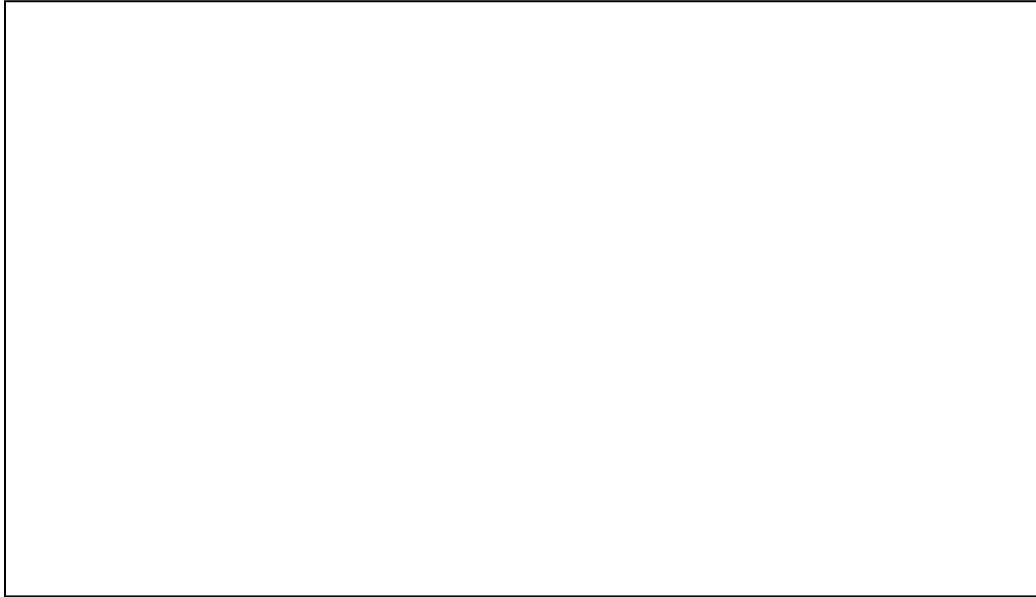


TERRESTRIAL ECOSYSTEM MAPPING

of

**CHILLIWACK LAKE PROVINCIAL PARK, CHILLIWACK RIVER ECOLOGICAL
RESERVE, and NAHATLATCH PROVINCIAL PARK**



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1.0 INTRODUCTION

This Terrestrial Ecosystem Mapping (TEM) project was initiated in 2000 by BC Parks, Lower Mainland District. Blue-listed (vulnerable) and red-listed (endangered) species, as identified by the BC Conservation Data Center, have been recorded within protected areas in the Lower Mainland. A Pacific giant salamander (red list) was observed in the Chilliwack Lake Provincial Park in 1990 and a grizzly bear (blue list) was observed in the Nahatlatch Provincial Park in 2000. BC Parks currently has very limited understanding as to how the occurrences may relate to terrestrial ecosystems within the protected areas. In order to properly manage for and protect blue and red-listed species, BC Parks has expressed the need to more accurately identify the habitats that these species are using. This TEM mapping product will be used as a foundation for identifying habitats potentially used by blue and/or red-listed species within two protected areas of the Lower Mainland.

1.1 BACKGROUND

Phase I of this project, the pre-typing phase, was completed in March, 2001 and consisted of the pre-field work and project planning components for three study areas: Chilliwack Lake Provincial Park, Nahatlatch Provincial Park, and Coquihalla Summit Recreation Area. This phase required the completion of bioterrain mapping, initial ecosystem mapping (approximately 10% of the project area), delineation of alpine and parkland boundaries, and development of a draft working legend and sampling plan.

In 2001 / 2002, Atticus Resource Consulting Ltd. was retained to complete Phase II of the project for two of the three protected areas: Chilliwack Lake Provincial Park and Nahatlatch Provincial Park. During Phase II, the BEC lines were finalized throughout the study areas, field sampling and verification of the bioterrain and BEC lines was completed, ecosystems were delineated and attributed, and the expanded vegetation legends and final report were developed. The material covered in this report outlines phase II of this project.

1.2 OBJECTIVES

The objectives of this TEM project were to:

- provide baseline bioterrain and ecosystem data for the two protected areas.
- describe the ecosystems within the two areas to ultimately obtain a better understanding as to how the occurrence reports relate to the mapped ecosystems.
- use the TEM data as a lead in the potential development of future habitat capability and suitability (CAPSU) mapping for blue and red listed species.

1.3 STUDY AREA

This project consisted of mapping TEM data within two protected areas. A brief description of each study area is listed below.

1.3.1 CHILLIWACK

Located in the upper Chilliwack River valley, and directly bordering on the northern boundary of the North Cascades National Park in the United States, the 9,344-hectare Chilliwack study area lies 43 kilometers southeast of Chilliwack and approximately 150 kilometers east of Vancouver (BC Parks 2000).

The Chilliwack study area encompasses the Chilliwack Lake Provincial Park and the Chilliwack River Ecological Reserve. Originally established as a 160-hectare park in 1973, significant expansion of the Chilliwack Lake Provincial Park occurred in 1997 as part of the Lower Mainland Protected Area Strategy (PAS) plan. The Chilliwack River Ecological Reserve was set aside in 1980.

At the north end of the park, the topography is extremely rugged, dominated by steep mountains and rocky slopes with an abundance of talus and shrub-dominated avalanche ecosystems. The west shore of the Chilliwack Lake is largely inaccessible due to steep slopes at lower elevations and rugged, mountainous terrain at higher elevations. Although there is limited road access to the park (restricted to the Chilliwack Forest Service Road along the eastern shore of lake), a series of well used hiking trails permits access to Lindeman, Greendrop, Flora and Radium Lakes. At the south end of the park, a short hiking trail permits access to the Chilliwack River Ecological Reserve.

1.3.2 NAHATLATCH PROVINCIAL PARK

Established in 1999, the 2,000-hectare Nahatlatch Provincial Park is one of BC's newest protected areas, protecting low elevation habitat along the Nahatlatch River as it flows into, out of, and between, a series of three lakes (Nahatlatch, Hannah, and Frances Lakes). This park is situated along the Nahatlatch Forest Service Road, approximately 25km northwest of Boston Bar.

1.3.3 DOMINANT SURFICIAL MATERIALS

In the Nahatlatch study area, hillslopes are typically dominated by well to rapidly-drained colluvial materials (often veneers or thin veneers). Morainal veneers and/or thin veneers are less common. Fluvial surficial materials (fans and plains) dominate much of the valley bottom along the Nahatlatch River. Organic veneers overlie the fluvial material in many areas along the river. Mushroom harvesting is a common site disturbance within

much of the Nahatlatch study area. During early October, many vehicles were parked along the main forestry through the northern section of the park.

Slopes within the Chilliwack study area are also largely dominated by well to rapidly-drained colluvial materials (often veneers or thin veneers). Regularly avalanching colluvial materials (often talus) dominate much of the Post, Flora and Radium Creek drainages. Vegetation communities in these areas are typically dominated by low-shrubs. Within the Chilliwack River Ecological Reserve, fluvial surficial materials (fans and plains) are common along the river.

Although logging is not actively occurring in either protected area, a small section on the west side of Lindeman Lake, within the Chilliwack study area, was logged several years ago.

2.0 CLASSIFICATION CONCEPTS

TEM is based upon a three-level classification hierarchy of ecological units including the *regional* ecosystem level, where the classification units are ecosections and biogeoclimatic (BEC) subzones and variants, the *local* ecosystem level, where site series is the classification, and the *vegetation developmental* level, where structural stage is used (RIC 1998).

2.1 REGIONAL CLASSIFICATION

The Ecoregion Classification system is used to stratify British Columbia's terrestrial and marine ecosystem complexity into discrete geographical units at five levels (Demarchi 1996). The first two levels (ecodomains and ecodivisions) are very broad and place B.C. in a global context. The three lowest levels (ecoprovinces, ecoregions, and ecosections) relate segments of the province to one another and describe areas of similar climate, physiography, hydrology, vegetation, and wildlife potential. Ecosections, the classification unit depicted in TEM mapping, are named after specific geographic or physiographic features, and are identified by a three-letter code.

The Chilliwack study area is located within the Pacific Ranges Ecoregion and Eastern Pacific Ranges Ecosection (EPR). The Nahatlatch study area is located within the Interior Transition Ranges Ecoregion and Leeward Pacific Ranges Ecosection (LPR).

2.2 BIOGEOCLIMATIC ECOSYSTEM CLASSIFICATION (BEC)

Biogeoclimatic zones, subzones, and/or variants (BEC units) represent classes of ecosystems under the same regional climate (Demarchi 1996). The following BEC units were mapped within the Chilliwack study area:

CWHds1	Southern Dry Submaritime Coastal Western Hemlock Variant
CWHms1	Southern Moist Submaritime Coastal Western Hemlock Variant

MHmm2	Leeward Moist Maritime Mountain Hemlock Variant
MHmmp2	Leeward Moist Maritime Mountain Hemlock Parkland Variant
AT	Alpine Tundra Zone

The following BEC units were mapped within the Nahatlatch study area:

IDFww	Wet Warm Interior Douglas Fir Subzone
CWHds1	Southern Dry Submaritime Coastal Western Hemlock Variant
CWHms1	Southern Moist Submaritime Coastal Western Hemlock Variant

A brief description of the location, mapped elevation, climate, and distinguishing vegetation of each BEC unit is included in the following paragraphs.

2.2.1 IDFww- Wet Warm Interior Douglas Fir Subzone

The IDFww Subzone has been mapped only within the Nahatlatch study area, where it forms a very narrow band on the north shores of the lakes on southern-facing slopes. The IDFww Subzone has a continental climate that is transitional to a maritime climate due to its proximity to the Pacific Ocean (Green and Klinka 1994) and is replaced by the CWHds1 Variant to the east. It is characterized by warm, dry summers and relatively moist, cool winters and represents the wettest and mildest part of the IDF zone in BC (Green and Klinka 1994). The diverse, well-developed shrub layer and decreased abundance of western hemlock (Hw) in the tree layer distinguishes this unit from the CWHds1 Variant.

2.2.2 CWHds1- Southern Dry Submaritime Coastal Western Hemlock Variant

The CWHds1 Variant has been mapped in both project areas, and occupies the lowest elevations, primarily on the north and east shores of Chilliwack Lake and at low elevations throughout most of the Nahatlatch study area. CWHds1 has been mapped from valley bottoms to 900m elevation, where it is replaced by the CWHms1 Variant. The CWHds1 climate is transitional between the coast and interior, and is characterized by warm, dry summers and moist, cool winters with moderate snowfall (Green and Klinka 1994). The rare occurrence of amabilis fir and Alaskan blueberry distinguishes this unit from the CWHms1 Variant above.

2.2.3 CWHms1- Southern Moist Submaritime Coastal Western Hemlock Variant

The CWHms1 Variant occupies elevations above the CWHds1 unit in both project areas. In the Chilliwack Lake Provincial Park, it has been mapped between approximately 900m and 1350m, above which the MHmm2 Variant replaces it. This is consistent with the elevations suggested elevations (Green and Klinka 1994) for subcontinental climates. Within the Nahatlatch study area, very little CWHms1 has been mapped (restricted to the

south shores above Hannah Lake). The CWHms1 climate is transitional between coast and interior, and is characterized by cool, relatively dry summers and moist, cool winters with heavy snowfall accumulations (Green and Klinka 1994). The presence of amabilis fir and Alaskan blueberry distinguishes this unit from the CWHds1 Variant below. Note that CWHms1 has been mapped to the lake edge on the south and west shores of Chilliwack Lake (no CWHds1 mapped below it).

2.2.4 MHmm2- Leeward Moist Maritime Mountain Hemlock Variant

The MHmm2 Variant has been mapped only within the Chilliwack Lake Provincial Park, at elevations above the CWHms1 Variant. It has been mapped between approximately 1350m and 1600m elevation, where it is replaced above by the MHmm2 Parkland Variant (MHmmp2). The MHmm2 climate is transitional between coast and interior, and is characterized by long, moist, cold winters and short, moist, cool summers (Green and Klinka 1994). The dominance of mountain hemlock (Hm) and amabilis fir (Ba) in the tree layer, and black huckleberry and minor white-flowered rhododendron in the shrub layer distinguishes this unit from the CWHms1 Variant.

2.2.5 MHmmp2- Leeward Moist Maritime Mountain Hemlock Parkland Variant

The MHmmp2 Variant occupies elevations above the MHmm2 unit in the Chilliwack Lake area. It has been mapped from between approximately 1600m and 2100m elevation, above which the AT (alpine tundra) Zone replaces it. As in the MHmm2 unit, the climate is transitional between coast and interior, and is likely characterized by long, moist, cold winters and short, moist, cool summers. The dominance of parkland vegetation and open forests / meadows distinguishes this unit from the MHmm2 Variant below. Within the MHmmp2 Variant, subalpine fir forms a component of the tree layer.

2.2.6 AT- Alpine Tundra Zone

The Alpine Tundra Zone has been mapped at elevations exceeding 2100m within the Chilliwack study area and forms a very small portion of the total project area. The AT Zone is non-treed and largely dominated by shrubs, herbs, bryophytes and lichens. Trees may exist in stunted (krummholz) form, but the percent cover is typically very low. Within the Chilliwack study area, the alpine zone is largely dominated by steepened rock (cliffs) and permanent snow, with very little vegetation. No alpine meadow units were mapped.

2.3 ECOSECTION AND BEC UNIT LABELS

Figure 1 illustrates a typical TEM map label, identifying the three-letter ecosection code and BEC unit.

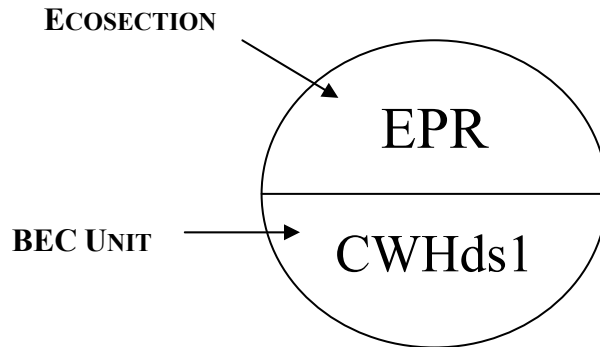


Figure 1. Example of TEM Map Label.

3.0 ECOSYSTEM MAPPING

The following attributes were recorded for each TEM polygon: site series, site modifiers, structural stage and structural stage modifiers. Depending upon the ecological complexity of the polygon, up to three deciles, or distinct ecosystems, were recorded. Each decile was limited to ecosystems covering at least 20% of the polygon area.

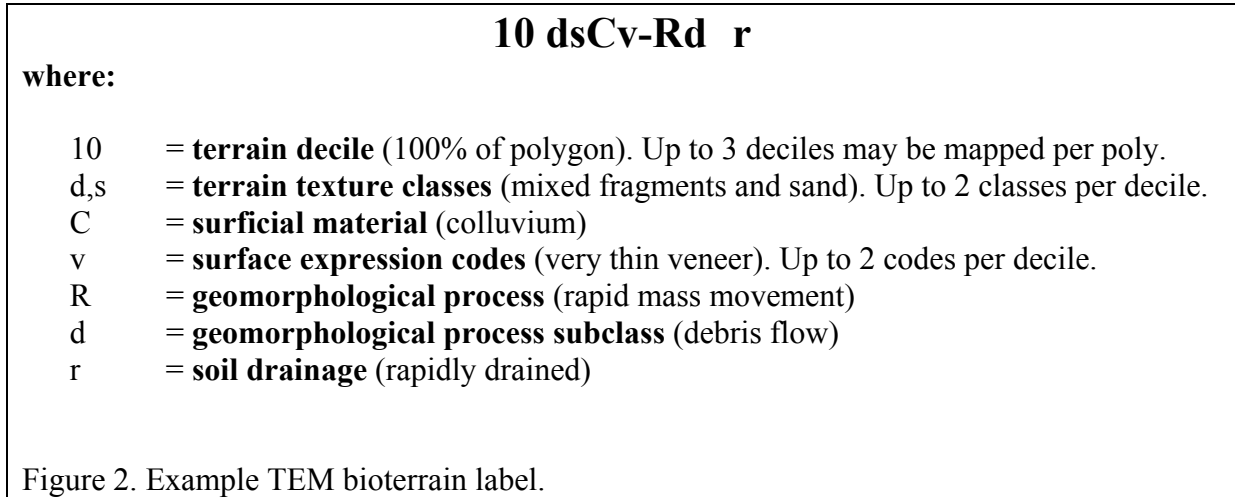
Polygons were split in several cases in an effort to isolate important habitat features of potential importance to many red and blue listed animals. Some important habitat components included (not limited to) small wetlands, shrubby edaphic areas, rock outcrops, and old forest.

3.1 BIOTERRAIN MAPPING

As a component of Phase I, a bioterrain specialist at June Ryder & Associates Terrain Analysis Inc. (JMRATA) completed the initial bioterrain mapping in 2000. It was completed for both project areas as a stand-alone product in 2000 and formed the basis for the subsequent ecosystem mapping phases. Soil maps were not used during any phase of this project.

Bioterrain mapping of the Chilliwack study area was completed on 1996 colour photos (approximately 1:15,000 scale). Mapping of the Nahatlatch Provincial Park was completed on 1997 colour photos (approximately 1:15,000 scale).

As per Howes and Kenk (1997), the terrain features and soil drainage were used as landscape delineation criteria during the typing. The following bioterrain attributes were mapped within each polygon: texture class, surficial material, surface expression, geomorphological process and subclass, and soil drainage. Figure 2 depicts a typical bioterrain label.



Each attribute is further defined in Tables 1 through 6 below (from Howes and Kenk 1997).

Table 1. Terrain texture classes.

TEXTURE			
<i>Symbol</i>	<i>Name</i>	<i>Size (mm)</i>	<i>Other Characteristics</i>
a	Blocks	>256	angular particles
b	Boulders	>256	rounded & subrounded particles
c	Clay	<.002	
d	mixed fragments	>2	mix of rounded and angular particles
g	Gravel	>2	mix of boulders, cobbles, & pebbles
k	Cobble	64-256	rounded & subrounded particles
m	Mud	<.062	mix of silt and clay
p	Pebble	2-64	rounded & subrounded particles
r	Rubble	2-256	angular particles
s	Sand	2-.062	
x	angular fragments	>2	mix of rubble and blocks
z	Silt	.062-.002	

Table 2. Surficial materials.

SURFICIAL MATERIALS		
<i>Symbol</i>	<i>Name</i>	<i>Description</i>
C	Colluvial	Products of mass wastage
D	weathered bedrock	From in situ material
E	Eolian	Materials deposited by wind action
F	Fluvial	River deposits
FA	fluvial "active"	Active river channel

FG	Glaciofluvial	Fluvial materials deposited by meltwater streams
L	Lacustrine	Lake sediments, includes littoral deposits
LG	Glaciolacustrine	Sediments deposited in glacial lakes
M	morainal (till)	Material deposited directly by glaciers
M1	ablation till	or distinguished by texture
O	Organic	Accumulation/decay of vegetative matter
R	Bedrock	Bedrock covered by less than 10cm

Table 3. Surface expression codes.

SURFACE EXPRESSION		
<i>Symbol</i>	<i>Name</i>	<i>Description</i>
a	moderate slope	Unidirectional surface; 27-49%
b	Blanket	A mantle of unconsolidated materials; >1m thick
c	Cone	A sector of a cone; >26%
d	Depression	A sharply demarked hollow
f	Fan	A sector of a cone; <27%
h	Hummocky	Hillocks and hollows; irregular plan; 27-70%
j	gentle slope	Unidirectional surface; 6-26%
k	moderately steep	Unidirectional surface; 50-70%
m	Rolling	Elongate hillocks; parallel in plan; 6-26%
p	Plain	Unidirectional surface; 0-5%
r	Ridged	Elongate hillocks; parallel in plan; 27-70%
s	Steep	Steep slopes; >70%
t	Terraced	Stepped topography and benchlands
u	Undulating	Hillocks and hollows; irregular in plan; 0-26%
v	Veneer	Mantle of unconsolidated material; 20 cm to 1 m thick
w	mantle of variable thickness	Surficial material of variable thickness; 0 to about 3 m
x	very thin veneer	Mantle of unconsolidated material; 2 cm to 20 cm thick

Table 4. Geomorphological processes.

GEOMORPHOLOGICAL PROCESSES		
<i>Symbol</i>	<i>Name</i>	<i>Description</i>
A	Avalanches	Terrain modified by snow avalanches
E	Channeled	Channel formation by glacial meltwater
F	slow mass movement	Slow downslope movement of masses of cohesive or non-cohesive material and/or bedrock
F''	initiation zone	Initiation zone of slow mass movement processes
H	Kettled	Depressions due to the melting of buried glacier ice
I	irregular channel	A single, clearly defined main channel displaying irregular turns and bends
J	anastamosing channel	A channel zone where channels diverge and converge around vegetated islands
L	surface seepage	Abundant surface seepage
M	meandering channel	Channels characterized by regular patterns of bends with uniform amplitude and wave length
P	Piping	Subterranean erosion by flowing water
R	rapid mass movement	Rapid downslope movement of dry, moist or saturated debris

R"	initiation zone	Initiation zone of rapid mass movement
S	Solifluction	Slow downslope movement of saturated overburden across a frozen or otherwise impermeable substrate
U	Inundation	Seasonally under water due to high watertable
V	gully erosion	Ravines due to erosion by various processes

Table 5. Geomorphological process subclasses.

GEOMORPHOLOGICAL PROCESS SUBCLASSES			
<i>Symbol</i>	<i>Name</i>	<i>Symbol</i>	<i>Name</i>
b	Rockfall	m	slump in bedrock
c	soil creep	p	lateral spread in bedrock
d	debris flow	r	rockslide
e	Earthflow	s	debris slide
g	rock creep	u	slump in surficial material
k	tension cracks	x	slump-earthflow
j	lateral spread in surficial material		

Table 6. Soil drainage classes.

SOIL DRAINAGE CLASS			
<i>Symbol</i>	<i>Name</i>	<i>Symbol</i>	<i>Name</i>
x	very rapidly drained	i	imperfectly drained
r	rapidly drained	p	poorly drained
w	well drained	v	very poorly drained
m	moderately well drained		

3.2 FIELD WORK & DATA ENTRY

The Phase II fieldwork was completed in September and October of 2001. The field crew consisted of two people, a project ecologist and a bioterrain specialist. Most of the polygons were accessed from the road and/or existing hiking trails. Three types of plots were completed: Full Ecosystem (FS882) plots, Ground Inspection plots and Visual Inspection plots. The FS882 plots provide the high level of detail to classify site series within the BEC units. Ground Inspections consist of quick confirmations of site series, and are often used to supplement the FS882 data. Visual Inspections, quick assessments of various ecological criteria, were often recorded from trails or roadsides. Note, as per the scope of the project, wildlife habitat information was not collected at the sample locations.

A total of 110 field plots were completed within the two study areas, including 4 Full Ecosystem Plots (FS882), 32 Ground Inspections (GI), and 74 Visual Inspections (Visuals). This corresponds to slightly over 11% of the total number of bioterrain polygons delineated within the two project areas. A total of 80 plots (approximately 10% of study area polygons) were completed during 5 days of sampling within the Chilliwack study area (analogous to a

Level 5 TEM). A total of 30 plots (approximately 21% of study area polygons) were completed during 2 days of sampling within the Nahatlatch Provincial Park (analogous to a Level 4 TEM).

The data from FS882 and Ground Inspection plots was entered into the Ministry's VENUS4.2 software and was reviewed in-depth prior to beginning the site series attributing phase.

3.3 LINE REVISIONS

Following fieldwork, some minor revisions were made to the initial bioterrain labels and lines. The BEC lines, as mapped prior to fieldwork, remained at the same elevations on the final map. Placement of the final BEC lines split many of the initial bioterrain polygons. The bioterrain specialist reattributed the altered (TEM) polygons along the newly added BEC lines prior to site series attribution.

3.4 SITE SERIES

Site series describe all land areas capable of supporting specific climax vegetation within a biogeoclimatic unit and usually relate to a specific range of soil moisture and nutrient regimes (RIC 1998). Each site series is described by a 'typical' set of environmental conditions focusing on important site, soils, and terrain characteristics.

Site series are named using one or two tree species, followed by one or two understorey species derived from the near-climax plant community on which they are based (Green and Klinka 1994). Each site series is given a two-digit numeric code and a two letter code that is unique within each BEC unit. For example, in the CWHds1 BEC unit, the 01 (zonal) site series is called "HwFd-Cat's Tail Moss (HM)". Each code must already be approved (I.e. appears in *mapcodes.xls*, the list of approved Ministry codes for TEM mapping) or must receive approval from the vegetation ecologist, MSRM, prior to being mapped.

A summary of the site series mapped by each BEC unit is located in Table 7. For a more thorough description of the site series mapped within the two study areas, including the typical soil moisture and nutrient regimes and a list of vegetation species by structural stage, refer to the expanded legends, which have been included in Appendix A. A list of the modifiers that were mapped has also been reported in the expanded legends.

Table 7. Site series, by BEC unit, mapped within the two study areas.

BEC Unit	Site Series	Site Series Code	Name	
ICHww	01	DH	FdCw – Hazelnut	
	02	DP	FdPl – Peltigera	
	03	DF	Fd – Falsebox – Feathermoss	
	05	RM	CwFd – Vine maple	
	06	RD	Cw – Devil’s club – Lady fern	
	07	RC	CwSxw – Skunk cabbage	
	00	FE	Organic sedge fen	
	00	OS	Organic shrub fen	
CWHds1	01	HM	HwFd – Cat’s tail moss	
	02	DK	FdPl – Kinnikinnick	
	03	FF	FdHw – Falsebox	
	04	DF	Fd – Fairybells	
	05	RS	Cw – Solomon’s seal	
	06	HQ	Hw – Queen’s cup	
	07	RD	Cw – Devil’s club	
	08	SS	Ss – Salmonberry	
	09	CD	Act – Red-osier dogwood	
	10	CW	Act – Willow	
	12	RC	CwSs – Skunk cabbage	
	00	AV	Dr – Vine maple avalanche unit	
	00	FE	Organic sedge fen	
	00	MA	Marsh	
00	OS	Organic shrub fen		
00	OF	Organic treed fen		
CWHms1	01	AM	HwBa – Step moss	
	02	DK	FdPl – Kinnikinnick	
	03	DF	FdHw – Falsebox	
	04	AO	BaCw – Oak fern	
	05	HQ	HwBa – Queen’s cup	
	06	AD	BaCw – Devil’s club	
	07	SS	Ss – Salmonberry	
	09	CW	Act – Willow	
	11	RC	CwSs – Skunk cabbage	
	00	AV	Dr – Vine maple avalanche unit	
	00	MA	Marsh	
MHmm2	01	MB	HmBa – Blueberry	
	02	MM	HmBa – Mountain heather	

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	03	MO	BaHm – Oak fern
	05	MT	BaHm – Twistedstalk
	06	MD	HmYc – Deer cabbage
	07	YH	YcHm – Hellebore
	00	AH	Sitka alder – Black huckleberry avalanche unit
	00	OS	Organic shrub fen
	00	LB	Liverwort - Brachythecium
	00	AA	Ba – Alaskan blueberry
	00	SM	Sedge – Mountain hairgrass (Parkland unit)
	00	BA	Ba – Valerian (Parkland unit)
	00	FH	BaBl – Mountain heather (Parkland unit)
	00	MR	Mountain heather – Racomitrium (Parkland unit)
MHmmp2	00	MR	Mountain heather – Racomitrium
	00	JK	Common juniper – Kinnikinnick
	00	BJ	BaBl - Juniper
	00	BV	Blue-leaved huckleberry – Sitka valerian
	00	LB	Liverwort - Brachythecium
	00	AS	Alaskan blueberry – Sitka valerian
	00	FH	BaBl – Mountain heather
	00	AA	Ba – Alaskan blueberry
	00	BA	Ba – Valerian
	00	SM	Sedge – Mountain hairgrass
	00	FE	Organic sedge fen
AT	00	CP	Copperbrush – Partridgefoot cliff
	00	PL	Partridgefoot – lichen rock

3.5 SITE MODIFIERS

Site modifiers are used to describe the variation or ‘atypical conditions’ within a site series. As per the 1998 TEM standards, up to two site modifiers were used to define an ecosystem unit. The following site modifiers were mapped within the study areas:

Modifier	Criteria
a	active floodplain ¹ – the site series occurs on an active fluvial floodplain, where evidence of active sedimentation and deposition is present.
g	gullying ¹ occurring – the site series occurs within a gully, indicating a certain amount of variation from the typical, or the site series has gullying throughout the area being delineated.
h	hummocky ¹ terrain – the site series occurs on hummocky terrain, suggesting a certain amount of variability.
j	gentle slope – the site series occurs on gently sloping topography (less than 25% in the interior, less than 35% in the CWH, CDF, and MH zones).
k	cool aspect – the site series occurs on cool, northerly or easterly aspects (285°–135°), on moderately steep slopes (25%–100% slope in the interior and 35%–100% slope in the CWH, CDF and MH zones).
n	fan ¹ – the site series occurs on a fluvial fan or on a colluvial fan or cone.
q	very steep cool aspect – the site series occurs on very steep slopes (greater than 100% slope) with cool, northerly or easterly aspects (285°–135°).
r	ridge ¹ (optional modifier)- the site series occurs throughout an area of ridged terrain, or it occurs on a ridge crest.
t	terrace ¹ – the site series occurs on a fluvial or glaciofluvial terrace, lacustrine terrace, or rock cut terrace.
w	warm aspect – the site series occurs on warm, southerly or westerly aspects (135°–285°), on moderately steep slopes (25%–100% slope in the interior and 35%–100% slope in the CWH, CDF and MH zones).
z	very steep warm aspect – the site series occurs on very steep slopes (greater than 100%) on warm, southerly or westerly aspects (135°–285°).
c	coarse-textured soils ² – the site series occurs on soils with a coarse texture, including sand and loamy sand; and also sandy loam, loam, and sandy clay loam with greater than 70% coarse fragment volume.

- d deep soil – the site series occurs on soils greater than 100 cm to bedrock
- m medium-textured soils – the site series occurs on soils with a medium texture, including sandy loam, loam and sandy clay loam with less than 70% coarse fragment volume; silt loam and silt with more than 20% coarse fragment volume; and clay, silty clay, silty clay loam, clay loam, sandy clay and heavy clay with more than 35% coarse fragment volume.
- p peaty material – the site series occurs on deep organics or a peaty surface (15–60 cm)³ over mineral materials (e.g., on organic materials of sedge, sphagnum, or decomposed wood).
- s shallow soils – the site series occurs where soils are considered to be shallow to bedrock (20–100 cm).
- v very shallow soils – the site series occurs where soils are considered to be very shallow to bedrock (less than 20 cm).

¹ *Howes and Kenk 1997*

² *Soil textures have been grouped specifically for the purposes of ecosystem mapping.*

³ *Canada Soils Survey Committee, 1987*

3.6 STRUCTURAL STAGE AND MODIFIERS

As per the latest TEM standards (RIC 1998), structural stages (ranging from 1, sparse/bryoid, through to 7, old forest) have been assigned to each polygon to describe the developmental stage of the mapped ecosystem. Substages have been mapped for structural stages 1, 2 and 3, as outlined in the following table.

Modifier	Criteria
1	Sparse / bryoid. Initial stages of primary and secondary succession (bryophytes and lichens). Time since disturbance less than 20 years for normal forest succession, but may be prolonged (50–100+ years) where there is little or no soil development (bedrock, boulder fields). Total shrub and herb cover less than 20% and tree layer cover less than 10%.
1a	Less than 10% vegetation cover.
1b	Bryophyte- and lichen-dominated communities.
2	Herb-dominated. Early successional stage or herbaceous communities maintained by environmental conditions or disturbance; dominated by herbs (forbs, graminoids, ferns). Tree layer cover less than 10%. Time since disturbance less than 20 years for normal forest succession.
2a	Forb-dominated. Herbaceous communities dominated by non-graminoid herbs, including ferns.
2b	Graminoid-dominated. Herbaceous communities dominated by grasses, sedges, reeds, and rushes.
2c	Aquatic. Herbaceous communities dominated by floating or submerged aquatic plants.
2d	Dwarf shrub-dominated. Communities dominated by dwarf woody species. (See list of dwarf shrubs assigned to the herb layer in the <i>Field Manual for Describing Terrestrial Ecosystems</i>).
3	Early successional stage or shrub communities maintained by environmental conditions or disturbance. Dominated by shrubby vegetation; tree layer cover less than 10%.
3a	Low shrub-dominated. Communities dominated by shrub layer vegetation less than 2 m tall. Time since disturbance less than 20 years for normal forest succession.

- 3b Tall shrub-dominated. Communities dominated by shrub layer vegetation that are 2–10 m tall. Time since disturbance less than 40 years for normal forest succession.
- 4 Pole / Sapling. Trees greater than 10 m tall, typically densely stocked, have overtopped shrub and herb layers. Self-thinning and vertical structure not yet evident in the canopy.
- 5 Young forest. Self-thinning evident and forest canopy has begun differentiation into distinct layers (dominant, main canopy, and overtopped). Time since disturbance is generally 40–80 years.
- 6 Mature forest. Trees established after the last disturbance have matured; a second cycle of shade tolerant trees may have become established. Time since disturbance is generally 80–250 years.
- 7 Old forest. Old, structurally complex stands composed mainly of shade-tolerant and regenerating tree species. Time since disturbance generally greater than 250 years.

3.7 ECOSYSTEM UNIT

An ecosystem unit is a combination of decile, site series code, site modifiers, and structural stage. Up to three deciles have been mapped per polygon. Figure 3 illustrates a typical ecosystem unit.

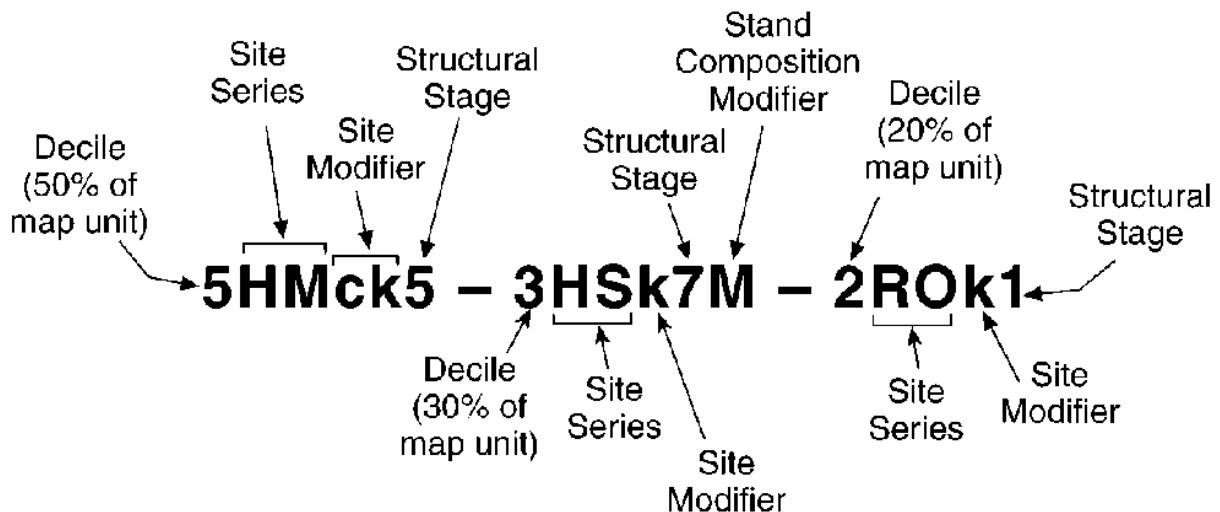


Figure 3. Example ecosystem unit (RIC 1998)

3.8 QUALITY ASSURANCE

An extensive quality assurance process is required of all TEM projects. Several specialists with the Ministry of Sustainable Resource Management (MSRM) were required to review, comment upon, and ultimately sign off the project deliverables.

Deepa Filatow, provincial bioterrain specialist, MSRM, reviewed and signed off the final bioterrain mapping.

Corey Erwin, vegetation ecologist, MSRM, reviewed and signed off the final ecosystem delineating and polygon attributes. He also reviewed the expanded legends and final report.

Tim Brierley, Ecosystem GIS Specialist, MSRM, reviewed and signed off the spatial deliverables.

4.0 EXPANDED LEGEND

An expanded legend was produced to describe each ecosystem mapped in the study areas. It includes a detailed description of each unit mapped and includes the following information: description of typical situation (slope position, surficial material, soil depth and texture, soil moisture regime, and coarse fragment content whenever available). It also includes a list of the dominant and associate vegetation species for all potential structural stages. For the structural stages where field information was lacking, the expected vegetation species were extrapolated from the Regional field guide or, preferably, from an ecosystem legend completed in a neighbouring study area (Marcoux et al. 1995).

The legends for all forested sites contain vegetation lists for herb-dominated through old forest structural stages (stages 2 through 7, respectively). For edaphic sites, such as avalanche tracks or meadow ecosystems) only the herb and/or shrub structural stages (stages 2 and 3, respectively) were described.

5.0 LIMITATIONS

Several limitations were encountered within the two project areas, and are briefly outlined below.

- Access limitations within Chilliwack Lake Provincial Park prohibited sampling within the high elevation BEC units, including MHmm2, MHmmp2, and AT. All plots were completed below 1250m, within the CWHds1 and CWHms1 BEC units. Note, there is very limited ability to land a helicopter at high elevations within this park. Consequently, the Chilliwack study area was sampled at Level 5 TEM intensity, rather than Level 4, as originally anticipated.

- As per the scope of the project, wildlife habitat information was not collected at the sampling locations, although this would have been useful for the development of future capability / suitability (CAPSU) ratings.
- Wherever possible, field plots were completed in a variety of ecosystems. However, due to limitations in sampling time and access, many of the mapped ecosystems were not verified in the field. Wherever available for these ecosystems, the ‘typical situation’ description and list of dominant and associate vegetation species have been borrowed from the biophysical map legend produced by Marcoux et al. (1995). For units not in their legend, the vegetation lists in the expanded legend were derived from the vegetation table summaries within Land Management Handbook 28 (Green and Klinka 1994).
- In several cases, generic wetland units (I.e. marsh, organic sedge fen) were mapped, thereby limiting the level of detail. The codes for these units, developed primarily for predictive ecosystem mapping projects, were obtained from the latest version of mapcodes (*mapcodes_nov2001.xls*). The vegetation lists developed for these units have not been confirmed with field sampling.

6.0 REFERENCES

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