ECOSYSTEM CLASSIFICATION AND MAPPING OF THE SMITH/VENTS RIVER AREA

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1.0 INTRODUCTION

1.1 Background

The Smith/Vents project area is located in north central British Columbia. It is situtated from the Yukon-British Columbia border in the north to the headwaters of the Vents River in the south and Muncho Lake Provincial Park in the southeast. The Liard River is located in the central part of the project.

Slocan Forest Products Ltd. (Fort Nelson Woodlands Division) and Forest Renewal British Columbia (FRBC) provided funding for this project. Slocan contracted Norecol, Dames & Moore Ins. (NDM) to complete Terrestrial Ecosystem Mapping and wildlife interpretations for the project area. Norecol, Dames & Moore contracted ECO-concepts ecological services to complete the expanded legend and to map ecosystems in conjunction with NDM.

1.2 Objectives

The purpose of the project was to complete ecosystem mapping of the Smith/Vents project area at 1:50,000 scale. Ecosystem mapping and wildlife interpretations were requested by Slocan Forest Products Ltd. in order to assist in forest management planning and wildlife habitat management. Wildlife capability and suitability ratings and mapping were produced for moose, mule deer, elk, caribou, marten, fisher, grizzly bear and bay-breasted warbler. Species accounts, models and the wildlife ratings table are located in a separate report titled Smith/Vents TEM Wildlife Models and Ratings Table (Norecol, Dames & Moore, 1998).

1.3 Study Area

The Smith/Vents project area is located northwest of Fort Nelson, directly south of the Yukon border, in north central British Columbia. The project area encompasses several watershed including the Smith and Vents rivers, as well as the smaller Teeter Creek and Forcier Creek drainages that are located on the centre east and southeast sides of the map area.

The study area includes a portion of the following TRIM map sheets: 94M.018, .019, .020, .026, .027, .028, .029, .030, .035, .036, .037, .038, .039, .040, .045, .046, .047, .048, .049, .050, .056, .057, .058, .059, .060, .066, .067, .068, .069, .070, .076, .077, .078, .079, .080, .085, .086, .087, .088, .089, .090, .095, .096, .097, .098, .099, .100 and 94N.021, .031, .041.

1.4 Physiography and Geology

This summary has been prepared to support the findings of the bioterrain portion of the Smith/Vents ecosystem mapping project conducted in a portion of the Liard Plain near Coal River in north eastern British Columbia. The summary is designed to be used in conjunction with the expanded legend to the bioterrain map labels to lay the ground work for forest management interpretations.

1.4.1 Physiography

The Liard River cuts through the study area in an east-west direction, dividing it approximately in two. North of the river lies the Liard Plateau. The Smith River is the main water course on the plateau. It is fed by east-west running creeks draining the heights of land on either side of the river and discharges into the Liard River at the south end. The west study area boundary is a mountain range dividing the Smith River drainage from the Coal River drainage to the west. The east study area boundary is defined by the Grayling and Deer River drainages and the Mount Halkett mountain range. The study area expands over the south end of Mount Halkett range, to include the Teeter Creek drainage, which flows directly into the Liard River near Liard River Hot Springs.

The study area south of the river lies on the Rabbit Plateau. The western boundary is an upland along the Rabbit River, and the southern boundary is the divide between the Vents River drainage to the north and the Gundahoo River drainage to the south. The Terminal Range of the Rocky Mountains and the Alaska Highway form the southeastern boundary. The area is drained by the Vents River and a number of smaller tributary creeks, northward into the Liard River.

The study area is underlain by several geological formations, modified by glaciation and post-glacial erosion. The result is an area characterised by complex physiography and strong relief. Elevations range from approximately 442 m along the Liard River floodplain to more than 2,000 m at the height of land in the Terminal Range (Campbell Peak).

1.4.2 Bedrock Geology

Bedrock geology consists primarily of clastic and chemical-biogenic sedimentary rocks from the Silurian, Devonian and Cambro-Ordovician Periods. Older clastic sedimentary rocks and intrusions of Precambrian plutonic rocks also occur, but are relatively minor (GSC, 1963). The geological characteristics of these groups of rocks give rise to distinctly different lithology, and consequently weathered materials, in different regions of the study area.

The mountains in the Terminal Range are composed of thin-bedded phyllite, siltstone, shale and silty limestone rocks, with some sandstone south of Campbell Peak. The rocks are finely fractured and jointed, giving rise to abundant subangular fragments in glacial tills and colluvial deposits. They tend to weather to silty sands in the soil matrix.

Most of the remaining mountain ranges in the study area occur as more massive and widely jointed formations, dominated by fine grained, limestone and calcareous dolomite materials. Weathering gives rise to karsting in otherwise competent rock, large subrounded coarse fragments, and silty matrix textures. An exception are the dolomite rock formations lying south west and east of the Smith River airport. These rocks are in fault contact with quartzite-pebble and cobble conglomerate, sandstone and siltstone. As a result, the soil matrix in these localised areas tends to have silty sand to sandy textures containing pebble- and cobble-size coarse fragments.

The rocks in the Teeter Creek drainage and nearby south and east of the Liard River Hotsprings are composed of shale, slate argillite, siltstone and sandstone strata. These rocks tend to weather to subangular to angular coarse fragments and silty or sandy silt matrix textures.

Finally, in the south west of the study area is an upland of shale, slate, siltstone and sandstone, intruded by sills and dykes of gabbro and diorite. Quartzite-pebble and cobble conglomerate are also present. As a result, soils in this area tend to have sandy to silty sand textures, with gravel and cobble sized coarse fragments.

1.4.3 Glaciation and Post-glacial History

Most of the bedrock is covered by a mantle of quarternary sediments laid down during the Pleistocene Epoch. The most recent glaciation during this time (the Fraser Glaciation) occurred from approximately 30,000 to 19,000 years before present. At this time, the north eastern edge of the Cordilleran ice sheet advanced northeasterly from the Cassiar Mountains across the southern half of the study area, and then easterly across the northern half of the study area. It is likely that the entire area was glaciated, although there is some speculation that it may have been in contact with the Continental Sheet in the extreme northeast corner of the mapping area (Ryder, pers. comm.).

Glaciation deposited an extensive till cover on all but the steepest and highest slopes, as evidenced by glacial erratics on Mount Halkett (at the headwaters of Teeter Creek) at an elevation of about 1,550 m, and till veneers on the alpine slopes of Campbell Peak (around 2,000 m) and the 1,600 m high ridge south of Long Mountain Lake.

Glacially derived landforms such as drumlinoid ridges, eskers and kettles are abundant throughout the study area, particularly in the southwest portion along Fishing Creek and Sick Wife Creek, and in the far north east near Crooked Lake. Meltwater channels abound in the north half of the study area, between Coal River and the Smith River, and along the westerly flank of the Mount Halkett mountain range. The most spectacular of these is Shaw Creek (which drains in an easterly direction into Smith River), with deeply incised walls cutting a sinuous path through thinly bedded limestone bedrock overlain by thick till and kettled glaciofluvial deposits.

During a period of ice retreat, glacial ice remnants in the Liard, lower Coal River and lower Smith River created temporary ice-dammed lakes in the Smith and Coal Rivers, and in the lower reaches of the Vents River. Silt and clay glaciolacustrine sediments were deposited into these lakes, forming thin beds along the submerged valley bottoms. As the ice dam receded, the glacial lakes drained and glaciofluvial outwash materials were deposited over top and alongside of the glaciolacustrine deposits. Post-glacial fluvial activity cut down through these sediments, creating steep, unstable scarp slopes along the lower parts of the drainages and terraces above the scarps.

Other active post-glacial processes include the deposition of aeolian veneers throughout most of the study area, the formation of fluvial fans and debris flow deposits, rock fall failures and colluvial deposits, gully and karst erosion, permafrost processes and soil formation. Of unique importance in the study area are the influence of wildfires and biogenic processes such as flooding caused by beaver-dams.

1.4.4 Mapping Methods and Reliability

The bioterrain mapping involved inventorying soil types and existing geomorphological features, conditions and processes of the landscape according to several standard methods. Mapping followed the Terrain Classification System for British Columbia (TCSBC) (Howes and Kenk, 1997). Field checking conformed to Guidelines and Standards to Terrain Mapping in British Columbia (GSTM) (Province of British Columbia, 1996). Slope gradient and soil drainage was partially based on The Canadian System of Soil Classification (CSSC) (Agriculture Canada, 1987), as well as on the TCSBC criteria. CSSC standards were followed for soil survey. Data entry was completed using standard codes and protocols, as described in Interim (1996) Standards for Digital Terrain Mapping Data Capture in British Columbia (Resources Inventory Committee, 1996).

1.5 Description of Surficial Materials and Geomorphic Processes

An objective of this study was to identify the main surficial materials and geomorphic processes occurring in the study area. In this section, we discuss the origins and typical characteristics of surficial materials, where they occurred in the study area and the main kinds of geomorphic processes which have altered the landscape.

1.5.1 Surficial Materials

The main surficial materials found in the study area were till, colluvium, fluvial and aeolian deposits, glaciofluvial and glaciolacustrine sediments, organic deposits and bedrock.

Glacial Till (M)

Glacial till refers to materials deposited directly from glacier ice. Their characteristics are highly variable, reflecting their mode of deposition and the source of the glacial debris. Typically, glacial till ranges from poorly sorted and loose materials to massive and highly consolidated (compacted) deposits. The degree of consolidation varies with mode of deposition, the mineral composition and the particle-size class of the matrix. Clasts (particles >2 mm) are usually supported in a fine-grained matrix. Drainage in till is a function of texture, degree of consolidation and slope position.

Blankets or veneers of till (Mb or Mv) were encountered throughout the study area, occurring on almost all but the steepest slopes. Till deposits were reasonably thin at high elevations (for example on the mountain ridge north of Long Mountain Lake and around Campbell Peak) and thicker on lower slopes in the valley bottoms. At these latter locations, they were sometimes overlain by glaciofluvial and colluvial deposits, or reworked by fluvial action.

Till matrix textures in the study area varied from moderately coarse sands and small pebbles in the south west of the study area, to finer silty sand and muddy textures in the regions east and west of the Smith River, and near the Liard River Hotsprings.

Variations in textures derive from local bedrock geology, as discussed above. Consolidation varied from very loose and permeable to highly consolidated.

Till clasts were mostly subrounded and of sedimentary lithology, reflecting the dominance of these rocks in the study area.

Tills with sandy textures and on sloping terrain were usually well drained while finer-textured till materials, particularly on subdued landforms or at toe-slope positions, were moderately to imperfectly drained.

In the study area, glacial till materials are considered relatively stable, although failures were observed in steeply sloping areas and in materials with fine textures and/or impeded drainage.

Colluvium (C)

Colluvium is material that has moved downslope due to gravity. It typically occurred throughout the study area as a relatively thin covering of rock-derived material on or at the base of steep slopes, or as debris flows and scarp failures of till and other sediments deposited at the downslope ends of gullies.

Colluvium derived from rock was widely encountered in high elevation areas. In these situations, rockfall as a result of natural fractures in the bedrock typically produced mantles of angular debris on mountain sides and terraces (Cv, Cb, Ck, Cs), and cone-shaped deposits at the base of rocky outcrops (Cc). In addition to bedrock failure, freeze-thaw processes also contributed to the formation of colluvium in high elevation areas. Rubbly, angular colluvium was often found on south facing slopes of most narrow creek valleys where fluctuating temperature extremes likely contributed to bedrock shattering. Frost shattering was also noted in thinly-bedded limestone and dolomite rocks in most alpine areas, and in the uplands in the south west study area. This process frequently resulted in stone circles, steps and stripes on level and moderately sloping ridge tops, as well as colluvial debris on downslope positions.

These rock-derived materials usually consisted of poorly consolidated, sandy deposits with varying amounts of rubbly, angular clasts. Drainage is normally moderate to rapid (depending on the aspect and slope position), and deposits may be subject to ravelling when disturbed, particularly on steep slopes.

Colluvium as a result of debris flows were commonly observed along the upper Smith River as shallow-sloping, fan-shaped deposits (Cf). Presumably, these deposits were derived from upslope failures of till, glaciolacustrine, glaciofluvial or aeolian mantles. They tend to have fine textures, contain pebble size coarse fragments and are moderately consolidated. As a result, they are imperfectly to moderately drained and prone to erosion when exposed. When deposited over abrupt slope breaks, seepage can induce secondary failure. These materials are also particularly sensitive to degradation from roadbuilding, site preparation and/or wildfires.

Colluvium also occurred as scarp failures in valley bottoms and along river edges. A spectacular example of this is a large slump failure of bedded glaciofluvial and glaciolacustrine terrace sediments east of the Smith River airport undercut by a meander of the Smith River.

A succession of failures has periodically blocked the river, resulting in a complex of old stream channels, boggy depressions and an undulating complex of colluvial debris along the river edge.

Fluvial Deposits (F)

Fluvial deposits are sediments that have been transported by flowing water. They consist of stratified, loosely packed, non-cohesive, porous and highly permeable materials. Textures range from sands and gravels, to cobbles and boulders, and clasts tend to be rounded. Drainage is usually imperfect over shallow water tables to rapid.

On vegetated river bars and banks, spring floods often deposit fine silt cappings over the more coarse-textured base materials. This results in layers of buried soil horizons with reasonably high fertility due to the constant input of fine-textured mineral material and litter, good drainage and the nearby water supply.

Fluvial material in the study area was encountered on active flood plains ($F^{A}p$) in most reaches of the main rivers and creeks. Textures, clast size and shape, the degree of sorting and consolidation, and drainage were consistent with classic fluvial deposits.

They tend to be stable in the study area, except at bank edges where they are oversteepened and easily eroded, especially under flood conditions or where access roads cross scarp features.

A somewhat unique phenomenon frequently occurred in the upper reaches of tributary creeks to the main rivers. In these areas, beaver dams often resulted in large lakes being formed in what would normally be a shallow-gradient creek. As a result, valley floors were often invaded by lacustrine sediments and wetland vegetation, developing into fens and bogs with significant moose and waterfowl habitat importance. The reverse was also noted, in which former bogs and wetlands had drained due to the disappearance of beaver activity, resulting in remnant peaty and mucky soils on sites removed from flooding.

Glaciofluvial Deposits (F^{G})

Glaciofluvial deposits are sediments that have been transported by glacial meltwater. Typically, they consist of loosely packed sediments of variable textures and variable permeability, depending on the site and mode of deposition, and how far materials have been carried from the glacier source. Typically, they are less well stratified than fluvial deposits and may have water-restricting cemented or cohesive layers. These deposits are generally stable, particulary on terrace tops, so are considered suitable for a variety of land uses. However, they are prone to failure along scarp edges and in road cuts, particularly when interbedded with fine-textured glaciolacustrine materials.

Glaciofluvial deposits were widespread throughout the study area, concentrated along all river margins, in the upper and lower reaches of the Smith and Vents Rivers, and in meltwater channels along mountain margins. The Smith River airport is built on a large glaciofluvial terrace ($F^{G}t$), with steep scarp edges ($F^{G}ks$) on the north and east sides as a result of downcutting by Shaw Creek and the Smith River.

Several similarly thick terrace deposits also occur in benches and as remnant “islands” along the Liard River and at the mouth of the Smith, Coal and Vents Rivers. Another significant glaciofluvial feature is the large, kettled terraces and till plains at the junction of Shaw Creek and Smith River, and the esker topography at the upgradient ends of Fishing Lake, Long Mountain Lake and the Rogers Lakes.

Puzzling drumlinoid features of possible glaciofluvial origin were noted in the west Fishing Creek area. They consisted of sandy to pebbly-textured deposits laid out in parallel ridges in a south west to north east direction, and separated by small wetlands and shallow sloping, permafrost-controlled drainages consisting of peat over sandy silty soils. They were less than 20 m high and ranged in length between 200 and 500 m, with pine dominating the ridges and spruce dominating the drainages. This area is of interest due to the vast expanse, the vegetative pattern between the ridges and drainages, and the unusual and widely different textures of the two associated landforms.

Glaciolacustrine Deposits (L^G)

Glaciolacustrine deposits are sediments that have been deposited into a lake by glacial meltwater. They are usually fine-textured, cohesive deposits consisting of fine sands, silts and clays. They may also contain occasional amounts of coarse fragments introduced into the lake bottom sediments as dropstones released from melting icebergs or as a result of debris torrents entering the edges of the former glacier lakes.

These materials tend to be slowly permeable with imperfect to moderate drainage, perched water tables and surface seepage, depending on the nature and degree of consolidation of the deposit.

Glaciolacustrine sediments occurred in the study area primarily as a veneer of silty clay, moderate coarse fragment content material draped over till along the lower slopes of mountain ranges adjacent to the upper Smith River. Deposits commonly occur to an elevation of between 750 to 800 m. This mantle has eroded in places, resulting in several debris flows of glaciolacustrine material along the Smith River. In some of these instances, occasional steep scarp edges (L^Gks) were also noted (exposed by post-glacial river downcutting, valley-side scarps, gullies and road cuts) but were often too small to be mapped at the scale of the photographs.

These materials are highly erodible and unstable. If vegetation is removed and surface soils are disturbed, gullies form rapidly, and surface erosion and sediment delivery to streams will be very rapid. Deep glaciolacustrine deposits slump readily when undercut, and soil creep can be significant particularly in north-facing areas underlain by permafrost.

A large, deep glaciolacustrine terrace (L^Gt) was encountered in an unnamed tributary of the Coal River along the north west study area boundary. This deposit was somewhat unique as it was unusually deep for the study area and displayed a characteristic dendritic erosional pattern.

A somewhat unique and more recent feature occurred in the upper reaches of Hutchison Creek. Portions of the creek had disappeared, either due to the failure in beaver dams which had formerly retained water, or to sudden collapse of the dolomitic rock base allowing water to disappear to ground. These areas were now characterised by fine-textured lacustrine and fluvial deposits, vegetated with thick grasses and herbs, and bordered by willow thickets.

Aeolian Deposits (E)

Aeolian deposits occur as a result of winnowing and movement of loose, single-grained surficial materials through wind action. They are typically composed of silt and sand-sized particles, and are free of coarse fragments. They are well-drained, poorly consolidated and non-cohesive.

These deposits were found virtually throughout the study area, occurring as a surface veneer over all other surficial materials. They were identified by a distinctly different soil texture and colour from the underlying material and occurred as an undisturbed surface layer usually between 15 to 50 cm thick. They were not found in river valley bottoms nor in exposed positions on mountain ridges (where they had been presumably eroded away).

The aeolian deposits in the study area is relatively unique due to their ubiquitous presence and undisturbed nature. Under normal conditions windthrown, uprooted trees mix these veneers into the underlying materials; in the study area this does not seem to have occurred, presumably because tree cover is often destroyed by wildfire, before windthrow can have signficant impact.

These soils are a valuable growing medium, but will be highly prone to wind and surface erosion when exposed by intense fire, clearcut logging or other dramatic disturbance.

Organic Deposits (O)

Organic materials occur under waterlogged conditions and cold ground temperatures, where the rate of vegetative accumulation exceeds the rate of decomposition. Orgranic accumulations typically occurred as peat or muck deposits throughout the study area, in valley floors and on north-facing slopes in narrow valleys.

Peat deposits were mainly fibric and mesic textured, although in some valley floor positions in bogs they consisted of well-developed humic materials. By their nature and slope position, they have low coarse fragment content and imperfect to very poor drainage.

Muck soils were prevalent in shallow lakes created by beaver dams, particularly in the northwest portion of the study area and around Grant Lake. In north aspects, these areas tended to accumulate significant vegetative debris, resulting in peat plateaus and hummocky ground covered in thick, insulating layers of moss. Stone pits due to differential frost heaving and sorting were occasionally evident in these areas as well.

Sloping peat bogs were encountered in the upper reaches of the Vents River and in Teeter Creek, presumably occurring as a result of the underlying permafrost. These materials were covered with a thick insulating layer of moss and lichen, and often contained relatively high angular coarse fragment content from frost shattering and heaving, and rockfall sources.

In one location, game trails had disturbed the moss cover, resulting in slumping failures due to the thawing of the underlying permafrost.

Site disturbance in peaty or mucky ground, particularly in areas with permafrost, should be minimised due to the risk of failures, hydrologic damage and their ecological importance.

Bedrock (R)

Bedrock is mapped where it outcrops at the surface or lies very close (less than 1m to surface). It is found predominantly in steep terrain and at higher elevations (Rk, Rks, Rs).

Bedrock is assumed to control the larger scale topography under colluvial and till deposits. These deposits characteristically overlie the bedrock either as a thin veneer (Cv, Mv), as a thicker blanket (Mb, Cb), or as a mantle of variable thickness (Cw, Mw). Where bedrock is exposed through a veneer or blanket of overlying material, it will be included in the terrain label as a stratigraphic unit or as a percentage of all surficial materials encountered.

1.5.2 Active Geomorphological Processes

Active geomorphological processes describe the different processes which act on surficial materials to either transport them downslope, or to alter them physically in place. Many of these processes give rise to distinctive surficial materials and landforms, such as colluvial deposits and gullied terrain.

In the following sections, we discuss the main processes which were observed in the study area and which pertain to terrain stability issues.

Rapid Mass Movements (-R", -R)

Rapid mass movements are the rapid downslope movement of surficial materials, driven by gravity and resulting in gullied terrain, slope failures, fan or lobed deposits and rockfall.

All polygons affected by rapid mass movement are either "initiation" or "transport/deposition" zones. Initiation zones (-R") usually occur on unstable slopes and are at risk of further destabilisation by logging activities. These areas are considered unstable. Transport/deposition zones (-R) have rapid mass movement passing through them with subsequent deposition of debris along slope breaks. This kind of rapid mass movement may be hazardous to people and equipment, but logging activities in these zones are unlikely to aggravate the problem.

Failing (-F, -F") (slow mass movement)

Slow mass movements are the slow downslope movement of surficial materials, driven by gravity, as evidenced by tension cracks, irregular ground surface, slumping surfaces, and distorted tree growth. Because -F" was only mapped where it was particularly rapid, polygons mapped with this geomorphological process usually have important instability problems.

Soil creep was also noted on many north-facing slopes and in narrow north-south valleys, where freeze-thaw cycles on permafrost resulted in severely tilted tree growth, and changes in vegetation from spruce forests to shrubby thickets. At alpine areas, solifluction also contributed significantly to soil creep.

Erosional Processes (-V, -K)

Erosional processes in the study area include gullying (-V) and karsting (-K). Gullies are formed when surface materials are eroded by flowing water, and by debris slides and flows in unconsolidated materials. Karsting is caused by the dissolution of carbonates and other soluble rocks, and the occurrence of sinkholes, caves and depressions as a result of below ground weathering.

Gullying was common on steep slopes throughout the study area. Surficial materials were often eroded down to the underlying bedrock, and gully sidewalls were often prone to secondary slope failure, particularly below deforested areas or on very steeply sloping ground.

Karst processes were common in all mountain areas composed of dolomite and limestone rocks (which were everywhere except in the southwest corner of the study area). These areas are significant in terms of being the source of fresh water for underground streams, and as wildlife habitat. They may also be prone to instability and failure when roadbuilding.

Snow Avalanches (-A, -Am, -Af, -Aw)

Snow avalanches usually initiate on steep slopes above the tree line, and can travel through mature forests. Avalanche tracks are clearly indicated by lack of mature vegetation in areas where avalanches occur each season. Avalanche hazards need to be considered when planning winter logging operations.

Avalanches most commonly occurred on the north slopes of the higher mountain ranges, at elevations above 1,400 m.

Fluvial Processes (-J, -M, -I)

Fluvial process symbols are added to terrain symbols for floodplains and fans. Most of the rivers were mapped as having anastamosing (-J), irregularly sinuous (-I) or meandering (-M) channels. The anastamosing channel pattern has multiple channels that split around forested islands. Islands are often subjected to periodic flooding and the deposition of overbank silts. This was typical of the Liard floodplain. Rivers with meandering channels occur as a regular series of bends over very low gradients, often containing a relatively fine sediment load and existing in association with imperfectly or poorly drained floodplains and boggy areas. The upper Smith River reaches consist of meandering channels. Floodplains with irregularly sinuous channels are typified by a single, clearly defined main channel, with old back channels, minor side channels, and gravel and sand bars. The lower reaches of the Vents River exhibited these processes.

Periglacial and Deglacial Processes (-C, -N, -S, -Z, -X, -E, -H)

Periglacial and deglacial processes refer to processes which occur in cold climates, or in periods of glacial retreat and wasting.

Cold-climate processes relate to permafrost and frost-related disturbance. They were found throughout the study area, particularly in alpine and subalpine areas, in narrow valleys and on north aspects. Cryoturbation (-C) is the movement of surficial debris through frost heaving, churning and general freeze-thaw processes. The process results in stone polygons, stripping, terraces, and pits, sand wedges, and other patterned ground phenomena. It was noted at high elevation throughout the study area, on northfacing slopes and in narrow or exposed valleys. Nivation (-N) occurs along the margin of snow patches which dwell in hollows and on north aspects. It results in the movement of the underlying material by frost shattering and heaving, meltwater erosion and soil creep. Solifluction (-S) is a more significant form of soil creep, occuring as movement of saturated, unfrozen overburden across a frozen or bedrock surface. Nivation and solifluction were only noted in alpine areas near Campbell Peak.

Collectively, these terms have been mapped as general periglacial processes using the map symbol “-Z”. In some locations, the general map symbol “-X” was used to indicate processes controlled by permafrost, such as slump flow failures of sloping bogs occurring as a result permafrost thaw.

Deglacial processes occur as a result of melting ice and meltwater erosion during deglaciation. They include kettled topography (-K) and meltwater channels (-M). Kettled topography occurs as depressions in surficial materials reuslting from the metling of buried or partially buried. This process was prevalent in the upper Smith River area. Meltwater channels are formed when meltwater travels alongside, beneath or in front of a glacier ice. These were found throughout the study area.

1.6 Soil Orders and Distribution

Five of the 10 soil orders found in Canada are present in the study area.

1.6.1 Regosolic Order

Regosols are weakly developed and the youngest soils in the pedogenic weathering sequence. They lack distinct genetic horizons and occur in recent alluvium and colluvial deposits, and under dry, cold conditions. They are characterised by shallow depths and thin B horizons, with or without an organically enriched surface horizon.

In the study area, they are found under three general conditons:

1. Orthic or Cumulic (somtimes with gleyed subsurface horizons) Regosols developed on silty and fine-sandy alluvial overbank deposits on imperfectly to well drained river floodplains;

2. Orthic Humic Regosols in sandy to sandy loam veneers in cold, imperfectly to well drained alpine areas; and

3. Orthic or Cumulic (often with well humified surface horizons) Regosols on well drained, failing rocky colluvial slopes.

1.6.2 Brunisolic Order

Brunisols are sufficiently developed to exclude them from the Regosolic Order, but still lack the horizon development to be included in other orders. They have brownish-coloured Bm horizons, or weakly expressed accumulations of clay (Btj) or iron and aluminum (Bfj). Eluviated surface horizons (Ae) and weakly gleyed subsurface horizons (Bgj or Cg) may also be present.

Brunisols are the dominant soil order in the study area, found from low to high elevation in a variety of landscapes, aspects, and vegetative communities. They are moderately to well drained. The eluviated Ae surface horizon was rarely seen. Three subgroups were identified.

1. Eutric Brunisols are generally found on medium to coarse textured calcareous outwash deposits, and on fine to moderate textured colluvium and till deposits. Parent materials usually have reasonably high coarse fragment content derived from limestone bedrock. They are well drained. They were often found in severely burned areas, probably because well drained soils tend to support the pine and aspen stands prone to wildfire;

2. Dystric Brunisols are found on outwash materials with very fine sandy loam to loamy sand textures and variable coarse fragment content in well- to rapidly-drained environments; and

3. Sombric Brunisols were identified in similar outwash environments, but in imperfectly drained, wet environments. As a result deep organic Ah horizons had developed, excluding they from the Dystric Subgroup. Only three Sombric Brunisols were mapped in the study area.

1.6.3 Luvisolic Order

Luvisols generally have light-coloured eluvial surface horizons (Ae) and clay-enriched subsurface horizons (Bt). They characteristically develop in forested environments under imperfectly- to well-drained conditions, in parent materials with a high base saturation and clay content. As a result, they tend to be fertile. The presence of clay soil textures, clay skins in subsurface horizons, and/or platey or blocky structures help to identify them.

The Luvisolic Order is nearly as widespread in the study area as the Brunisolic Order. They rarely have surface Ah horizons, are found at low to mid-elevations on all aspects, and are generally developed from lacustrine or other fine- to medium-textured parent materials. Mean annual temperatures are likely too low to support the development of the Grey Brown Great Group, so only Grey Luvisol were found in the study area.

Two main Subgroups were identified:

1. Orthic Grey Luvisols tend to develop in imperfect to moderatley drained parent materials consisting of glaciolacustrine veneers over till, colluvium and outwash. Horizons are generally light coloured, with moderately blocky structures at depth. Lower horizons have clay loam or clay soil textures. These soils were often found in association with ponded water; and

2. Brunisolic Grey Luvisols occur in similar parent materials. However, these soils have coarser textures (loams to clay loams) and are better drained than the Orthic Subgroup. They are therefore usually found in well-drained sites, but also sometimes found on scarp faces, in kettled topography and along drainages.

Two other Subgroups were also identified, but were rare. Intense fire disturbance in one area near Niloil Lake had created a weakly podzolized, loamy sand surface horizon, with a blocky subsurface horizon. This soil was identified as a Podzolic Grey Luvisol. A Dark Grey Luvisol was identified in a lacustrine veneer on the edge of a lake. Organic accumulation had created a characteristic deep Ah surface horizon for this Subgroup.

1.6.4 Crysolic Order

Cryosols are formed in either mineral or organic materials with permafrost close to the soil surface. They are widespread throughout the study area, in discontinuous locations mainly associated with exposed climatic conditions, alpine terrain, or north aspects in narrow valleys. Cryoturbation is common, as indicated by distorted tree growth, disrupted soil horizons, and patterned ground such as stone pits, stripes, and circles, peat plateuas and earth hummocks. They were often difficult to type properly due to the difficulty in digging through 1m of rubbly ground to identify the presence of permafrost.

Three main Great Groups were identified:

1. Organic Cryosols are most prevalent of the Cryosolic Order. They include Humic Organic Cryosols (associated with peat plateaus, poor drainage and sites in narrow, low-gradient or exposed valley bottoms), Mesic Organic Cryosols (in similar association) and Fibric Organic Crysols (usually found in extremely cold, submerged wetlands);

2. Turbic Cryosols occur in muddy, rubbly colluvium over rock at mid to high elevations and/or in north aspects. They are indicated by strong patterned ground formations and moderate drainage conditions. Soil formation is generally limited and horizons are frequently disrupted, and contain angular fragments; and

3. Static Cryosols occur in similar locations as Turbic Cryosols do, but with less evidence of turbation and more often at midslope positions. Water delivered from upslope often results in imperfect drainage in these soils, contributing to the formation of the Gleysolic Subgroup.

1.6.5 Organic Order

Soils of the Organic order are composed of materials with surface horizons containing at least 17% organic matter, as indicated by dark colours, high vegetative content, or greasy, non-gritty/sandy textures. The organic layers must be greater than 40 to 60 cm in depth, and may contain lenses of mineral material. They include peat, muck or bog soils.

They occur throughout the study area, in depressions and level areas under saturated conditions, so are poor to very poorly drained. Three Great Groups were identified:

1. Fibrisols are found in very poorly drained wetlands with water close to the surface most of the year, often in very cold water. They occur primarily in high to mid-elevation tributary creeks, with low-gradient flows, often in association with beaver activity;

2. Mesisols generally occur in poor to very poorly drained sphagnum bogs at mid elevations in low-gradient reaches of tributary creeks; and

3. Humisols occur in imperfectly to poorly drained sites, usually at low elevation and sometimes in association with backchannels and ponded wetlands on fluvial terraces. In these situations they sometimes contain lenses of silt and fine sands.

Upland organic soils were occasionally identified in the study area, with deep organic horizons developing in parent materials on sloping, imperfectly drained ground with north aspects. However, they occur due to the presence of permafrost, which impedes soil drainage and slows the rate of organic matter decomposition. In these situations, soils were classified as Organic Cryosols rather than Organic soils.

1.7 Wildlife

The Smith River and Vents River TEM project area supports a varied fauna with species of provincial and regional significance. Seven species of mammals and one species of bird were the focus of the wildlife interpretation component of the TEM project.

The varied terrain associated with the Liard River and its major tributaries afford riparian habitat zones that are utilized year-round by moose (*Alces alces andersoni*); this species also moves into higher elevations during the summer and well into the fall and early winter. Caribou (*Rangifer tarandus caribou*) range over much of the study area, being most common in the Vents River drainage. Elk (*Cervus elaphus nelsoni*) and mule deer (*Odocoileus hemionus hemionus*) occur in smaller numbers in the Liard River valley. Grizzly bear (*Ursus arctos horribilis)* occur in the Liard River valley and throughout much of the Vents River drainage; they are, however, scarcer in the Smith River drainage. Marten (*Martes americana)* occur in much of the forested habitats throughout the lower elevations of the project area while fisher (*Martes pennanti)* are more limited in distribution, favouring the mature mixed forests such as those found in the Liard River valley.

One songbird species was included in the interpretation for habitat suitability. The bay-breasted warbler (*Dendroica castanea)* is a neo-tropical migrant that occurs in the lower elevations of the project area only during the spring and summer, being associated primarily with mature forests in the Liard River valley. Habitat suitability was assessed for all eight species on a seasonal basis and for life requisites.

1.8 Vegetation

Four Biogeoclimatic units (BGC) occur within the project area. These are the Boreal White and Black Spruce, dry cool subzone (BWBSdk2), Spruce-Willow-Birch Zone, moist cool subzone (SWBmk), Spruce-Willow-Birch Zone, moist cool scrub subzone (SWBmks) and Alpine Tundra.

The only BCG unit described by the MOF is the BWBSdk2 (Banner et al., 1993). The most extensive of these BGC units is the BWBSdk2. This zone occupies the lower elevations up to 1,020 m on cool aspects and up to 1,155 m on warm aspects. This unit ecologically represents a northern continental climate. It has long, very cold winters and short growing seasons. Frequent outbreaks of Arctic air masses are common (Meidinger and Pojar, 1991). Lodgepole pine, trembling aspen, white spruce, black spruce, balsam poplar, tamarck and common paper birch are the major tree species in the forested sections of the BWBS. Overall the forests are in a seral stage, with lodgepole pine being the dominant tree species present. Zonal sites are dominated by lodgepole pine with a poorly developed shrub and herb layer composed mainly of soopolallie, high-bush cranberry, Labrador tea, twinflower and bunchberry. The moss layer is very well developed, consisting of step moss, red-stemmed feathermosses and knight’s plume.

The Spruce-Willow-Birch zone is the subalpine zone above the BWBS (Meidinger and Pojar, 1991). This zone occupies the elevations between 1,020 m to 1,380 m on cool aspects and on warm aspects from 1,155 m to 1,440 m. The climate of the Spruce-Willow-Birch zone represents an interior subalpine type. Although long term-climatic data is sparse, generally winters are long and cold, summers are brief and cool (Meidinger and Pojar, 1991). Climax forests are composed of white spruce and subalpine fir. Generally lodgepole pine is the prevalent seral species present. Subalpine fir dominates at higher elevations and in particular on cool aspects. Zonal sites are dominated by lodgepole pine with lessor amounts of white spruce and subalpine fir. The understorey is composed of scrub birch, willows, Labrador tea, crowberry and bunchberry. A moderately dense moss layer of red-stemmed feathermoss, step moss and knight’s plume occurs.

The Spruce-Willow-Birch, scrub zone occurs above the SWBmk zone. Elevationally this zone occurs on cool aspects between 1380 m to 1,584 m and on warm aspects between 1,440 m to 1,750 m. Meidinger and Pojar did initially not describe this zone. Even though climatic data is not available for this zone because it occurs above the SWBmk, several assumptions can be stated. The winters will be longer and colder, and the summers are shorter and colder, than the SWBmk. This zone consists of lower elevation forests in the parkland and the krummholtz. The vegetation consists of forested sites on both the cool and warm aspects and a series of high elevation herb and shrub dominated communities.

Forested units on a cool aspect represent an open canopy dominated by subalpine fir. The sparse understorey is composed of Sitka valerian and red-stemmed feathermoss and step moss.

The Alpine Tundra occurs above the SWBmks at elevations ranging from 1,450 m on cool aspects to 1,750 m on the warm aspects. This zone occupies the least area in the project area.

The harsh alpine climate is cold, windy and snowy and characterized by low growing season temperatures and a very short frost -free period (Meidinger and Pojar, 1991). By definition, the alpine zone is treeless. Generally, the vegetation consists of low dwarf woody plants and herbs, which occur on wind blown sites with a high percentage of rocks. The dominant plants are netted willow with the herbs entire-leaved mountain-avens, woolly lousewort, blackish locoweed, moss campion, alpine bluegrass, ragged snow and a low lichen cover.

2.0 ECOSYSTEM UNITS CLASSIFICATION AND SYMBOLS

2.1 Classification System

Three levels of classification are used in mapping habitats. These include Ecoregions, Biogeoclimatic Units (subzones and variants) and Ecosystem Units.

Ecoregion classification system is used to stratify B.C.'s terrestrial and marine ecosystems complexity into discrete geographical units at five different levels. The two highest levels, Ecodomains and Ecodivisions, are broad and place B.C. globally. The three lowest levels, Ecoprovinces, Ecoregions and Ecosections are progressively more detailed and narrow in scope, and relate segments of the province to one another. They describe areas of similar climate, physiography, oceanography, hydrology, vegetation and wildlife potential (Demarchi, 1993).

Biogeoglimatic Subzones are areas over which a distinct climatic climax community or zonal ecosystem occurs. A subzone consists of unique sequences of geographically related ecosystems.

Biogeoclimatic Variants are a subdivision of a subzone and represent a further reduction in the climatic and geographic variability with a subzone. These climatic differences result in corresponding differences in vegetation, soil and ecosystem productivity.

Ecosystem Units incorporate the site series of BEC in addition to physical attributes and structural stages. Generally site series are relatively homogenous with regard to soils, surficial materials, topographic position, topoclimate and trends of secondary succession.

Site Modifiers are used to refine site series into more specific ecosystem units based on distinguishing site, soil and terrain characteristics (Ecosystem Working Group, 1995).

Structural Stages describe the dominant stand appearance for the ecosystem unit (Ecosystem Working Group, 1995). Five ecoregions, four biogeoclimatic units, 48 ecosystem units (each of which may be subdivided into structural stages), and eight sparsely vegetated and anthropogenic units are present in the study area.

2.2 Ecoregions and Biogeoclimatic Units Description

2.2.1 Ecosections

The study area occurs within four Ecoregions comprising five Ecosections. The Hyland Highland Ecoregion contains the Hyland Highland Ecosection, the Liard Basin Ecoregion contains the Liard Plain Ecosection, the Northern Canadian Rocky Mountains Ecoregion contains the Eastern Muskwa Ranges and the Eastern Muskwa Foothills Ecosections, and the Boreal Mountains and Plateaus Ecoregion contains the Kechika Mountains Ecosection (Demarchi, 1995).

The following is a description of the five ecosections (Demarchi, 1996; Demarchi et al 1990):

Table 2.1 Ecosections in the Smith/Vents Project Area

EMR	Eastern Muskwa Ranges	High, rugged mountains with more snowfall than the foothills to the east.
HYH	Hyland Highlands	The Hyland Highland Ecosection is an area of rolling upland that extends from the Liard River canyon into the Yukon and Northwest Territories. It provides a low barrier between the Interior Plains to the east and the Canadian Cordillera to the west.
KEM	Kechika Mountains	High mountains with low, wide valleys in the rainshadow of the Cassiar Ranges to the west.
LIP	Liard Plain	Broad, rolling inter-mountain plain with a cold, sub-arctic climate.
MUF	Muskwa Foothills	Subdued mountains which are isolated by wide valleys, in the rain shadow of the Rocky Mountains to the west. Commonly under the influence of cold Arctic air in the winter.

2.2.2 Biogeoclimatic Units

Four biogeoclimatic units occur within the study area. These are BWBSdk2, SWBmk, SWBmks and AT.

A description of the biogeoclimatic units follows:

Table 2.2 Biogeoclimatic Units the Smith/Vents Project Area

AT	Alpine Tundra	Elevation: N 1450 -; S 1615 - Alpine tundra occurs on the higher mountains in the study area. The AT zone is treeless and is dominated by herb communities.
BWBSdk2	Liard Dry Cool Boreal White and Black Spruce	Elevation: N - 1020; S - 1155 This variant is characterized by having forests of lodgepole pine and white spruce with minor amounts of AT and black spruce. Soopolallie, prickly rose, green alder, bunchberry twinberry and ligonberry are understorey species. Wetlands are common.
SWBmk	Moist Cool Spruce-Willow-Birch	Elevation: N 1020 - 1380; S 1155 - 1440 This unit is characterized by having forests of white spruce and subalpine fir. At lower elevations, white spruce dominates with variable amounts of lodgpole pine and trembling aspen. At higher elevations, subalpine fir dominates. Scrub birch, willows, Labrador tea, ligonberry, bunchberry, crowberry and Altai fescue are common understorey species.
SWBmks	Moist Cool Scrub Spruce-Willow-Birch	Elevation: N 1380 - 1584; S 1440 - 1750 Upper elevations in the SWB are mapped in the scrub subzone. The forests are typically open and dominated by subalpine with scrub birch and willows. In areas of cold air ponding, a non-forested mosaic of shrubfields, fens and grasslands occur.

2.2.3 Ecosection and Biogeoclimatic Map Labels

The diagram (Figure 2.1) depicts the map label which shows the ecosection and biogeoclimatic units.

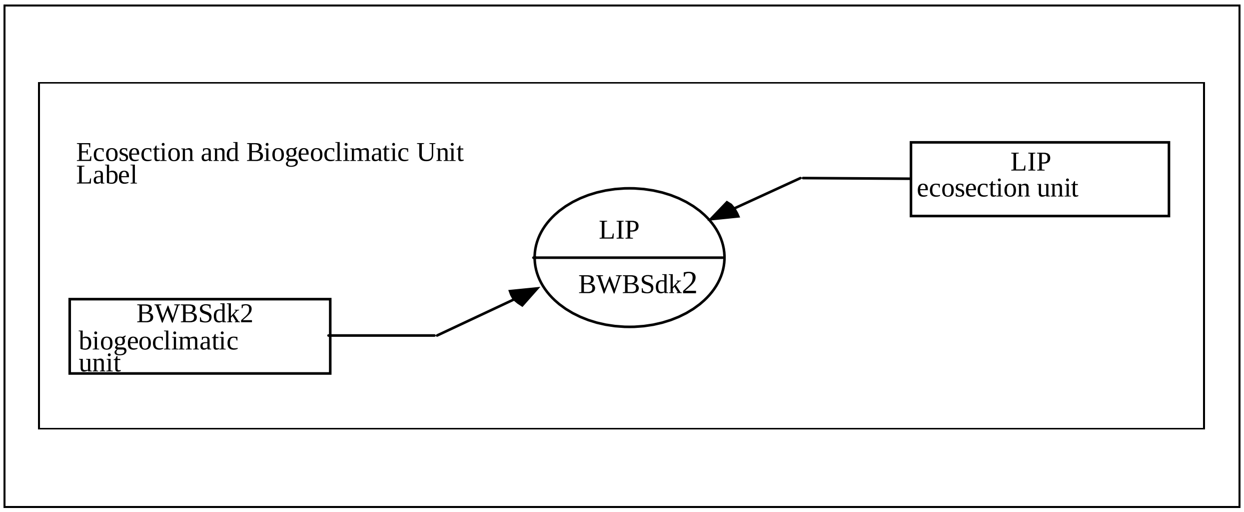

Figure 2.1 Symbols for Ecosection and Biogeoclimatic Units

2.3 Ecosystem Unit Methodology

The ecosystem unit mapping followed the methodology outlined by the Ecosystem Working Group (1995). The map symbol is comprised of a two-letter unit code which correlates to the Ministry of Forests site series. The two letter code is followed by site modifiers, then a structural stage symbol. If a seral community has been described it follows the structural stage symbol. Seral associations are represented on the ecosystem unit label with a two-letter lower case code.

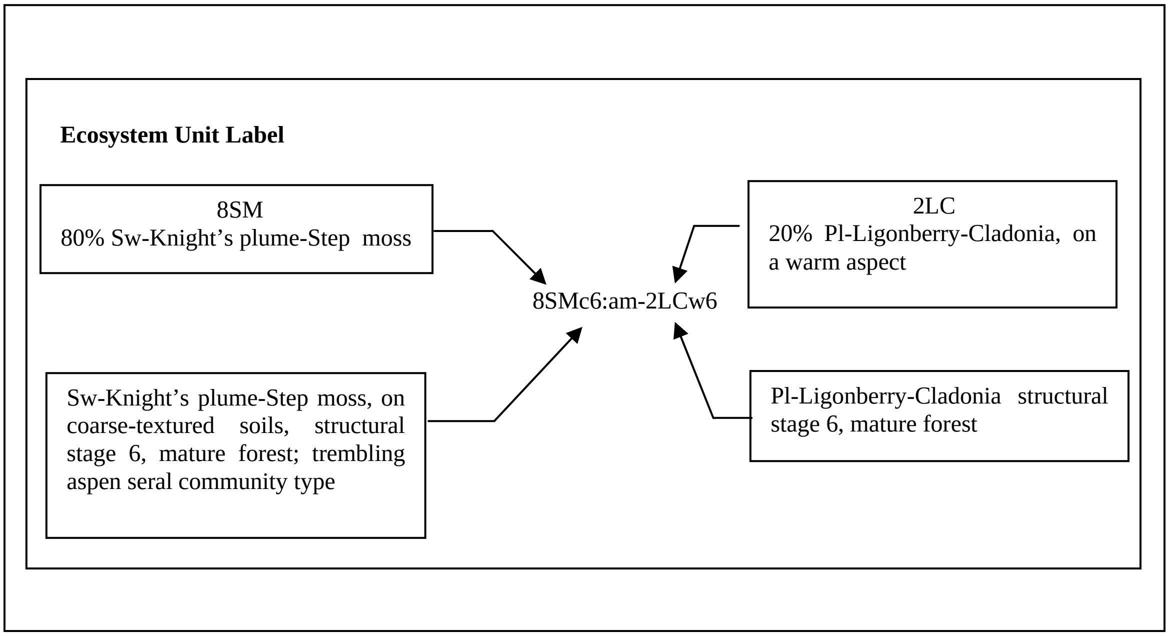

Figure 2.2 Symbology for Ecosystem Unit Label

Site modifiers are used for mapping on sites that are not typical. For this project, site modifiers represent the environmental attributes associated with the site series in order to correlate with the previous published reports. Potential site modifiers used were as follows:

Table 2.3 Site Modifiers for Atypical Conditions

Symbol	Criteria
a	active floodplain
c	coarse-textured soils (includes sandy loam, loamy sand, fine matrix with over 70% coarse fragments and medium matrix with over 35% course fragments)
d	deep soil (greater than 100 cm to bedrock)
f	fine-textured soils (heavy clay, silty clay, clay and sandy clay textures)
g	gullying occurring
h	hummocky terrain
j	gentle to moderate slope (less than 25% slope)
k	Cool, northerly or easterly aspect (285-135 degrees, slopes >25%)
m	medium-textured soils (includes silty clay loam, clay loam, silt, silt loam, loam, and sandy clay loam textures)
n	fan or cone
p	peaty material on surface
r	ridge top
s	shallow soils (20-100 cm to bedrock)
t	terrace
v	very shallow soil (less than 20 cm to bedrock)
w	Warm, southerly or westerly aspect (135-285 degrees, slopes >25%)
z	very steep, slope greater than 70%

Structural stages describe the current successional stage of the ecosystem unit. Each ecosystem unit, including non-forested units, is mapped with a structural stage. Structural stages that are split into an ‘a’ and ‘b’ category are used only on edaphic sites.

The structural stages are as follows:

Table 2.4 Structural Stages and Codes

Symbol	Structural Stage	Age Criteria and Description
1	Sparse/bryoid	Initial stages of primary and secondary succession; total shrubs and herb cover less than 20%.
1a	Non-vegetated	Less than 5% vegetation cover. (Less than 20 years.)
1b	Sparse	Less than 10% vegetation cover. (Less than 20 years.)
2	Herb	Early successional stage disclimax or climax, dominated by herbaceous vegetation (tree cover < 10%, herb cover < 25% or > = 33% of total cover). (Less than 20 years.)
3	Shrub/Herb	Early successional stage disclimax or climax communities dominated by shrub vegetation < 10 m in height (tree cover < 10%, herb cover < 25% or > = 33% of total cover). Used for communities that will be forested at climax. (Less than 20 years.)
3a	Low Shrub	Early successional stage disclimax or climax communities dominated by shrub cover < 2 m in height (tree cover < 10%, herb cover < 25% or > = 33% of total cover). (Less than 20 years.)
3b	Tall Shrub	Early successional stage disclimax or climax, communities dominated by shrub cover 2-10 m in height (tree cover <10%, herb cover <25% or = 33% of total cover). (Less than 20 years.)
4	Pole/Sapling	Trees > 10 m tall that have topped the shrub and herb layers. Stands are typically dense. (Less than 20-40 years.)
5	Young Forest	Self-thinning is usually evident and the forest canopy has begun differentiation into distinct layers. (40-80 years).
6	Mature Forest	Trees established after the last disturbance have matured and a second cycle of shade tolerant trees may have established. (80 to 140 years, BWBSdk2; 80-250 years for the SWBmk, SWBmks.)
7	Old Forest	Old structurally complex stands. (80-140 years, BWBSdk2; 80-250 years for the SWBmk, SWBmks.)

2.4 Ecosystem Units

The following tables list the ecosystem units for the Smith Vents project area.

Table 2.5 Ecosystem Units

Subzone	Symbol	Site Series	Site Series Name [1]	Typical Situation	Mapped Site Modifiers
AT	AW	00	Entire-leaved white mountain-avens - Netted Willow	crest slope position; shallow soils over bedrock, coarse-textured soils	j, w, z
AT	HW	00	Netted Willow - Four - angled mountain heather	significant slope[2], coal aspect; shallow soil over bedrock, coarse-textured soils	z
BWBSdk2	AK	81	At - Common juniper - Kinnikinnick, grassland scrub	significant slope[2], warm aspect; shallow soil over bedrock, coarse-textured soils	g, k, r, v, z
BWBSdk2	BF	04	Sb - labrador tea - Feathermoss	gentle slope, cool sites; deep medium-textured soil	c, f, g, h, k, n, p, s, t
BWBSdk2	BL	03	Sb - Lingonberry - Knight's plume	level, deep, coarse-textured soils of glaciofluvial material	f, g, h, k, m, n, r, s, t, v, w, z
BWBSdk2	BT	07	Sb - Labrador tea - Sphagnum	forested bog	t
BWBSdk2	BW	00	Beaked sedge - Water sedge	fen, level sites; organic wetland	
BWBSdk2	DM	00	Deer sedge - Sausage moss	fen;organic wetland, around lake margins	
BWBSdk2	FA	00	Scrub-birch - Altai fescue	gentle slope; deep, coarse-textured soils (well drained)	
BWBSdk2	GS	00	Hair bentgrass - Silverweed - Bluejoint	gentle slopes, deep coarse-textured soils	
BWBSdk2	LC	02	Pl - Lingonberry - Cladonia	gentle slope; crest position, shallow soil over bedrock	d, g, h, k, v, w, z
BWBSdk2	MS	00	Shore sedge - Hook moss	fen, level sites; deep organic wetland	
BWBSdk2	PH	00	Acb - Mountain alder - Common horsetail	level fluvial active floodplain; deep coarse-textured soil	n
BWBSdk2	SG	00	Sw - Willow - Glow moss	Shrubby fen, level sites; deep organic soils	a
BWBSdk2	SH	06	Sw - Currant - Horsetail	level sites, highwater table; coarse-textured soils	a, m, n, p, t

Table 2.5 Ecosystem Units

Subzone	Symbol	Site Series	Site Series Name [1]	Typical Situation	Mapped Site Modifiers
BWBSdk2	SM	01	Sw - Knight's plume - Step moss	gentle slope; deep medium-textured soils	c, f, g, h, k, n, r, s, t, w, z
BWBSdk2	SW	05	Sw - Wildrye - Toad-flax	gentle slopes; deep medium-textured soils	c, f, g, h, k, n, s, t, w
BWBSdk2	TM	08	Lt - Glow moss	forested swamp, poorly drained organic materials	
BWBSdk2	WM	00	Pacific willow - Mackenzie willow	level sites; deep, coarse-textured soils; tall willow thicket on fluvial materials	a, n, p
SWBmk	AS	00	Entire-laved white mountain avens - Sedges	bedrock, coarse-textured; dry sites, sparsely vegetated in wind swept positions	j, k, m, v, w
SWBmk	HS	00	Mountain hairgrass - Sedge	marsh; deep coarse-textured soils on active fluvial materials	
SWBmk	MB	00	Mountain avens - Bog birch; herb dominated community	significant slope[2], cool aspect; shallow soils over bedrock, coarse-textured soils; herb dominated community	m
SWBmk	PL	02	Pl - Lichen	significant slope[2], warm aspect; shallow soil over bedrock	h, j, k, r, v, z
SWBmk	SB	01	Sw - Bog birch	gentle slope; deep, medium-textured soils	c, g, h, k, n, r, s, w
SWBmk	SC	06	Sw - Crowberry	significant slope[2], cool aspect; deep, medium-textured soils	c, g, h, j, n, s, v, z
SWBmk	SF	00	Sedge fen	fen; deep organic wetland	
SWBmk	SH	08	Sw - Horsetail	gentle slopes; deep coarse-textured soils	n, p, s
SWBmk	SK	03	Sw - Kinnikinnick	significant slope[2], warm aspect; deep, medium-textured soils	c, g, h, j, r, s, z
SWBmk	SL	05	Sw - Labrador tea	significant slope[2], cool aspect; deep, medium-textured soils	c, g, h, j, r, s, v, z
SWBmk	SS	07	Sw - Scrub birch	gentle slope; deep, medium-textured soils	c, g, n, s

Table 2.5 Ecosystem Units

Subzone	Symbol	Site Series	Site Series Name [1]	Typical Situation	Mapped Site Modifiers
SWBmk	SW	04	Sw - Willow	gentle slope; deep, medium-textured soils	c, g, h, k, n, r, s, v, w
SWBmk	WB	00	Willow - Bluejoint	level sites; deep coarse-textured soils	a, n, s, t
SWBmk	WH	00	Willow - Common horsetail	gentle slopes; deep, coarse-textured soils	m, s
SWBmk	WS	00	Willow - Sedge wetland	fen; deep organic wetland	
SWBmks	AS	00	Entire-leaved white mountain-avens - Sedges	crest slope positions; shallow soils over bedrock, coarse-textured; dry sites, sparsely vegetated in wind swept positions	j, k, m, v, w
SWBmks	BH	00	Bog birch - Four-angled mountain-heather; moise swale areas	gentle slope; shallow soils over bedrock, coarse-textured; moist swale areas	k, w
SWBmks	BL	00	Bog birch - Common coral lichen; shrub community on knolls	gentle slope; deep coarse-textured soils; shrub community on knolls	k, r, s, v
SWBmks	FB	00	Subalpine fir - Five-leaved bramble; krummholz site	significant slope[2], cool aspect; deep, coarse-textured soils; krummholz site	g, j, r, s, v, z
SWBmks	FG	00	Subalpine fir - Globeflower; forested site	significant slope[2], warm aspect; deep, coarse-textured soils; forested site	g, j, s, v, z
SWBmks	FV	00	Subalpine fir - Sitka valerian; forested site	significant slope[2], cool aspect; deep, coarse-textured soils; forested site	g, j, r, s, v, z
SWBmks	FW	00	Sub-alpine fir - Grey-leaved willow; krummholz site	significant slope[2], warm aspect; shallow soils over bedrock, coarse-textured soils; krummholtz site	d, g, v, z
SWBmks	MA	00	Entire-leaved white mountain-avens - Arctic lupine; herb dominated community	significant slope[2], warm aspect; shallow soils over bedrock, coarse-textured soils; herb dominated community	d, z
SWBmks	MB	00	Entire-leaved white mountain-avens - Bog birch; herb dominated community	significant slope[2], cool aspect; shallow soils over bedrock, coarse-textured soils; herb dominated community	j, m, z
SWBmks	PA	00	Cow-parsnip - Arrow-leaved groundsel, wet meadow; moist herb meadow	moist herb meadow; gentle slope; deep, coarse-textured soils	n
SWBmks	VH	00	Sitka valerian - Indian Hellebore; avalanche chute	significant slope[2], cool aspect; shallow soils over bedrock; coarse-textured soils; avalanche chute	g, n, z

Table 2.5 Ecosystem Units

Subzone	Symbol	Site Series	Site Series Name [1]	Typical Situation	Mapped Site Modifiers
SWBmks	WM	00	Willow - Mountain sagewort; shrub dominated community	significant slope[2], cool aspect; deep, medium-textured soils; shrub dominated community	c, n, s, z
SWBmks	WV	00	Willow - Sitka Valerian, moist shrub units	gentle slopes; deep, medium-textured soils, moist shrub units	c, g, k, n, s, w
Other sparsely or non-vegetated units					
	CB		Cut bank		
	ES		Exposed soil		
	GB		Gravel bar		
	GP		Gravel pit		
	LA		Lake		
	OW		Open Water		
	PD		Pond		
	RI		River		
	RO		Rock outcrop		
	TA		Talus		

1 Includes unclassified ecosystem units
2 Significant slopes are greater than 25% slope

3.0 ECOSYSTEM MAPPING METHODOLOGY

3.1 Background

Mapping was completed according to the methodology outlined in Standards for Terrestrial Ecosystem Mapping in British Columbia (Resources Inventory Committee, 1995) and Addenda to Terrestrial Ecosystem Mapping Standards (Cadrin et al., 1996).

3.2 Bioterrain

Bioterrain units were pre-typed onto 1:60,000 scale, black and white aerial photographs before field work was undertaken. Bioterrain mapping is the first step in the ecosystem mapping process. It involves primary subdivision of the landscape according to the physical conditions, such as slope position and soil moisture that influence ecosystems. The criteria used for this landscape classification are the same as those applied to standard terrain mapping, namely surficial materials and their texture, surface expression (landforms and material thickness), and geomorphic processes. Surficial materials are the primary control of soil drainage and the soil’s ability to retain moisture for plants. Landforms and material thickness also influence soil moisture, as well as other factors relevant to plant growth such as depth to water table, soil thickness, and exposure to sun and wind. Geomorphic processes such as gullying, landslides, avalanching and the shifting of streams also influence ecosystems. These processes contribute to the diversification of vegetation communities and of structural stages (herb, shrub or young forest) in the landscape.

Bioterrain mapping was carried out following the Terrain Classification System for British Columbia (Howes and Kenk, 1996), the Guidelines and Standards to Terrain Geology Mapping in British Columbia (Terrain Geology Task Group) and ecosystem mapping standards (RIC, 1995, 1996). Bioterrain mapping differs slightly from standard terrain mapping. On the air photographs, the area was examined closely and terrain polygons were delineated, based primarily on the surficial material, topography and geomorphological patterns, such as gullying. Polygon boundaries were also drawn to take account of soil drainage, aspect, exposure and, where possible, vegetation patterns. Pre-typing (air photo interpretation) was completed by Herb Luttmerding. Terrain symbols, geomorphic processes and soil drainage classes were place on each polygon. Selected pre-typed photographs were provided to the Ministry of Environment, Land and Parks (MELP) bioterrain correlator for review. Mapping on the air photographs was checked during the field work carried out during August 1997 (see Section 3.3). Following completion of the field work, the bioterrain polygon lines, terrain symbols and soil drainage classes were revised to take field data into account. Revisions were completed by Eveline Wolterson.

3.3 Field Work

Field work was completed over a 25-day period in August and early September 1997 at survey intensity level 4. Each field crew consisted of a plant ecologist, terrain/soil specialist and wildlife biologist. The scientists who participated in the field sampling program are as follows: vegetation data were collected by Carol Thompson, Chris Maundrel and Stephan Kesting; terrain and soils data were collected by Eveline Wolterson and Larissa Motiuk; wildlife data were collected by Chris Schmidt and Brian Churchill.

Sixty-four full plots, 190 ground inspections and 592 visual/aerial inspections were completed. The Ecosystem Field Plot form (1997 version FS 882) was completed for full plots, while the Terrestrial Ecosystem Mapping Visual Inspection Form was used for ground inspections and ground visuals. The Field Manual "Describing Terrestrial Ecosystems" (Ministry of Forests and BC Environment, Draft, 1996) provided a detailed methodology for data collection at plot and ground inspections locations. Data for air visuals were recorded in field notebooks and marked on photographs. Colour photographs were taken of the soil pit and of the general plot area at the full plots and ground inspections.

Access was largely achieved by helicopter as few roads exist in the project area. The location of full plots, ground inspections and visual inspections were marked on the air photographs, topographic mapsheets and forest cover maps.

Corey Erwin (MELP Ecology Correlator), Bob Maxwell (MELP Ecology Correlator), Sal Rasheed (MELP Wildlife Correlator) and Andy Stewart (MELP Wildlife Correlator) accompanied project field crews on August 24th and 25th.

3.4 Data Review

Upon completion of the field studies, the project specialists reviewed the field forms. Data from the full plots was recorded in VENUS format, while data from ground inspections and visual checks were recorded in an electronic spreadsheet (Excel format). Project data were provided to MOF Regional Ecologists for review. Since site series classification was not complete for all biogeoclimatic units in the project area, the field data were used to create ecosystem units in the SWBmk, SWBmks and AT, and for non-forested (edaphic) units in the BWBSdk2. Symbols and names for the new units were provided by C. Erwin.

The BGC classification for the plots was not verified by the MOF. The wetland edaphic sites were reviewed by Will Mackenzie (MOF, Smithers). The BGC lines were placed onto the 1:20,000 scale maps and then transferred to the bioterrain mylars. Except for the AT, the BGC lines were determined by evaluating the plot data elevations and field elevation transects. The AT lines were hand-drawn onto air photographs and transferred digitally onto the mylar used for mapping.

3.5 Bioterrain Mapping

Mapping occurred over several stages. Mr. Herb Luttmerding carried out preliminary terrain typing by air photo interpretation using a mirror stereoscope, on approximately 1:67,000 scale black and white photos taken in 1984. Terrain polygons were delineated, based on surfical material characteristics, topography, and other geomorphological patterns such as gullying. Polygon boundaries were also drawn along changes in aspect, drainage conditons and, where possible, vegetation type to provide a basis for ecological mapping.

Following field checking, the preliminary typing on the air photos was revised. This included some modifications to existing polygon boundaries and labels, adding new polygons, and adding slope and soil drainage modifiers to each polygon label.

The format of terrain symbols applied to each mapped polygon were based on TCSBC (Howes and Kenk, 1997). The symbols include modifiers for surficial geological materials, textures, surface expression and geomorphological processes acting on the materials.

Typical surficial materials and their associated landforms, and the active geomorphological processes are defined in more detail in Sections 1.4 and 1.5.

Slope classes were estimated from contours on the 1:50,000 scale topographic maps provided, and from clinometer measurements taken in the field. Drainage classes were estimated based on slope position, vegetative patterns, field observations, and the nature and texture of surficial materials.

3.6 Ecosystem Mapping

Following completion of the field program, review of the field data and revision of bioterrain polygons and symbols the polygons were digitized into a digital file. Integrated Mapping Technologies Inc (IMT) completed the digitizing (monorestitution). The polygons were then plotted on a mylar base map. Digital TRIM (1:20,000) files supplied by MELP were used to create the 1:50,000 base maps. Topographic lines (screened to about 50%) and hydrology features were included on the mylar plots. Biogeoclimatic unit boundaries were drafted onto the mylar bases.

Ecosystem unit labels were created by project ecologists. Ecosystem unit labels include a site series, modifier(s) (where conditions differ from the typical situation described for a site series) and a structural stage. The mylar base maps were placed overtop of forest cover maps to assist in determining structural stage for labels. Project ecologists examined the aerial photographs to determine the labels for each polygon. Ecosystem labels may consist of simple units (one ecosystem unit) or be complex and consist of up to three ecosystem units. Bioterrain polygons were frequently subdivided due to the placement of biogeoclimatic lines and due to the presence of ecological features that could identified on the air photographs. When the bioterrain polygons were split into additional polygons by the ecosystem mappers, lines were placed on the base mylar. These mylars were returned to IMT for revision of the digital polygon file. Representative samples of the maps were provided to MELP Ecology Correletor for review and comment. Comments were incorporated into the final mapping.

Ecosystem unit and bioterrain labels were entered into a polygon database (Excel format). Mapping standards provide a list of the core polygon attribute data that is required. Some of the core data found in the ecosystem database for each polygon include ecosection, biogeoclimatic zone, subzone, variant and phase, ecosystem labels (decile, site series, modifier(s) and structural stage, recorded up to three times per polygon) and disturbance history. Terrain attributes were entered in a separate database.

Ecosystem maps were created in ARC/Info format by Forest Information Services (Formis) by combining the polygon digital files and the ecosystem databases. A map legend was created and added to the maps to assist any map user. In addition to other information (see maps), the legend lists all of the ecosystems mapped in the project area. The biogeoclimatic unit, ecosystem name, typical situation, assumed modifiers and mapped modifiers are provided for each ecosystem unit. Copies of the maps were provided to the MELP Correlators for review and comment.

A discussion of some of the specific approaches used in the ecosystem mapping follows in Sections 3.6.1 to 3.6.4. Descriptions of the ecosystem units are found in Section 4.0.

3.6.1 BWBSdk2

Map users will note that the tree layer in the forested site series (ecosystem units) in the BWBsdk2 is typically composed of some combination of lodgepole pine, white spruce and black spruce. Tree layers in site series 01 (SM), 05 (SW) and 02 (LC) are dominated by either white spruce and/or lodgepole pine. These units are mapped on areas were the forest cover maps showed either of these two tree species as leading. Sites series 03 (BL), 04 (BF) and 07 (BT) are typically found on poor sites dominated by black spruce. These ecosystem units were mapped on areas with environmental conditions appropriate to the specific units and where the forest cover maps indicated that black spruce is the dominant tree.

The BL ecosystem unit is mapped on subxeric to mesic sites on cool north aspects and level areas that do not receive moisture. This unit is often associated with coarse-textured glaciofluvial or morainal parent material, however, it is also mapped on fine-textured glaciolacustrine materials were black spruce is dominant. The BF ecosystem unit is mapped on sites with subhygric to hygric moisture regimes on lower slope and gently sloping moisture receiving areas. The BF unit is also mapped on organic veneers.

Lodgepole pine is very common in the tree canopy because of forest fire history in the project area. The zonal site series 01 (SM ecosystem unit) is mapped on submesic to mesic sites where lodgepole pine and/or white spruce is dominant in the tree layer. The seral association $-Trembling aspen-moss (map symbol am) was mapped infrequently for the SM ecosystem unit where trembling aspen is a significant component in the tree canopy. Site series 05 (SW) is generally mapped in areas were it was sampled or that the forest cover maps indicate white spruce with a strong deciduous component.

Site series 02 (LC) is mapped on xeric sites on crest positions and steep upper slopes. It is associated with shallow and very shallow soils ("v" modifier). The 06 site series is found on subhygric to hygric sites (often fluvial materials) with white spruce in the tree canopy.

Several edaphic (non-forested) ecosystem units were sampled in the BWBSdk2. A permanent cover of herbaceous (stage 2), low shrub (stage 3a) or tall shrub (stage 3b) vegetation characterizes these units. The most commonly mapped edaphic units include the BW, WM and SG ecosystem units. The BW ecosystem unit is a sedge fen that is typically found on organic blankets and veneers. WM is mapped on level, coarse-textured soils with subhygric moisture regimes. It is a shrubby unit dominated by willows. The BW ecosystem unit is a sedge fen that is typically found on organic blankets and veneers. The SG ecosystem unit is shrubby and is typically found on level sites on poorly drained organic soils. It was also occasionally found and mapped on shallow organic veneers over active fluvial materials (SGa). The other BWBSdk2 edaphic units (DM, FA, GS, and MS, PH) were mapped much less frequently and generally where field data identified the presence of the units.

3.6.2 SWBmk

Site series classification had not been completed and published for the SWBmk and SWBmks biogeoclimatic units prior to the field work undertaken for the project. Thirteen ecosystem units have been described and mapped in the Smith/Vents study area as a result of the project; these include eight forested units and five edaphic ecosystems. In addition, two ecosystem units found in the SWBmks were mapped in the SWBmk (see below).

The eight forested ecosystem units were generally mapped in situations as described in the typical situations provided on the map legend. Map modifiers indicating the depth of soil, soil texture (coarse-textured soils were very common), gulling and aspect were most frequently used with the forested ecosystems. SB typically occurs on mesic sites on gentle slopes with deep-medium textured soils. It is also mapped on mesic sites on warm and cool aspects and coarse-textured soils. Two ecosystems occur on significant slopes on warm aspects.

The PL unit typically occurs on very xeric to xeric sites with shallow soils (upper slopes). It is also mapped on very shallow soils, very steep slopes (>70%) and on shallow to very shallow soils on crest positions. SK is mapped on xeric to submesic sites on warm aspects on deep, medium-textured soils. It is frequently mapped on shallow soils and very steep slopes; it is infrequently mapped on ridges, gentle slopes and ridges.

Two of the forested SWBmk units, SL and SC typically occur on steep, cool aspects. SL occurs on submesic sites on deep, medium-textured soils. It is frequently mapped on coarse-textured, shallow to very shallow soils and very steep slopes. SL is occasionally mapped on gentle slopes and ridges. SC typically occurs on cooler, moister subhygric sites on deep-medium textured soils. It is commonly mapped on sites with coarse-textured and/or shallow soil. It is occasionally mapped on gentle slopes, cones/fans and very shallow soils. In addition, SL occurs on units with the geomorphological process, cryoturbation.

SW typically occurs on submesic to mesic sites on gentle slopes and deep, medium-textured soils. It is commonly mapped on coarse-textured soils; SW is found less frequently on moderate to steep warm aspects from mid to lowers slope positions and on gullies in cool aspects.

SS typically occurs on gently sloping, deep medium-textured soils. It is found on subhygric sites on lower slope positions. It is commonly found on coarse-textured soils and infrequently on active fluvial sites, shallow soils and cones/fans. SH typically occurs on gentle slopes with deep, coarse-textured soils (subhygric to hygric, moisture receiving sites). It is mapped very occasionally mapped on fans, shallow soils and peaty material.

The edaphic units that were mapped most frequently include the WB and WS ecosystem units. WB is a low shrub dominated unit that is typically mapped on coarse-textured soils on level fluvial materials. It is also mapped on active fluvial sites (a), fans (n), shallow soils (s) and terraces (t). The WH ecosystem unit is also a low shrub community that is found on gently sloping coarse-textured soils (moist to wet sites). It is also mapped with medium-textured soil (m) and shallow soil (s). The SF and WS units are mapped on level sites with organic soils. The SF unit is mapped on organic sites were the plant community is in structural stage 2 (sedges are dominant) while WS has a low shrub appearance (structural stage 3a).

HS is a grass-dominated marsh which was only mapped around Skeezer Lake.

Two herb dominated ecosystem units from the SWBmks are also mapped in the SWBmk. Of the two ecosystems units, AS is mapped most frequently. It is mapped on exposed crest and upper slope positions of the foothills and low mountains that crest in the SWBmk. These sites create environmental conditions similar to the situations where AS is found in the SWBmks. The MB ecosystem unit is mapped in situations that are similar to those where it is found in the SWBmks (i.e. shallow coarse-textured soils, on cool aspects; very rare on medium-textured soil).

3.6.3 SWBmks

Thirteen ecosystem units have been described and mapped in SWBmks for the Smith/Vents study; these include two forested units, six shrub dominated ecosystem units and five herb dominated ecosystem units. The majority of the SWBmks biogeoclimatic unit occurs on project map sheet Nos. 7 and 8, with lesser amounts on map Nos. 4 and 5.

These ecosystem units were generally mapped in situations as described in the typical situations provided on the map legend. Map modifiers indicating the depth of soil, topography and gullying were most frequently used in the ecosystem labels. Coarse-textured soils were assigned to the typical descriptions for all of the units in the SWBmks, with the exception of WM and WV.

FG and FV are the two forested units in the SWBmks. FG typically occurs on sites with subxeric to submesic moisture regimes on steep, warm aspects. These forested units were frequently mapped on shallow soils and/or very steep slopes. FG was occasionally mapped on gentle slopes and ridges. FV typically occurs on sites with mesic to subhygric moisture regimes on warm aspects. It is commonly mapped on sites with shallow soils and/or very steep slopes. It is found very infrequently on gentle slopes and ridges.

Two SWBmks units, FB and FV, have a krummholz appearance (i.e. scrubby, stunted growth form of trees) and were commonly used on the map sheets. FB typically occurs on cool aspects on deep soils. It is commonly found on shallow and/or very steep sites. It is infrequently mapped on gentle slopes, ridges and very shallow soils. The FW krummholz unit typically occurs on warm aspects on shallow, coarse-textured soils. It is commonly found on very steep sites and infrequently mapped on deep and very shallow soils.

The most frequently mapped shrub and or herb dominated ecosystem units are the AS and MB (both herb dominated plant communities), followed by the MA (herb dominated) and WV (shrub-dominated) ecosystem units. AS typically occurs on shallow soils on crest slope positions (exposed sites). It is infrequently found on exposed upper slopes (cool and warm aspects), medium-textured soil and very shallow soils. MB typically occurs on steep, cool aspects on shallow, coarse-textured soil on mid to upper slopes. MB is commonly mapped on very steep upper slopes; it is very infrequently mapped on medium-textured soils and gentle slopes. MA is typically found on steep, cool aspects on shallow, coarse-textured soils. It is commonly mapped on very steep slopes; it occurs rarely on deep soils. WV is a shrub-dominated ecosystem unit that typically occurs on moist, gently sloping sites with deep, medium-textured soil. These moist shrubby sites are also mapped on coarse-textured soils, shallow soils, fans, and gullies on both warm and cool aspects.

The BH, BL, PA, VH and WM ecosystem units are not common in the project area (found on map sheet Nos. 7 and 8). BH is typically found on gently sloping, moist sites with shallow soils. It is mapped very rarely on both cool and warm aspects. BL typically occurs on gently sloping sites with deep soils (submesic moisture regime). It is commonly found on shallow soils, while it is very uncommon on cool aspects, ridges and very shallow soils. PA typically occurs on gently sloping moist sites on deep soils. It is very uncommonly found on fans. The avalanche unit VH typically occurs on steep cool sites on shallow soils. It is most frequently found (mapped) on very steep slopes, and is rare on gullies and colluvial cones. WM is a shrub-dominated community that typically occurs on steep, cool aspects and deep, medium-textured soils. It is mapped on steep cool aspects on coarse-textured soils, shallow soils and/or very steep slopes. It is also very rarely mapped on fans/cones.

3.6.4 AT

Two vegetated units have been identified and mapped in the AT zone (map sheet Nos. 7 and 8). AW typically occurs on shallow, coarse-textured soil on crest slope positions. It is also very rarely mapped on gently sloping sites, warm aspects and warm, very steep sloping sites. HW typically occurs on steep, cool aspects on shallow coarse-textured soils. It is most frequently mapped on very steep slopes.

3.6.5 Application of Modifiers

Terrain and soils data collected in the field indicate that coarse-textured soils are common throughout the area. These coarse-textured soils are generally found on fluvial, glaciofluvial, morainal and colluvial parent materials. The definition used for coarse-textured soils is based on modifier definitions given in the mapping standards (RIC, 1995, and 1996).

The coarse-textured modifier was assigned to those ecosystem units in polygons were the terrain texture is mapped as being coarse-textured or in areas were fluvial, glaciofluvial, morainal or colluvial parent materials are mapped and no texture data is available. Medium and/or fine-textured soils are generally found on lacustrine, glaciolacustrine and some morainal materials.

Soil depth modifiers were applied to situations where soil depth for a particular ecosystem did not meet the typic conditions. For example, in cases were deep soils are typic, the shallow soil modifier was used were the veneer surface expression was applied to a parent material (i.e. Mv or Cv) in the terrain label. The very shallow modifier was used where the surface expression “very thin veneer” (x) was applied to a parent material in the terrain label (i.e. Cx), where bedrock was significant component of the terrain label or where field data supported its use.

Other modifiers (such as h, j, k, n, p, r) were used in situations that did not meet the typic situation. The gullying modifier was applied when the bioterrain label included the gullying geomorphological processes (V) and the gullying was equal to or greater than 20% of the polygon.

3.6.6 Disturbance History

Several large wild fires have occurred in the project area specifically in 1959 and 1961, mostly south of the Liard River. Structural stage 3 was most frequently used in mapping of these burned areas due to field observations, and the age of the stand and height class (<10 m) given on the forest cover maps.

3.6.7 Limitations

One of the most significant limitations encountered during mapping was the quality of the air photographs. The project photographs were 1:60,000 scale flown in 1986 and were, therefore, several (11) years out of date at the time of the field work. Interpretation of ecosystems from these photographs was also difficult because the photographs were of poor quality (i.e. poor sharpness of image) and a smaller scale than the final mapping product. Therefore, it was difficult to interpret items such as species composition or tree height in the canopy from the photographs.

Another difficulty encountered by the ecologists was the diversity of ecosystems units found in the area and the tendency of several ecosystem units in a biogeoclimatic unit to occur on the same parent materials. For instance, in the BWBSdk2, site series 03 (BL) and site series 01 (SM) were found to occur on both glaciofluvial and morainal materials. Since both of these units may a have a canopy dominated by lodgepole pine in shrub stages and young forests, it was often difficult to differentiate the units on the photographs.

The lack of classification in the SWBmk, SWBmks, as well as the number of non-forested units and abundance of young forests in the BWBSdk2, made interpretation of the landscape difficult. This combination of lack of classification and diversity of ecosystems in the landscape made it difficult for the field ecologists to quickly develop “models” of where to expect the units and to be able to recognize the site series between the photographs and the ground.

3.6.8 Bioterrain Mapping Reliability

Mapping reliability is considered reasonable because the wide variety of relief in the area allowed most land forms to be identified with good accuracy. However, portions of the area in the north and southwest were difficult to type due to the relatively low relief. Mapping reliability may also have been compromised by:

- the use of small scale, black and white aerial photographs, (and the transfer of 1:67,000 scale data to 1:20,000 scale TRIM maps);
- the inaccessibility of the terrain and the inability to conduct foot traverses due to the scale of the mapping, the presence of wildfire deadfalls and the lack of openings in the tree canopy in most of the area. This required that a large number of observations were concentrated around bogs, rivers bars, mountain ridges or other accessible helicopter landing spots, or were conducted from the air or high vantage points. This did not allow a highly accurate understanding of much of the study area;
- inadequate exposures of surficial materials (typically obvious at road cuts and slope failures);
- heavy vegetative cover in inaccessible areas.

These limitations made it necessary to make inferences about surficial materials and processes based on adjacent landforms which could be field checked, and on past experience in similar terrain.

3.7 Wildlife Capability and Suitability Mapping

Wildlife capability and suitability mapping were produced for moose, mule deer, elk, caribou, marten, fisher, grizzly bear and bay-breasted warbler. These interpretative maps were created by applying the wildlife suitability ratings found in the wildlife ratings table to the ecosystem data contained in the individual ecosystem maps. The species accounts, models and the wildlife ratings table used to create the maps are located in a separate report titled Smith/Vents TEM Wildlife Models and Ratings Table (Norecol, Dames & Moore, 1998).

4.0 DESCRIPTION OF ECOSYSTEM UNITS

A description of the ecosystems mapped in each biogeoclimatic unit is provided in the following tables. Each ecosystem unit is described on both a site and vegetation page. One the site page, the biogeoclimatic unit and site series number is provided in the box on the upper left corner. The two-letter ecosystem map symbol, ecosystem name and list of all modifiers used with the individual ecosystem symbol are listed in the map unit box. A summary of the environmental and physical site characteristics, as determined from the plots and ground inspections, is provided in the site description box. Site data include elevation, slope, aspect, soil moisture regime, nutrient regime and drainage class. Terrain and soil characteristics provided are the surficial material, soil type, coarse fragment content, humus depth and form, and soil texture encountered for that ecosystem unit at the inspection sites.

The vegetation page provides a summary of the dominant and associate plant species for each potential structural stage of the ecosystem unit. Plant species were treated as dominants and associates based on the following criteria.

Dominant trees: Closed canopy ≥65%; open canopy ≤65%.
Dominant shrubs: Occur in over 50% of the plots with a cover ≥10%.
Associate shrubs: Occurs in 40 to 50 % of the plots with a cover ≥5%
Dominant herbs: Occurs in over 50 % of the plots with a cover ≥5%
Associate herbs: Occurs in 40 to 50 % of the plots with a cover between 0 to 5%
Dominant moss: Occurs in over 50% of the plots with a cover ≥60%
Associate moss: Occurs in 40-50% of the plots with a cover of 15 to 65 %.

Six potential structural stages are listed for the forested ecosystem units. These include herb, shrub, pole sapling, young forest, mature forest and old forest. For edaphic ecosystem units, only the herb and/or shrub structural stages are described. Notes that may provide further descriptions of the ecosystem unit are provided at the bottom of the vegetation table. The plot, ground inspection and visual inspection number(s) completed within each structural stage of the ecosystem unit are listed. When no inspection numbers are provided for a particular structural stage, the dominant and associate species have been extrapolated from inspections completed in other structural stages. Full plot numbers completed in the project area start with 96 followed by five numbers. Only the last three numbers were put on the maps and air photos due to space constraints.

Ground inspections are shown as the two-letter codes GT, GK and GM followed by an inspection number. Air calls were labelled AC followed by an inspection number. For example, GK-1 represents a ground inspection completed by S. Kesting. Visual inspections follow a similar format using the symbols VT, VK and VM in combination with an inspection number. The two-letter code represents G for ground and then the first initial of the last name of the ecologist.

The ground visual inspection numbers completed by the ecologists are listed below.

Field Crew Member Completing Inspection	Ground Inspection Numbers	Visual Inspection Numbers	Air Visual Inspection Numbers
Carol Thompson	GT-1 to GT-85	VT-1 to VT-160	AT-145 to AC-348
Stephan Kesting	GK-1 to GK-78	VK-1 to VK-55	AC-1 to AC-144
Chris Maundrel	GM-1 to GM-27	VM-1 to VM-29	

The following tables provide a description of the ecosystems mapped in each biogeoclimatic unit.

BIOGEOCLIMATIC ECOSYSTEM CLASSIFICATION	**ECOSYSTEM MAP UNIT Symbol**	**Name**
SWBmk 00	AS ASj, ASk, ASm, ASv, ASw	Entire-leaved white mountain-avens - Sedges, sparsely vegetated

Typic AS occurs on crest slope positions on shallow colluvial parent material over bedrock; generally the soils are coarse-textured; unit represents exposed wind-blown sites with a high percentage of rocks on the surface.

SITE DESCRIPTION

	Range	Mean
Elevation (m)	1177-1385	1254
Slope (%)	0-5	5
Aspect (degrees)	level (crest), 140	

Moisture Regime 2 Nutrient Regime B

Drainage well drained

Surficial Material
silty colluvial veneer/bedrock;
sandy colluvial veneer;
silty sandy colluvial veneer/bedrock

Soil Development
Orthic Eutric Brunisol
Orthic Humic Regosol

	Range
Coarse Fragments (%)	20-60
Humus Depth (cm)	0-6.5

Soil Texture
sandy loam to silty loam

Humus Form
Humimor, Resimor

BIOGEOCLIMATIC ECOSYSTEM CLASSIFICATION	ECOSYSTEM MAP UNIT Symbol	Name
SWBmk 00	HS	Mountain hairgrass - sedge, marsh

Typic HS occurs on level to gently sloping deep coarse-textured materials on active fluvial plains; unit represents a wet poorly drained herb dominated meadow.

SITE DESCRIPTION

	Range	Mean
Elevation (m)	1135	1135
Slope (%)	0	
Aspect (degrees)	level	

Moisture Regime 7 Nutrient Regime C

Drainage poorly drained

Surficial Material
muddy, sandy active fluvial plain

Soil Development
Gleyed Cumulic Regosol

	Range
Coarse Fragments (%)	1
Humus Depth (cm)	0-9

Soil Texture
loam to very fine
sandy loam

Humus Form
Leptomoder

BIOGEOCLIMATIC ECOSYSTEM CLASSIFICATION	ECOSYSTEM MAP UNIT Symbol	Name
SWBmk 00	MB MBm	Entire-leaved white mountain-avens - Scrub birch, herb community

Typic MB occurs on steep cool aspects on coarse-textured shallow colluvium over bedrock; occurs on upper to mid slope positions; unit represents a herb dominated community on a north aspect.

SITE DESCRIPTION

	Range	Mean
Elevation (m)	1155-1255	1256
Slope (%)	40-45	42.5
Aspect (degrees)	11-30	

Moisture Regime 3   Nutrient Regime B

Drainage: well drained

Surficial Material
colluvial veneer/bedrock
sandy, silty colluvial veneer

Soil Development
Cumulic Regosol
Brunisolic Turbic Cryosol

	Range
Coarse Fragments (%)	25-45
Humus Depth (cm)	

Soil Texture
sandy loam

Humus Form
Hemimor, Mormoder

BIOGEOCLIMATIC ECOSYSTEM CLASSIFICATION	ECOSYSTEM MAP UNIT Symbol	Name
SWBmk 00	PL	Lodgepole pine - Lichen
	PLg, PLh, PLhv, PLj, PLk, PLkv, PLkz, PLr, PLrv, PLv, PLvz, PLz	

Typic Pl occurs on steep warm aspects in upper slope positions on shallow colluvium; common on ridges (PLr) and on rock (PLv).

SITE DESCRIPTION

	Range	Mean
Elevation (m)	940	940
Slope (%)	50	50

Aspect (degrees) 189

Moisture Regime 2   Nutrient Regime A

Drainage rapidly to well drained

Surficial Material
gravelly fluvial

Soil Development
Orthic Dystric Brunisol

	Range
Coarse Fragments (%)	80
Humus Depth (cm)	

Soil Texture
coarse sandy loam

Humus Form
Hemimor

BIOGEOCLIMATIC ECOSYSTEM CLASSIFICATION

SWBmk
00

ECOSYSTEM MAP UNIT

Symbol	**Name**
SB	White spruce - Scrub birch

SBc, SBcg, SBch, SBck, SBcn, SBcr, SBcs, SBct, SBcw, SBgk, SBgs, SBgw, SBh, SBhs, SBks, SBrs, SBs, SBsw

Typic SB occurs on moderate to gentle slopes on deep medium-textured morainal material; frequently eolian veneers overly morainal parent materials.

SITE DESCRIPTION

	Range	Mean
Elevation (m)	910 - 1395	1117
Slope (%)	0-36	11

Aspect (degrees) level, north to south

Moisture Regime 3-4 Nutrient Regime B-C

Drainage well to moderately well drained

Surficial Material
muddy eolian veneer/sandy, muddy morainal blanket;
muddy colluvial veneer; sandy, muddy colluvial veneer/bedrock;
clay morainal veneer; silty sandy colluvial veneer;
silty silty eolian veneer/sandy morainal blanket

Soil Development
Orthic Dystric Brunisol
Brunisolic Grey Luvisol
Brunisolic Turbic Cryosol
Orthic Grey Luvisol
Eluviated Dystric Brunisol

Coarse Fragments (%) Range 0-90

Humus Depth (cm) Range 0-9

Soil Texture
sandy loam to clay loam

Humus Form
Humimor, Hemimor, Resimor

BIOGEOCLIMATIC ECOSYSTEM CLASSIFICATION	ECOSYSTEM MAP UNIT Symbol	Name
SWBmk 00	SC	White spruce - Crowberry
	SCc, SCcg, SCch, SCcj, SCcn, SCcs, SCcv, SCcz, SCg, SCgs, SCgz, SCh, SCjs, SCs, SCsz	

Typic SC occurs on steep cool aspects on medium-textured deep colluvial materials; frequently occurs on cryosolic soils.

SITE DESCRIPTION

	Range	Mean
Elevation (m)	893-1320	1135
Slope (%)	50-60	57

Aspect (degrees) 310-122

Moisture Regime 5-6 Nutrient Regime A-C

Drainage poorly to moderately well drained

Surficial Material
- muddy colluvial veneer;
- sandy colluvial blanket;
- humic organic veneer/muddy colluvial veneer;
- muddy sandy glaciofluvial

Soil Development
- Orthic Dystric Brunisol
- Eluviated Dystric Brunisol
- Humic Organic Cryosol

	Range
Coarse Fragments (%)	60-82
Humus Depth (cm)	0-50

Soil Texture
- loamy sand to loam

Humus Form
- Hemimor, Saprimoder

BIOGEOCLIMATIC ECOSYSTEM CLASSIFICATION	ECOSYSTEM MAP UNIT Symbol	Name
SWBmk 00	SF	Sedge fen

Typic SF occurs on deep organic units; occasionally occurs on poorly drained, low nutrient fluvial plains.

SITE DESCRIPTION

	Range	Mean
Elevation (m)	920-1020	955
Slope (%)	0	
Aspect (degrees)	level	

Moisture Regime 8 Nutrient Regime D

Drainage

Surficial Material
organic blanket;
silty, sandy fluvial plain

Soil Development

	Range
Coarse Fragments (%)	

Humus Depth (cm)

Soil Texture Humus Form

BIOGEOCLIMATIC ECOSYSTEM CLASSIFICATION	ECOSYSTEM MAP UNIT Symbol	Name
SWBmk 00	SH	White spruce - Horsetail
	SHn, SHp, SHs	

Typic SH occurs on gentle slopes on deep coarse-textured glaciofluvial parent material; occurs in lower slope moisture receiving positions.

SITE DESCRIPTION

	Range	Mean
Elevation (m)	970-1100	1035
Slope (%)	10-11	11

Aspect (degrees) 300-10

Moisture Regime 5-7 Nutrient Regime B-C

Drainage well to imperfectly drained

Surficial Material
muddy, sandy glaciofluvial;
sandy morainal

Soil Development
Orthic Dystric Brunisol
Orthic Sombric Brunisol

	Range
Coarse Fragments (%)	15-35
Humus Depth (cm)	0-29

Soil Texture
sandy loam to
coarse sandy loam

Humus Form
Mormoder, Humimor

BIOGEOCLIMATIC ECOSYSTEM CLASSIFICATION	**ECOSYSTEM MAP UNIT Symbol**	**Name**
SWBmk 00	SK	White spruce - Kinnikinnick
	SKc, SKcg, SKch, SKcj, SKcr, SKcs, SKcz, SKgs, SKgz, SKh, SKhs, SKjs, SKs, SKsz	

Typic SK occurs on steep warm aspects on deep medium-textured colluvial parent materials; occurs in upper to mid slope positions.

SITE DESCRIPTION

	Range	Mean
Elevation (m)	835-1405	1220
Slope (%)	39-60	46
Aspect (degrees)	140-285	

Moisture Regime 2 Nutrient Regime B

Drainage well drained

Surficial Material
- sandy colluvial cone; sandy, silty colluvial blanket;
- silty, sandy colluvial veneer;
- muddy colluvial veneer;
- muddy colluvial veneer/bedrock

Soil Development
- Orthic Humic Regosol
- Orthic Melanic Brunisol
- Orthic Dystric Brunisol
- Orthic Eutric Brunisol

	Range
Coarse Fragments (%)	45-95

Humus Depth (cm)

Soil Texture	Humus Form
sand to sandy clay loam	Hemimor, Mormoder, Resimor

BIOGEOCLIMATIC ECOSYSTEM CLASSIFICATION	ECOSYSTEM MAP UNIT Symbol	Name
SWBmk 00	SL	White spruce - Labrador tea
	SLc, SLcg, SLch, SLcj, SLcr, SLcs, SLcv, SLcz, SLg, SLgs, SLgz, SLhs, SLjs, SLrs, SLs, SLsz, SLvz	

Typic SL occurs on moderate to steep cool aspects on deep morainal parent materials.

SITE DESCRIPTION

	Range	Mean
Elevation (m)	820-1355	1159
Slope (%)	30-65	
Aspect (degrees)	300-100	

Moisture Regime 3 - 5 Nutrient Regime B-C

Drainage well to imperfectly drained

Surficial Material
muddy colluvial veneer;
muddy colluvial veneer/sandy morainal blanket;
muddy colluvial veneer/bedrock;
silty, sandy colluvial veneer/bedrock

Soil Development
Orthic Eutric Brunisol; Orthic Humic Regosol;
Brunisolic Grey Luvisol; Orthic Dystric Brunisol;
Eluviated Eutric Brunisol; Gleysolic Static Cryosol

	Range
Coarse Fragments (%)	30-85
Humus Depth (cm)	0-19

Soil Texture	Humus Form
loamy sand to silt loam	Humimor, Hemimor, Resimor

BIOGEOCLIMATIC ECOSYSTEM CLASSIFICATION	ECOSYSTEM MAP UNIT Symbol	Name
SWBmk 00	SS	White spruce - Scrub birch
	SSa, SSac, SSc, SScg, SScn, SScs, SSgs, SSn	

Typic SS occurs on gentle slopes on deep medium-textured parent materials; generally occurs in lower slope positions on warm aspects.

SITE DESCRIPTION

	Range	Mean
Elevation (m)	1235	1235
Slope (%)	15	
Aspect (degrees)	240	

Moisture Regime 5 — Nutrient Regime C

Drainage: moderately well drained

Surficial Material
silty sandy colluvial veneer, blanket/bedrock

Soil Development
Orthic Dystric Brunisol

	Range
Coarse Fragments (%)	10
Humus Depth (cm)	

Soil Texture: loam

Humus Form: Humimor

BIOGEOCLIMATIC ECOSYSTEM CLASSIFICATION

SWBmk
00

ECOSYSTEM MAP UNIT

Symbol	**Name**
SW	White spruce - Willow

SWc, SWcg, SWch, SWcn, SWcr, SWcs, SWcv, SWcw,
SWgk, SWgs, SWgw, SWhs, SWrs, SWs, SWsw, SWw

Typic SW occurs on gentle slopes on deep medium-textured colluvial parent material; frequently occurs on moderate to steep warm aspect from lower slope to mid slope positions (SWw).

SITE DESCRIPTION

	Range	Mean
Elevation (m)	810-1440	1154
Slope (%)	0-51	20
Aspect (degrees)	level, 115-350	

Moisture Regime 3-4 Nutrient Regime C

Drainage well to moderately well drained

Surficial Material
muddy colluvial fan; sandy, silty morainal veneer;
silty, sandy fluvial fan; muddy colluvial veneer/bedrock;
silty. thin eolian veneer/muddy colluvial blanket;
silty, sandy colluvial blanket; sandy, silty eolian veneer;

Soil Development
Orthic Eutric Brunisol; Eluviated Dystric Brunisol;
Orthic Regosol; Orthic Sombric Brunisol; Brunisolic Grey Luvisol;
Cumulic Regosol; Eluviated Eutric Brunisol;
Orthic Grey Luvisol; Orthic Humic Regosol

	Range
Coarse Fragments (%)	10-85
Humus Depth (cm)	0-9.5

Soil Texture	Humus Form
loamy sand to clay loam	Hemimor, Humimor, Resimor

BIOGEOCLIMATIC ECOSYSTEM CLASSIFICATION	ECOSYSTEM MAP UNIT Symbol	Name
SWBmk 00	WB	Willow - Bluejoint
	WBa, WBn, WBs, WBt	

Typic WB occurs on level to gently sloping, deep, coarse-textured fluvial plains.

SITE DESCRIPTION

	Range	Mean
Elevation (m)	900-1256	1025
Slope (%)	0	
Aspect (degrees)	level	

Moisture Regime 5-6 Nutrient Regime B

Drainage poorly to imperfectly drained

Surficial Material
- sandy fluvial plain;
- silty active fluvial plain;
- silty, sandy fluvial veneer/sandy fluvial plain;
- fibric organic thin veneer

Soil Development
- Cumulic Regosol
- Orthic Regosol

	Range
Coarse Fragments (%)	

Humus Depth (cm)

Soil Texture
- silt loam

Humus Form
- Mormoder, Fibrimor

BIOGEOCLIMATIC ECOSYSTEM CLASSIFICATION

SWBmk
00

ECOSYSTEM MAP UNIT

Symbol	Name
WH	Willow - Common horsetail
WHm, WHs	

Typic WH occurs on a gently sloping deep coarse-textured fluvial parent materials.

SITE DESCRIPTION

	Range	Mean
Elevation (m)	960 - 1125	1053
Slope (%)	9	9

Aspect (degrees) 220

Moisture Regime 7 Nutrient Regime B

Drainage poorly drained

Surficial Material
sandy, silty fluvial blanket

Soil Development
Orthic Humic Regosol

	Range
Coarse Fragments (%)	35
Humus Depth (cm)	

Soil Texture
sandy loam

Humus Form
Saprimoder

BIOGEOCLIMATIC ECOSYSTEM CLASSIFICATION	ECOSYSTEM MAP UNIT Symbol	Name
SWBmk 00	WS	Willow-Sedge, fen

Typic WS occurs on level poorly drained organic parent material; commonly found on moderately decomposed mesic soils with a high water table for most of the year; edaphic plant community dominated by a shrub/herb complex.

SITE DESCRIPTION

	Range	Mean
Elevation (m)	900-1125	1020
Slope (%)	0	
Aspect (degrees)	level	

Moisture Regime 7-8 Nutrient Regime A

Drainage poorly to very poorly drained

Surficial Material
- mesic organic blanket;
- fibric organic blanket;
- humic organic veneer plain

Soil Development
- Typic Fibrisol
- Typic Mesisol
- Typic Humisol

Coarse Fragments (%) Range

Humus Depth (cm) Range

Soil Texture

Humus Form
Fibrimor, Mesimor

BGC UNIT SWBmks/00	MAP UNIT AS Entire-leaved white mountain-avens - Sedges, sparsely vegetated

MAP SYMBOL	AS2
Plant Species	**Edaphic Climax**
Dominants	entire-leaved white mountain-avens alpine bearberry
Associates	scrub birch blackish locoweed Arctic lupine moss campion sedges low moss and lichen cover
Plot No.'s	VT-81, VT-125, VT-132, GT-39, GM-11, VK-35, 29336, 29331
Notes:	

BGC UNIT **SWBmks/00**	**MAP UNIT BH** Scrub birch - Four-angled mountain-heather, moist swale

MAP SYMBOL	**BH3a**
Plant Species	**Edaphic Climax**
Dominants	scrub birch four-angled mountain-heather
Associates	netted willow black-tipped groundsel two-toned sedge Altai fescue narcissus anemone step moss low cover of moss and lichen
Plot No.'s	29335
Notes: Low occurrence in project area	

BGC UNIT SWBmks/00	MAP UNIT BL Scrub Birch - Cottontail coral lichen, shrub community

MAP SYMBOL	BL3a
Plant Species	**Edaphic Climax**
Dominants	scrub birch step moss
Associates	lingonberry cottontail coral lichen
Plot No.'s	29329
Notes:	

BGC UNIT **SWBmks/00**	**MAP UNIT** **FB** Subalpine fir - Five-leaved bramble,krummholtz

MAP SYMBOL	**FB3a**
Plant Species	**Edaphic Climax**
Dominants	subalpine fir scrub birch red-stemmed feathermoss
Associates	netted willow five-leaved bramble bunchberry nagoonberry twinflower Rocky Mountain fescue crowberry knight's plume step moss
Plot No.'s	29355, VT-80
Notes:	

BGC UNIT SWBmks/00	MAP UNIT FG Subalpine fir - Globeflower, forested

MAP SYMBOL	FG3b
Plant Species	**Edaphic Climax**
Dominants	subalpine fir scrub birch grey-leaved willow entire-leaved white mountain-avens single-spike sedge northern goldenrod
Associates	Arctic lupine twinflower Altai fescue Sitka valerian globeflower red-stemmed feathermoss
Plot No.'s	VM-24, VM-25, 29333
Notes:	

BGC UNIT SWBmks/00	MAP UNIT FV Subalpine fir - Sitka valerian, forested
MAP SYMBOL	**FV3b**
Plant Species	**Edaphic Climax**
Dominants	open canopy of: subalpine fir Sitka valerian
Associates	red-stemmed feathermoss step moss
Plot No.'s	29323, 29347, GT-64
Notes: A dense canopy resulted in a low diverse herb cover.	

BGC UNIT **SWBmks/00**	**MAP UNIT** **FW** Subalpine fir - Grey-leaved willow, krummholtz

MAP SYMBOL	**FW3a**
Plant Species	**Edaphic Climax**
Dominants	subalpine fir
Associates	grey-leaved willow fireweed black-tipped groundsel narcissus anemone globeflower tall bluebells sedges stiff clubmoss step moss common leafy liverwort
Plot No.'s	VK-39
Notes: A dense shrub cover resulted in a low herb cover.	

BGC UNIT **SWBmks/00**	**MAP UNIT MA** Entire-leaved white mountain-avens-Arctic lupine, herb community

MAP SYMBOL	**MA2**
Plant Species	**Edaphic Climax**
Dominants	entire-leaved white mountain-avens netted willow Arctic lupine
Associates	meadow death-camas alpine bistort globeflower crumpled-leaf moss low moss and lichen cover
Plot No.'s	GT-26, 29334
Notes:	

BGC UNIT **SWBmks/00**	**MAP UNIT** **MB** Mountain avens - Scrub birch, herb community

MAP SYMBOL	**MB2**
Plant Species	**Edaphic Climax**
Dominants	entire-leaved white mountain-avens four-angled mountain-heather netted willow
Associates	scrub birch single-spike sedge kinnikinnick alpine bearberry purple mountain saxifrage step moss low moss and lichen cover
Plot No.'s	
Notes:	

BGC UNIT **SWBmks/00**	**MAP UNIT** **PA** Cow parsnip - Arrow-leaved groundsel, moist herb meadow

MAP SYMBOL	**PA2**
Plant Species	**Edaphic Climax**
Dominants	cow-parsnip fescue
Associates	fireweed mountain monkshood anemone Sitka valerian Arctic dock arrow-leaved groundsel common horsetail bluejoint tall bluebells
Plot No.'s	29346
Notes: Low occurrence in project area	

BGC UNIT SWBmks/00	MAP UNIT VH Sitka valerian - Indian hellebore, avalanche chute

MAP SYMBOL	VH2
Plant Species	**Edaphic Climax**
Dominants	Indian hellebore fireweed globeflower Sitka valerian mountain monkshood graceful mountain sedge bluejoint
Associates	common horsetail black-tipped groundsel arrow-leaved groundsel cow-parsnip clasping twistedstalk mountain arnica nagoonberry tall bluebells
Plot No.'s	29330
Notes: Limited occurrence in project area	

BGC UNIT SWBmks/00	MAP UNIT WM Willow - Mountain sagewort, shrub community

MAP SYMBOL	WM3b
Plant Species	**Edaphic Climax**
Dominants	Barratt's willow subalpine fir woolly willow grey-leaved willow Sitka valerian Altai fescue mountain sagewort
Associates	bluejoint netted willow mountain monkshood palmate-leaved coltsfoot yarrow narcissus anemone common horsetail globeflower fireweed low moss and lichen cover
Plot No.'s	29322
Notes:	

BGC UNIT SWBmks/00	MAP UNIT WV Willow - Sitka valerian, moist shrub

MAP SYMBOL	WV3a
Plant Species	**Edaphic Climax**
Dominants	grey-leaved willow Barratt's willow Alaska willow common horsetail
Associates	showy Jacob's-ladder Sitka valerian mountain monkshood tall bluebells fireweed western meadowrue narcissus anemone nagoonberry Rocky Mountain fescue
Plot No.'s	29337, 29354
Notes:	

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