols (defined below) are used to indicate the relative amounts of each terrain type, and the components are always written in decreasing order of importance. (rew) These descriptions qualify either surficial material or modifying process terms and are used to supply additional information about the mode of formation, or modification of terrain map units. - The components on either side of this symbol are approximately Used to modify non-glacial surficial materials where there is evidence that glacler ice affecte the mode of deposition of materials (e.g. P⁰). / The component in front of this symbol is more extensive than the one that follows. // The component in front of this symbol is considerably more exten sive that the one that follows. Used to qualify surficial materials by indicating that a modifying process is either operating continuously, or is of a recurrent nature at the present time, or that there is evidence that the formation of a surficial material is operative at the present time (e.g. Γ^h_p). (e.g. Hb/R//Cv) R is less extensive than Hb; Cv is considerably less than R. Inactive Used to qualify surficial materials by indicating that a modifying process is not continuing or recurrent, or the process of formation of a surfi-cial material has ceased. 6. SURFACE EXPRESSION Surface expression is the topography or form of the land surface. In general, the terms listed here are used to describe features that are not sidequately shown on the topographic map. A flat or gently sloping unidirectional surface with a gradient of 0 to 2" (0-3%). (e.g. Fp). A unidirectional (planar) surface with a gradient of 2 to 10° (3-182). (e.g. Hj) A unidirectional (planar) surface with a gradient of 10 to 35" (18-70%). (e g. Ca). A steep erosional slope with a gradient commonly exceeding 35" (70%). (e g. Rs). tly sloping, irregular rimes and depressions. Slopes are generally between 2 and 10° (3-18%). (e.g. Hu). Steep sided, irregular hillocks and hollows. Slopes may range from 10 to 35" (18-70%) on unconsolidated materials, 10 to >35" (18>70%) on rock. (e.g. F^ch). Elongate or linear, parallel or subparallel hills or ridges with slopes generally 2 to 10° (4-18%) and local relief more than 1 m. (e.g. Hm). Elongate and steep sided rimes and depressions. Slopes may range from 10 to 35" (18-70%) on unconsolidated materials. Bedrock slopes may be steeper. (e.g. Rr). ridged Stepped or benched topography consisting of well defined scarps separating horizontal or gently inclined surfaces. (e.g. Ft). fan A fan shaped surface that is a sector of a low angle come. Slopes are generally between 2 and 10* (3-182). (e.g. Ff). A surface layer of material that is of relatively uniform thickness and less than one matre deep. (e.g. Cv). A mantle of surficial material which derives its general surface expression from the topography of the unit which it overlies. It is more than one metre thick. (e.g. Mb). A layer or discontinuous layer of surficial material of variable thickness that fills or partially fills depressions in an irregu-lar substrate. Thickness ranges from 0 to about 3 m. (e.g. Hw). Øve Explanatory Notes 1. The use of two or more surface expression symbols together implies that there is a mixing of discrete forms, not a set of intermediate forms. 1-m vb-2. Where more than one murface expression symbol is used, no mignificance is attached to the order in which the symbols are written (e g. Gvb does not imply that w is more common than b). LrCv=Mb GEOLOGICAL PROCESSES These are terms which indicate processes that are currently modifying, or have modified, surficial materials and surface expressions. Symbol Name Detachment of masses of disintigrating bedrock from steep slopes and its descent mostly through the air by leaping, bouncing and rolling. In the Morice study area also used to include small rockslides and rock avalanches that contribute to talus accumula-tion. Generally involves repeated falls of small amounts of debris resulting in fresh scars on rock faces (e.g. Rs-Rb) and fresh talus debris (e.g. rCaf-Rb). Rb rockfall Rapid downslope movement of a mass of bedrock along a well defined slip plane (e.g. Rs-Rr). The moving mass disintegrates or is severely deformed. Observed only in the Kitnsyskwa River valley. rockslide debris torrent Rapid flow of a slurry containing rock fragments and vegetative debris down a well defined, steep mountain side stream channel. In the Horice study area identified by debris accumulation, mediment plugs and/ar meattered large blocks in the channel (e.g. rCvb//Ra-Rt), and by coarme, non-morted debrim, large blocks, leveem and wood debrim on fans affected by debrim torrentm (e.g. rCf-Rt). bedrock slump Sliding of an internally coheaive mass of bedrock along a surface of rupture that is either concave upwards, planar or irregular. In the Kitnayakwa and Clora River valleys characterized by scarp alopes (alide scare) and tension cracks associated with displaced slump blocks (e.g. Rs-Pa). Surfaces eroded into long, narrow, steep sided depressions by running water, man movement processes, or snow avalanches (assumed process status - active). In the Horice study srea mapped extensively on steep, rocky mountain slopes (e.g. Rs/rCv-VA), on till slopes (e.g. Myb-V), and in canyons (e.g. Rs/rCv-VRDRs). litte gulling Rapid downslope movements of snow, ice and other incorporated debris on steep mountain slopes (e.g. rCv/Hv-A), and often onto avalanching valley floors (e.g. rCs-A). Active channel zone is occupied by wany diverging and conveying channels separated by bars. Subject to channel and bar shifting, lateral instability and channel avulsions (e.g. sgF^Ap-B). Typical process in large, low gradient mountain valleys that are receiving excess sediment from steep tributary valleys and/or glaciers. braiding channel irregularily Channel displays irregular turns and bends without repetition of similar features (e.g. sgP^Apt-I). Typical process on rela-sinuous tively low gradient, laterally confined floodplains throughout the Morice study area. sinuous A channel characterized by a repeated pattern of bends with uniform amplitude and wave length (e.g. sF^Ap-H). Happed only on a low gradient reach of the upper Clore River. meandering channel Heaving, churning and related movements that result from repeated freezing and thaving of moist unconsolidated sediments. In the Morice study area characterized by development of morted circles, stone stripes, and earth hummocks on alpine/mubalpine miopes (e.g. rEv-C) and plateau murfaces (e.g. My _C). Rhu cryoturbation Erosion and enlargement of hollows containing snow patches due to a combination of freeze-thaw processes, physical and chemical effects of meltwater, solifluction and soll creep. In the Morice study srem characterized by circular to elongate "snow patch hollows" on alpine/submipine slopes (Rhz-N) and on platemu surfaces (e.g. Mw/Rhu-N). N nivation S solifluction Slow downslope movement of moist or saturated, sensonally frozen unconsolidated material over a relatively impermeable substrate that may be bedrock or frozen ground. In the Morice study area characterized by lobes, sheets or terraces of soliflucted material on alpine/subalpine slopes (e.g. rCvb-S). periglacial Used where cryoturbation, nivation and solifluction processes are all evident (e.g. $\frac{Mv}{Rhu}$. 9. ON-SITE SYMBOLS 8 SOIL DRAINAGE CLASSE tallow 82-17750 sample site Symbol gravel pit Soil holds little moisture after rain (s.g. coarse textured soils). When used for rock refers to the drainage of associated shallow unconsolidated materials. Also typical soil drainage rapidly drained fossil locality slide scar; large, small for coarse textured fluvioglacial cirque terraces. seltwater channel; direction known, unknown No excess moisture for most of the year. Typical soil drainage for wid to upper till or colluvial slopes, till well drained esker; direction known, unknow plains and fluvial or fluvioglacial terraces. debris torrent Excess moisture for a short but signif-icant part of the year. Typical soil drainage for lower slopes, fans, or lowlands receiving seepage. moderately well drained avalanche traci ridged lateral or terminal moraine 30 ^{127°00′} 28 629000m E. imperfectly drained Soil remains wet for a moderately lon Soil remains wet for a moderately long period of the year. When used in sub-alpine/alpine areas undergoing peri-glacial processes, likely includes areas of well, moderately well and poor soil drainage. Stallarily, when used on floodplains, may include areas of well, moderately well and poor soil drainage. TERRAIN 93 6 D03 Hablie en 19/0, par la DIRECTION DES LEVES ET DE LA CARTOGRAPHIE. MINISTÈRE DE L'ENERGIE, DES MINES ET DES RESSOURCES, d'après des photographies aériennes prases en 1968 Levés sur le terrain en 1968 Imprimée en 1974 Mapped by L. Lacelle, Surveys and Resource Mapping Branch, British Columbia Ministry of Environment, Kelowns, British Columbia. poorly drained Excess moisture throughout the soil for P a long period of the year. Typical soil drainage on wetter portions of Date of fieldwork. September 13-19, 1983 floodplains and in water accumulating depressions on till plains. Date and scale of serial photoms: 1951, 1957 1:63 360 Ces cartes sont en vente au Bureau des Cartes du Canada, ministère de l'Énergie, des Mines et des Ressources, Ottawa, ou chez le vendeur le plus près v very poorly drained Free vater remains at or within 30 cm Publication date: 1986
 of the surface most of the year
 Typical soil drainage for organic mat Base drafted by: Cartography Unit, Surveys and Resource Happing Branch, British Columbia Hinistry of Environment, Victoris. 🛇 Canada 1974 tous droits réservés

> Explanatory Notes (τ - ν) designates soil drainage ranging from rapid to well, whereas
> (ν, p) designates that distinct well and poorly drained classes are
> present in a terrain map unit

Map drafted by. L. Lacelle

TERRAIN JJL/U

2. TEXTURE



Produced 1970, by the SURVEYS AND MAPPING BRANCH, DEPARTMENT OF ENERGY, MINES AND RESOURCES, from aerial photographs taken in 1968 Field surveys 1968 Frinted 1974 Copres may be obtained from the Canada Map Office, Department of Energy, Mines and Resources, Ottawa, or your nearest map dealer. 🕲 Canada Copyrights Reserved 1974.

Roads Routes loose or stabilized surface, all weather... gravier aggloméré, toute saison ... <u>2 lanes or more</u> 2 voies ou plus moins de 2 voies

MORICE STUDY AREA TERRAIN

RS-FCA NAR

RS-VARE

Rs //+Cva+WARb

87

CANADA 30 Joins 93 L/12 45' 82

80 Joins 93 L/4 82 83 BURNIE LAKE

COAST LAND DISTRICT RANGE 5

BRITISH COLUMBIA

Scale 1:50,000 Échelle

Metres 1000 0 1000 2000 3000 4000 Mêtres

Yards 1000 0 1000 2000 3000 4000 Yerges

Miles 1 0 1

79

-84

3 Milles

This Provisional Map is equivalent to a standard map in accuracy of content

Some names on this map are not yet official. Corrections or additions are invited by the Surveys and Mapping Branch

CONTOUR INTERVAL 100 FEET Elevations in Feet above Mean Sea Level North American Datum 1927 Tran_verse Mercator Projection

83

AREY

EDITION 1 91 35' 9 **35'** 92

90

Cette carte provisoire équivaut une carte régulière au goint de vue précision de li information

Cértains noms inscrits sur cette carte ne sont pas encore officiels. La Direction des levés et de la cartographie saurait gré au public de lui signaler corrections et additions

EQUIDISTANCE DES COURBES 100 PIEDS

Élévations en pieds au dessus du niveau moyen de la mer Système de référence géodésique nord américain, 1927 Projection transverse de Mercator

and M. Study.

	1 J 1 [MORICE STUDY ARE	A TERRAIN LECEND	-	TERRAIN	93L/5
company report:	J	TON OF LETTER NOTA	to used to designate	each terrain asp unit.		the size, roundae	ss and sorting of particle	s in
uhr, B., M. Fenger, L. Lacelle, R. Marsh, nd M. Rafiq. 1986. Morice Biophysical	The relativ	e position of lette they represent.	rs within the symbol	Surface Expression	clastic sediments. Hep Symbo <u>l Name</u>	Size_(mo) Other Character	latica
udy. Wildlife Working Report No.WR-18. Linistry of Environment, Wildlife Branch.	Surficial H Texture	aterials	sg ^{pG} f−V	Geological Process	g gravel p pebble)2 mm 2 - 64 mm	rounded particl rounded particl includes inters	
	_ Soil Draina	ge Class	(u -r)		x angular Fragments a blocky r rubble s sand	>2 mm >256 mm 2 - 256 mm 0.0625 - 2 mm	s, á and c angular particl angular particl	±3 ±4
94 95 596°30m E 127°30'	Explanator	Nates:			<pre>silt c clay Explanatory Notes:</pre>	.002 mma → 0. <.002 mma	particles .0625 mm - -	
	or more Cvb = b	e groups of letters (vb (Box 5).	separated by slashes	in are designated by two and/or equal signs e.g.	1. When the same suri or process status) is indicated twi at indication of t	ame texture but different ce in a map unit symbol, t he material applies to bot	h (e.g.
	writte	sls underlying the n beneath the surfs ntal line e.g. <u>de</u> M R	ce unit symbol and se	n by a symbol that is parated from it by a	term from a map w was not observed air photography 00	nit symbol indicat in the field and c r from a knowledge	ases, the absence of a tex es that the texture of the annot be reliably interpre of bedrock geology (e.g. material descriptions (Bo	material ted from Myb). The
		rainage classes are (Box 8).	shown in brackets be	encath the terrain unit	general textural 2. Where two textura order of increasi	information. 1 terms are writte ng importance (e.g	n together, they are write . So is eilty sand with >	en in
Contraction of the second se	• • •				matrix texture (< variable in tills	applied to moraine 2 mm size fraction (ranging from 14	(till) (e.g. sol) refers) only. Coarse fragment (to 72Z by weight for 4 man	ples
					analyzed). Conse	quently, it is not ion for all other	: indicated in the map sym surficial materials inclu-	NOL, 188
		IAL MATERIALS cial materials are and compaction, whi	classified according ch in turn control co	to their mode of formation additions of drainage and a	a or deposition. This in slope stability.	fluences their phy	sical characteristics such	as texture,
A HERE AND A	Кар	Name			Description			
) c	colluvial	rived from local l from rockfall from includes variable	wastage. Commonly occurs bedrock. Also includes of a units mapped as Rah-Rb. amounts of blocky coarse	ten extensive areas of ta All colluvium is indicat fragments, plus, sand, si	lus cones, fans of as having r (ru ilt and clay inters	r sprons (e.g. rGs, rGr, r Jbble) texture, but in fac Ititial material.	a) teouting t, generally
	1	fluvial	sandy gravel text fluvial materials Op/P ^A p).	rted and deposited by stre are (based on visual and h also occur on low gradien	and texture estimates) (e t reaches of rivers (e.g.	. dar ^a p) as do capi	er, sandy and silty sand t pings of organic materials	(e.g.
2	P _G	fluvioglacial	along inclued creating, or slump at	deposited in contact with eks (s.g. sgF ^G f). General ructures (s.g. sgF ^G hd). M ugh sand textured outwash	ly shows evidence of ice out commonly has sandy gu	melting such as in svel textures (bas	regular topography, irreg	plar ped"
	I L ^C	ics glaciolacustrine	Lacustrine materia	ice where evidence of act als that have been deposit e. Mapped only in section	ed in contact with glacie	r ice, or contain	evidence of deposition in	close proxim-
	H	morainel	stratified materi	d directly by glaciers (ti al that contains = wide ra dy area appear to be close	inge of perticle sizes in ity related in texture and	a matrix (<2 mm) - i clast lithology	of sand, silt and clay. I to the predominant local v	olcenic.and
	4 		17752, 17757, 177 bedrocks but were	ntary bedrocks. These til 82, 17783 - Table 1). Til not observed during the v nd lateral moraines near g estimates) (a.g. xMrw). V	Is with sandy matrix text ery limited number of sto (laciers) are indicated as	tures might occur ops in such sreas - having x (angula	in areas of coarse grained during the field survey. r fragment) textures (base	plutonic Neoglacial d on visusl
33	0	organic	Neoglacial tills. Haterial resultin					
To and is for the state of the	R	bedrock	Horice study area plutonic bedrocks		ite buffs, brecciss and :	flows. Quartz mon	zonite, granodiorite and q	vartz diorite
IS MUD NO COLOR	, U	undifferentiated material	A sequence of mor separated at the	e then three types of surf scale of mapping (e.g. Ve-	icial materials cropping -V). Table 1	out on a steep er	velonal scarp or slope, an	a amanye de
King Real Company	, , ,	ann	~	ural Analysis and Atterber PERCENTAG	g Limits Morice Study Ard	ea Till Samplus 	- ATTERBERG LIN	115
Mby Mby 21	5AMPLE NU	52 till	Coarse Fra (>2 mm 71) (2≁.0625 mm.) 13	Silt (.0625→.002 mms) 10 24	Clay (<.002 um) 6	Liquid Límit 20.36 22.83	Plastic Limit 15.27 19.53
	62-177 62-177 62-177	57 E111 82 E111	43 72 14	25 15 34	24 10 35	8 3 17	22.83 15.13 22.03	19.33 11.56 15.97
	}	FYING DESCRIPTORS			5. COMPOSITE UNITS			
	process t	erms and are used (ify either surficial to supply additional i n of terrain map unit	material or modifying information about the mode 3.	intermixed or occupy separate units at th	such small areas e scale of mapping tive amounts of es	a two or three types of te that they cannot be design . Symbols (defined below) of terrain type, and the o of importance.	ated as
REAL PROPERTY 27	Hap Symbol	Name	<u></u>	iption	equal.		of this symbol are approxi	
	G	when the active Used	e there is evidence t mode of deposition of to qualify surficial	u surficial materials that glacier ice affected ! materials (e.g. ?). ! materials by indicating	one that fol	lown.	symbol is considerably ma	
		cont pres for	ent time, or that the	recurrent nature at the re is evidence that the material is operative at	(e.g. Mb/R/	/Cv) R is less ex less than R.	tensive than Mb; Cv is co	nsiderably ,
The line of the second s	I	inactive Used the Fect	to qualify surficial t a modifying process	aterials by indicating is not continuing or of formation of a surfi-				
	6. SURPA	CI	L BACUTINI INA CEASEG.					· ,
PRINT PRINT	Surf adequatel	ace expression is y shown on the top	the topography or form ographic map.	of the land surface. In	general, the terms liste	d here are used to) describe features that a	re mot
	Map Symbol	Name			Descriptio		х. Ре.).	
RS/IPCVA	P j	gentle slope	unidirectional (plan	ing unidirectional surface nar) surface with a gradie nar) surface with a gradie	at of 2 to 10° (3-18%).	(e.g. Kj).		
25		undulating	Gently sloping, irreg	pe with a gradient commonly ular rises and depressions	. Slopes are generally b	etween 2 and 10°		
	h T	rolling	(18>70%) on rock. (e	r hillocks and hollows. S -8. Fh). arallel or subparallel hil				
	F	ridged	Elongate and steep si slopes may be steeper	ded rises and depressions. . (e.g. Rr). pography consisting of wel				
TEY OF SOFAFEE TOP-I	f	fan	A fan shaped surface	that is a sector of a low terial that is of relative	angle cone. Slopes are ;	generally between	2 and 10" (3-18%). (e.g.	
		mentle	is more than one metr A layer or discontinu	ous layer of surficial mat	erial of variable thickn	-		
		ory Notes:		ness ranges from 0 to abou mbols together implies tha		iscrete forms, not	a set of intermediate for	us .
AN	2. When impl	e more than one sur y that v is more co	face expression symbo mmon than b).	l is used, no significance	is sttached to the order	r in which the sym	bols are written (e.g. Gu	b does not
$\mathbf{Co} = \mathbf{M}\mathbf{v} \cdot 2$		OGICAL PROCESSES	indicate processes th	at are currently modifying	; or have modified, surf:	lcial materials an	i surface expressions.	
WIS TO	Map <u>Symbol</u>	Manae			Descriptio	_		
	Rb		rolling. In the Hori tion. Generally invo talus debris (e.g. T		amounts of debris res	ulting in fresh sc	are on rock faces (e.g. R	-Rb) and fresh
	Rr Rt	rockalide debris torrent	Repid downslope movem severely deformed. O Repid flow of a slurr	ent of a mass of bedrock a baserved only in the Kitnay y containing rock fragment	akwa River valley.	down a well define	d, steep mountain side str ed large blocks in the che	een channel. nnel (e.g.
Mulicu Bl Sol		1 . 1	In the Horice study a rCvb//Rs-Rt), and by rCf-Rt).	rea identified by debris a coarse, non-sorted debris,	accumulation, sediment provide the sediment provides sediment provide the sediment provides sediment provide the sediment provides s	d wood debrie on f	er conceve upwards, planat	rents (8.8.
	v v	gulling	In the Kitnayakwa and slump blocks (e.g. R Surfaces eroded into	(Clore River valleys chara s-Fm). long, marrow, steep sided	depressions by running w		DEGGERARE, OF ADDW AVALAT	ches (assumed
S Cool	A		slopes (e.g. Hvb-V),	, and in canyons (e.g. Xs/) wents of anow, ice and oth	TCV-YRDRS)-			
A A A A A A A A A A A A A A A A A A A	B	braiding channel	lateral instability a receiving excess sedi	is occupied by many diverg and channel avulsions (e.g. ment from steep tributary	• sgP ^A p-B). Typical proc valleys and/or glaciers.	ess in large, low	gradient mountain valleys	that are
Rt.	I		tively low gradient, A channel characteriz	egular turns and bends with laterally confined floodpi ed by a repeated pattern of	lains throughout the Mori	ce study area.	1	
	с	channel cryoturbation	low gradient reach of Reaving, churning and Morice study area cha	the upper Clore River. I related movements that re- tracterized by development temu surfaces (e.g. <u>Mv</u>).	sult from repeated freez of sorted circles, stone	ing and thawing of	moist unconsolidated sedi	ments. In the
The man and the main and the ma	j N	nivation	Erosion and enlargeme effects of meltwater,	resu surfaces (e.g. <u>Av</u> _C). Rhu ent of hollows containing a solifluction and soil cr balpine slopes (Rhs-N) and	now patches due to a com sep. In the Morice study	area characterize	→thaw processes, physical d by circular to elongste	and chemical Tanow patch
The second the second the	s S	solifluction	Slow downslope moveme	ent of moist or saturated, or frozen ground. In the b	measonally frozen uncons	olidated material	over a relatively imperment heets or terraces of solid	ble substrate lucted material
	z	periglacial processes	Used where cryoturbs:	tion, nivation and soliflue	tion processes are all e	vident (e-g. <u>Hv</u> _ Rhu	z).	
RICORD RUS		DRAINAGE CLASSES			9. ON-SITE SYMBOLS			
SEFTIFA THANKING	Hap <u>Symbol</u> T	<u>Name</u> repidly drained	Soil holds 1	Description ittle moisture after rain		semple site gravel pit		
			(e.g. coars used for roc associated s materials. for coarse t	e textured soils). When k refers to the drainage o hallow unconsolidated Also typical soil drainage extured fluvioglacial	of F	fossil locality slide scar; larg cirque	e, small	,
	, ,	well drained	terraces. No excess mo year. Typic	extured fluviogracial stature for most of the sal soil drainage for mid : r colluvial slopes, till	مسسر مسیر مسر مسیر مسر مسیر	-	, direction known, unknow known, unknown	'n
THE REAL OF	1 2 3	moderately well	plains and f terraces. Excess moist	luvial or fluvioglacial ure for a short but signi:		lineation debrim torrent avalanche track		
Rhome will be a first the start of the start	5΄, ι	drained imperfectly dra	icant part o drainage for lowlands rec sined Soil remains	of the year. Typical soil lover slopes, fans, or ceiving seepage.	8 "	avalanche track ridged lateral ou escarpment	: terminal motaine	
G5 GC 1023 E 127°30'	}	• • •	period of the alpine/alpin glacial proc areas of web soil drainag	he year. When used in sub- ne areas undergoing peri- cesses, likely includes 11, moderately well and po- ge. Similarily, when used	 0F			-
Établie en 1970, par la DIRECTION DES LEVÉS ET DÉ LA CARTOGRAPHIE, MINISTÈRE DE L'ÉNERGIE, DES MINES ET DES RESSOURCES, d'après des pholographies aériennes prises en 1968 Levés sur le terrain en 1968 Imprimée		poorly drained	on floodplai well, modera drainage Excess moist	ns, may include areas of stely well and poor soil ture throughout the soil fo	10. CREDITS Mapped by' L. Lace		tesource Mapping Branch, B Tronment, Kelowna, British	
des photographies aériennes prises en 1968 Levés sur le terrain en 1968 Imprimee en 1974 Ges cartes sont en vente au Bureau des Cartes du Canada, ministère de l'Énergie, des Mines et des Ressources, Ottawa,		viaited	a long perio soil drainag floodplains	the soli i od of the year. Typical ge on wetter portions of and in water accumulating on till plains.	Date of fieldwork: Date end scale of a	September 13-19, merial photos: 195	1983	
© Canada 1974, tous droits réservés	• •	very poorly dra	of the surfa	remains at or within 30 cm ace most of the year. I drainege for organic mat	- Base drafted by: C	artography Unit, S	Surveys and Resource Mappin Infatry of Environment, Vi	

Nap drafted by: L. Lacella

(r - w) designates soil drainage ranging from rapid to well, whereas
 (w, p) designates that distinct well and poorly drained classes are
 present in a terrain map unit.

Explanatory Notes:



Transverse Mercator Projection

Projection transverse de Mercator

				HORICE STUDY ARE	A TERIALN	LECIER	TERR	AIN	93.1	/4
-	ANATION OF LETTER				2. TEXTI					1
The rela	embination of let stive position of at they represent	ters is used to design latters within the sym-	bol indicates	the character-	clastic	ture refers to sediments.	the size, rounds	ass and CO		
•	ing Descriptor		Suz	face Expression	Hap Symbol	Naue	Size_{p	m)	Other Charac	
Texture Soil Dra	ainage Class	9gF ^G f−V (₩+r)	Geo	logical Process	g P T	gravel pebble angular framente	>2 mm, 2 − 64 mm, >2 mm,		rounded part rounded part includes int s, s and c	icles
				,	# r \$	fragments blocky rubble sand	>256 mm 2 - 256 mm 0.0625 - 2 m		angular part angular part angular to r	icles
					¢ C	silt clay	.002 wa - <.002 km	0.0625 mm	particles - -	
· • • • • • • • •	itory Notes:	two or more types of	terrain are d	esignated by two	Explana	tory Notes:				
or	tis consisting of more groups of 1 /b = Hvb (Box 5).	etters separated by sl	ashes and/or	equal signs e.g.	or giv	process statu ven for the fi	rficial material s) is indicated f rat indication of	wice in a the water	map unit symb ial applies t	ol, the texture to both (e-g-
VT	iterials underlyin fitten beneath the prozontal line e-g	g the surface unit are surface unit symbol a . <u>daHrb</u> . Rb	shown by a s nd separated	lymbol that is from it by a	ter Vas	rm from a map s not observed	t). In all other unit symbol indic in the field and or from a knowled	ates that I cannot be	the texture of text	f the material erpruted from
3. So sy	oil drainage class ymbol (Box 8).	es are shown in bracks	ts beneath ti	ne terrain unit	. ges	ader is referr neral textural	ed to the surfici	al materie	al description	s (Box 3) for
					0T0 474	der of increas 1 lesser silts	ing importance (9.g. ## 1#	silty send wi	th >50% sands
					34) Vet	trix texture (riable in till alyzed). Cons	<pre><2 mm size fract: w (ranging from) equently, it is o ition for all other</pre>	ion) only. 4 to 72% b ot indica	Coarse fragm by weight for ted in the map	ent content is 4 samples • symbol, The
3. SU	RFICIAL MATERIALS					arse fraction		it Buillen	I Bateriais i	
		a are classified accord a, which is turn contro					nfluences their p	hysical ch	aracteristica	such as texture,
Hap <u>Symbol</u>	Name					Descriptio	<u>n</u>			
С	colluvial	rived from log from rockfall	cal bedrock. from units m	Commonly occurs a Also includes oft apped as Rah-Rb.	en extensi All colluy	ive arean of t rium is indica	alus cones, fans ted as having r (or aprons rubble) te	(e.g. rCa, rC xture, but in	f, rCa) resulting
Ŧ	fluvial	Materials transactions sandy gravel	nsported and texture (base	of blocky coarse f deposited by stres d on visual and ha	ums and riv	ers. Fluvial estimates) (saterials in the e.g. spFt). Howe	Morice st ver. sandy	udy area most and silty as	nd textured
, FG	fluvioglacial	Op/F"p). Fluvial mater:	ials deposite	ur on low gradient d in_contact with	glacier ic	e. Includes	poorly sorted sam	dy gravel	kaze terraces	and fame exposed
•		ding, or slum	p structures	<pre>sgP^Gf). Generall (e.g. sgP^Ghd). Ho textured outwash o</pre>	st commonl	y has sandy g:	ravel textures (b	irregular ased on vi	topography, i sual estimate	rregular bed- e and hand
I L ^G	ice glaciolacustr	ine Lacustrine ma	terials that	e evidence of acti have been deposite d only in section	d in conta	ct with glaci	er ice, or contai	n evidence	of deposition	n in close proxim-
Н	morainal	Haterial depo	sited directl	d only in section y by glaciers (til	1). Gener	ally consists	of moderately co	mpact to c	ompact, non-s	orted, and non-
		in the Morice associated se 17752, 17757,	study area a imentary bed 17782, 17783	ontains a wide ran ppear to be closel rocks. These till - Table 1). Till	y related a most com a with sam	in texture an monly have a dy matrix tex	i clast lithology silty sand to wan tures wight occur	to the pr dy silt ma in areas	edominant loc trix texture of coarse gra	al volcanic and (e.g. #sN) (82- ined plutonic
		bedrocks but v tills (termina	were not obse al and latera are estimates	rved during the ve 1 moraines near gl) (e.g. xMrw). Va	ry limited aciers) ar	I number of sto o indicated as	ops in such areas having x (angul	during th ar fragmen	e field surve t) textures (y. Neoglacial based on visual
o f	organic	Material resul (partially dec	ting from th composed) sed	e decay and accumu ges or mosses.						
j R	bedrock	Outcrope and m Norice study a plutonic bedro	rea include	by less than 10 cm andesite to rhyoli locally.	of uncons te tuffs,	olidated mater breccias and i	ial (e.g. Rah). Nowa, Quartz mo	Common vo nzonite, g	lcanic bedrock ranodiorite an	types in the d quartz diorite
U	undifferentia material			ree typem of surfi mapping (e.g. Us-V).	ials cropping	out on a steep e	rosional s	carp or slope,	, and cannot be
		π	extural Analy	veie and Atterberg	Table 1 - Limits Hou	rice Study Are	a Till Samples			`~
SAMPLE	NUMBER SURPICIA	L MATERIAL COATSE	Fragments	PERCENTAGE Sand	1	Stit	Clay	Liquic	ATTERBERG	LIMITS Plastic Limit
		:111	==) 71 43	(20625 mma) 13 25	(.062)	5∽.002 mms) 10 24	(<.002 mms) 6 8		0,36 1-83	15.27 19.33
			72 14	15 34		10 35	3 17	15	1.13 1.03	11.56 15.97
4. QUA	LIFYING DESCRIPTO	RS			5. CON	POSITE UNITS				_
Process	terms and are us	qualify either surfici ed to supply additiona ation of terrain map u	l information		intermi: separate	red or occupy s units at the	are employed when such small areas scale of mapping	that they Symbols	cannot be dem (defined bel	ignated as ow) are used
Hap Symbol	Name	De	scription		are alwa	sys written in	ive amounts of en decreasing order s on either side	of import	tance.	-
c		Used to modify non-gla where there is evidenc			,	equal. The component one that foll	in front of this	symbol is	wore extensi	ve than the
٨	Active	the mode of deposition Used to qualify surfic that a modifying proce	ial materials	by indicating	11	The component sive that the	in front of this one that follows	symbol is	considerably	more exten-
		continuously, or is of present time, or that formation of a surfici- the present time (e.g.	a recurrent there is evid al_material i	nature at the ence that the		(e.g. Hb/R//	Cv) R is less ex less than R.	teasive th	an Hb; Cv is	considerably
I	inactive	Used to qualify surfic that a modifying proce recurrent, or the proc	ial materials as is not com	tinuing or						
		cial material has cess	ed.							
	FACE EXPRESSION	is the topography or fo	one of the la	nd surface. To or		taina liakad	have one word to	1	·	
adequato Map	ely shown on the	topographic map.		•						are ase
Symbol P	<u>Name</u> plain	A flat or gently alo	ofor unidiza		**	Description	(0-3 %) (
t t	gentle slope moderate slope	A unidirectional (p)	lanar) eur(ec	e with a gradient	of 2 to 10	• (3-18%). (.g. Hj).	<i>,</i> ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,		
•	steep slope	A unidirectional (p) A steep erosional s	lope with a g	radient commonly e	xceeding 3	5" (70%). (e	.g. Rs).			
u h	undulating hummocky	Gently slaping, irre Steep sided, irregul (18>70%) on rock. (ar hillocks							a, 10 to >35°
•	rolling	Elongate or linear, (e.g. Mm).								
• .	ridged terraced	Elongate and steep a slopes may be steepe Stepped or benched t	er. (e.g. Rr).						
f	fan Veneer	A fam shaped surface A surface layer of a	that is a s	ector of a low ang	le cone.	Slopes are ger	erally between 2	and 10* (3-18Z). (c-g	
ъ	blanket	A mentle of surficia is more than one met	l material w re thick. (hich derives its g e.g. Mb).	eneral sur	face expressio	on from the topog	raphy of t	he unit which	
v Explanat	mantle tory Notes.	A layer or discontin lar substrate. Thic	uous layer o kness ranges	f surficial materi from O to about 3	al of vari m. (e.g.	able thickness Hw).	that fills or p	artially f	ills depressio	ons in an irregu-
1. The	use of two or not	e surface expression symb								
	.,	urface expression symb common than b).	w used, (••guiricance is	arrached (w ine order 1	which the symbol	in are wri	itten (e.g. C	vb do c s not
	ogical processes	h indicate processes t	hat are curre	ntly modifying, or	have modi	fied, surfici	al materials and	surface ex	pressions.	
Hap Symbol	Name	-				Description				
Rb	rockfall	Detachment of masses rolling. In the Hor:	ice study are	a also used to inc	lude small	pes and its do	nd rock avelanche	s that con	tribute to ta	lus accumula-
Kr	rockalide	tion. Generally invo talus debris (e.g.) Rapid downslope mover	lves repeate rCaf-Rb).	d falls of small a	mounts of	debris result:	ing in fresh scar	e on rock	faces (e.g. R	s-Rb) and fresh
Rc	debris torrent	Rapid downstope moves severely deformed. (Rapid flow of a slur: In the Morice study)	Dbserved only ry containing	in the Kitneyskys rock fragments an	River val d vegetati	ley. Ve debris dow	n a well defined,	steep wou	ntain side at	ream channel.
-	hadmach -+	rCvb//Rs-Rt), and by rCf-Rt).	coarse, non-	sorted debris, lar	ge blocks,	levees and w	ood debris on fan	a affected	by debria to	rreats (e.g.
Fa	bedrock slump	Sliding of an intern In the Kitnayakwa and slump blocks (e.g.)	i Clore River Rs-Pu).	valleys character	fized by so	arp slopes (s	lide scars) and t	ension cta	cks associate	d with displaced
v	gulling	Surfaces eroded into process status - act slopes (e.g. Mvb-V)	ive). In the , and in cany	Morice study area ons (e-g. Rs//rCv-	wapped ex VRbRs).	tensively on	ateep, rocky moun	tain slope	• (e.g. Rø/rC	v-VA), on till
A 8	avalanching braiding	Rapid downslope moves valley floors (e.g.) Active channel zone : lateral instability	rCa-A). Le occupied b	y many diversing a	of convey!	ng channels a	energiated by bour	Cub da an		
I	channel irregularily	receiving excess sed	ment from at	eep tributary vall	eys and/or	glaciers.	in large, low gr	adient mou	ntain valleys	that are
н	ningularity sinuous channels meandering	Channel displays irre tively low gradient, A channel characteria	Taterally Co	niihed floodpinina	throughou	t the Morice (itudy area.			
ċ	channel cryoturbation	A channel characteris low gradient reach of Heaving, churning and Morice study area cha	related mov	ementa that result	from rece	ated francisc	and thoulan of -			•
N	nivation	(e.g. rCv-C) and plat	cau surfaces	(e.g. <u>Xv</u> _C). Rhu	orted cire	les, stone str	ipes, and earth	hummocks or	1 alpine/subal	pine slopes
N	solifluction	Erosion and enlargeme effects of meltwater, hollows" on alpine/su Slow downslone moveme	balpine slope	(Rhe-N) and on y	la the Ho plateau au	rice study are cfaces (e-g. H	ea characterized v/Rhu-N).	by circula	to elongate	"mow patch
2	solifluction periglacial	Slow downslope moveme that may be bedrock o on alpine/subalpine a	lopes (e.g.)	Cvb-S).	e study are	ea characteriz	ed by lobes, shee	ets or term	vely imperment aces of molif	ndle substrate lucted material
4	periglacial processes	Vsed where crysturbat	-oa, aivetión	. any BULIFLUCTION	Processes	are All evide	ar (e.g. <u>Hv</u> _Z). Rhu			
8. SOIL	DRAINAGE CLASSES				9. ON-SII	TE SYMBOLS				
Hap Symbol	Name_		Description		82-177	50 sau	ple site			

Soil holds little moisture after rain (e.g. coarse textured soils). When used for rock refers to the drainage o associated shallow unconsolidated aaterials. Also typical soil drainage for coarse textured fluvioglacial terraces. repidly drained No excess moisture for most of the year. Typical soil drainage for mid to upper till or colluvial alopes, till plains and fluvial or fluvioglacial Excess moisture for a short but signif-icant part of the year. Typical soil drainage for lower slopes, fans, or lowlands receiving meepage. Soil remains wet for a moderately long period of the year. When used in sub-alpine/alpine areas undergoing peri-glacial processes, likely includes areas of well, moderately well and poor soil drainage. Similarily, when used on floodplains, may include areas of well, moderately well and poor soil Well, moderately well and poor soil drainage.

Explanatory Notes

(r ~ w) designates soil drainage ranging from rapid to vell, whereas
 (w, p) designates that distinct well and poorly drained classes are
 constrained of a second provide rapid second s

Grannage. Napped by: L. Lacella, Surveys and Resource Mapping Branch, British ---p poorly drained Excess moisturs throughout the soil for Golumbia Hinistry of Environment, Kalowna, British Columbia. soil draineg on wetter portions of Date of fieldwork: September 13-19, 1983 floodplains and in water accumulating depressions on till plains. Date and scale of aerial photom: 1951, 1957 1:63 360 v very poorly drained
 Free water remains at or within 30 cm
 Publication date: 1936
 of the surface most of the year.
 of the surface most of the year.
 Typical soil drainage for organic mat Base drafted by: Cartography Unit, Surveys and Resource Mapping Branch,
 British Columbia Hinistry of Environment, Victoria.

Map drafted by: L. Lacelle

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