TERRESTRIAL ECOSYSTEM MAPPING
BRITTAIN LANDSCAPE UNIT

Prepared For:

Sunshine Coast Timber Supply Area Licensee Group
Ian Robertson, R.P.F., FIA Coordinator
c/o International Forest Products Ltd.
311-1180 Ironwood St
Campbell River, BC V9W 5P7

Prepared By:

Timberline Natural Resource Group
401-958 West 8th Ave
Vancouver, BC V5Z 1E5

March 31, 2009

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Natural Resource Group

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Natural Resource Group

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311-1180 Ironwood St.
Campbell River, BC
V9W-5P7

Attention: Ian Robertson, R.P.F., FIA Coordinator

Reference: **Terrestrial Ecosystem Mapping within the Sunshine Coast TSA: Brittain Landscape Unit**

Dear Ian,

Please find enclosed the final project deliverables for the Brittain LU TEM project:

Non-Spatial Attribute Databases

1. TEM project database - (tem_4915*_mta.csv)
2. TEM polygon database - (tem_4915_ecp.csv)
3. Venus 5.0 (ground inspection) database - (tem_4915_eci.mdb)
4. Excel (visual inspection) database - (tem_4915_eci.xls)

Reports and Legends

5. Map legend - (tem_4915_ml.pdf)
6. Expanded (vegetation) legend - (tem_4915_el.pdf)
7. Final Report - (tem_4915_rpt.pdf)

ARC/INFO Spatial Databases

8. TEM polygon information - (tem_4915_ecp.e00)
9. TEM field plot data - (tem_4915_eci.e00)

Other Deliverables (available upon request)

- Typed air photos (with numbered ecosystem polygons and labeled BGC lines)
- Original field forms

* *Business Area Project ID (BAPID, supplied from the Ministry of Environment)*

Please contact me if you have any further questions or comments on the submitted deliverables.

Sincerely,

Scott Hawker, B.Sc., R.P.Bio.
Project Manager

Timberline Natural Resource Group Ltd.

ACKNOWLEDGEMENTS

Terrestrial ecosystem mapping of the Brittain Landscape Unit could not have been successfully completed without the efforts of many people.

This project was funded through the Forest Investment Account (FIA) and was coordinated by the participating Sunshine Coast TSA Licensee Group members. Ian Robertson, R.P.F., Forsite Consultants Ltd., acted as the FIA Administrator on behalf of the Sunshine Coast TSA Licensee Group.

Ecological data collection was completed by the following Timberline staff: Scott Hawker, R.P.Bio. (Project Manager), Jim Webb, Kara Aleksich, R.P.F. and Korey Green, P.Ag. The skilled staff of Oceanview Helicopters (Powell River, BC) provided safe and efficient helicopter transportation throughout the landscape unit.

Digital photo control was completed by Andrew Neale of Andrew Neale Digital Mapping (Victoria, BC). Data capture (via monorestitution) was completed by Eros Pavan, R.P.F., of Timberline. Nick Zukanovic and Eros Pavan of Timberline provided GIS expertise throughout the project.

Helen Reid, R.P.Bio., provided an independent third party quality assurance review of the final classification, with emphasis on the quality and consistency of mapping between the mappers and on the correct use of map codes and site modifiers.

EXECUTIVE SUMMARY

The 38,000 hectare Brittain Landscape Unit (LU), situated along the western shores of Jervis Inlet on the Sunshine Coast, supports a range of natural resource and wildlife values. Industry stakeholders must balance their resource needs with community and ecological requirements. One component in creating a balance between the economic, community and ecological requirements is to catalogue the terrestrial ecosystems within the land base through the terrestrial ecosystem mapping (TEM) process. In order to catalogue the ecological resources of the Brittain LU, the Sunshine Coast Timber Supply Area (TSA) Licensees commissioned a terrestrial ecosystem mapping (TEM) project within this LU. The purpose of the project was to complete a TEM of the landscape unit for use in future timber supply reviews and other resource management activities. A total of **3,370** terrestrial ecosystem polygons were mapped within this landscape unit.

Mapping was completed according to the *Standards for Terrestrial Ecosystem Mapping in British Columbia* (RIC 1998), although the project followed a non-standard approach, as outlined in this document. As per standard TEM projects, the ecosystem mapping was based on the three level ecosystem classification framework, which includes ecoregion units, biogeoclimatic units and ecosystem units. Following prior discussions between the mapping contractor (Timberline), the Sunshine Coast TSA Licensees and Ministry of Environment staff in the previous fiscal years, several variances were granted from the 1998 TEM standards. The following approved variances applied to this project:

- Bioterrain attributes were not mapped;
- Structural stage attributes were not mapped;
- The sampling intensity targets applied largely to the productive forest land base (i.e. parkland ecosystems were not as intensively field sampled; they were largely photo interpreted);
- FS882 (detailed) field forms were not completed in the field;
- The Coastal Mountain-heather Alpine (CMA) zone was neither mapped nor classified; and
- The expanded legend did not provide a detailed listing of vegetation species by structural stage.

The following five biogeoclimatic units were mapped in the project area:

- CWHdm – dry maritime Coastal Western Hemlock subzone
- CWHvm1 – submontane very wet maritime Coastal Western Hemlock variant
- CWHvm2 – montane very wet maritime Coastal Western Hemlock variant
- MHmm1 – windward moist maritime Mountain Hemlock variant
- MHmmp1 – windward moist maritime Mountain Hemlock parkland variant

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1 INTRODUCTION

1.1 Project Background

The 38,000 hectare Brittain Landscape Unit (LU), situated along the western shores of Jervis Inlet on the Sunshine Coast, supports a range of natural resource and wildlife values. The relative remoteness and limited public access within this landscape unit prohibits it from receiving extensive recreation use. Recreation activities in the area include sailing, kayaking, fishing, hiking and wildlife viewing. In recent years, the primary industry within the landscape unit has been forestry. Industry stakeholders must balance their resource needs with community and ecological requirements. One component in creating a balance between the economic, community and ecological requirements is to catalogue the terrestrial ecosystems within the land base through the terrestrial ecosystem mapping (TEM) process.

As defined in the current TEM standards (RIC 1998), terrestrial ecosystem mapping is the stratification of a landscape into discrete map units, according to a combination of ecological features, primarily climate, physiography, surficial material, bedrock geology, soil and vegetation.

Together, the ecological features result in distinctive and repeatable site conditions and climax vegetation communities (site series) across the landscape. Each site series depicts a specified range of vegetation species and site productivity that can be found in a particular location. Ecosystem polygons are essentially lines that demarcate the site series or site series complexes.

TEM data forms a planning framework for a wide range of land or ecosystem-based management applications including:

- base-case analysis in timber supply reviews (TSR),
- ecosystem distribution and sensitivity analysis,
- long-term ecological monitoring,
- habitat supply modeling and assessment,
- rare ecosystem, plant or animal mapping or modeling,
- forest development, silviculture, site productivity (SIBEC) planning,
- riparian, biodiversity planning,
- wildfire risk analysis, and
- other operational and strategic planning initiatives.

The Sunshine Coast TSA Licensee Group commissioned this project with funding from the Forest Investment Account (FIA). This project contained several variances from the TEM standards (RIC 1998), as the priority was to complete ecosystem mapping for the forested land base. Note that a Vegetation Resources Inventory (VRI) project is being

completed concurrently within the Sunshine Coast TSA and therefore the structural stage attributes were not a deliverable for this mapping project.

1.2 Objectives

The objectives of this mapping project within the Brittain Landscape Unit were to:

1. delineate the terrestrial ecosystems;
2. collect field data to better describe the site series;
3. field sample forested landscapes to Survey Intensity Level 4;
4. assess biogeoclimatic lines and provide new elevation rules, if necessary;
5. provide a seamless map of terrestrial ecosystems (with localized biogeoclimatic information); and to
6. provide deliverables for submission into the Ministry of Environment's Ecological Reports Catalogue (EcoCAT).

1.3 Study Area

1.3.1 Location

At nearly 38,000 hectares, the Brittain LU is located along the western shores of Jervis Inlet, on the Sunshine Coast. It encompasses the watersheds of the Brittain River and a number of other smaller creeks, all of which drain into Jervis Inlet. This landscape unit covers portions of the following 1:20,000 scale BCGS mapsheets:

- 092F100
- 092G081, 092G091
- 092J001, 092J011
- 092K010, 092K020, 092K030

The Brittain LU lies within the traditional territory of the Sechelt (shíshálh) First Nation, which has a small reserve within the landscape unit, at the mouth of the Brittain River.

Figure 1 presents an overview map of the Sunshine Coast Forest District (Sunshine Coast Timber Supply Area). The Brittain LU boundary is illustrated in Figure 2 (the pale green areas represent the TSA land base).

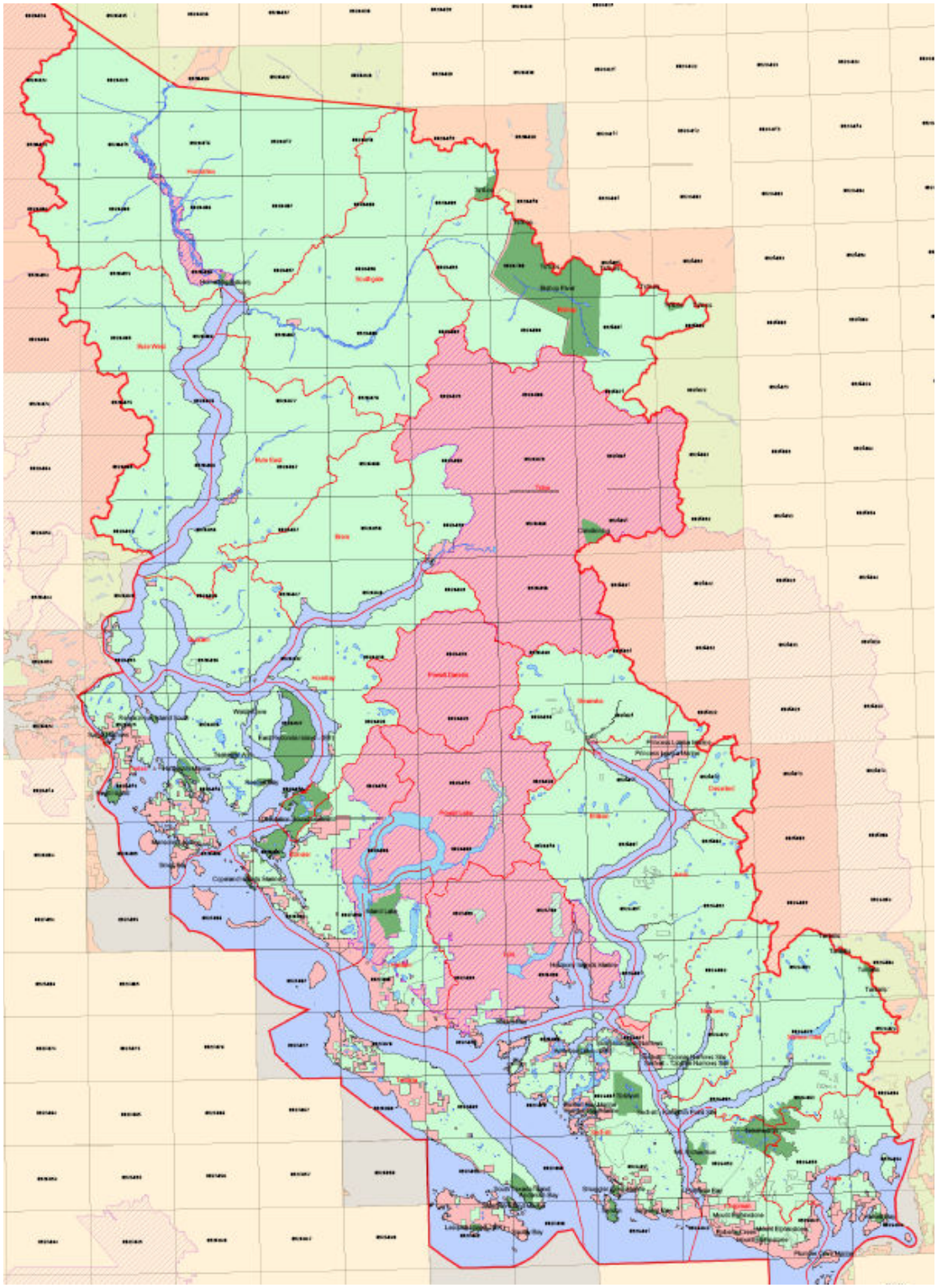

Figure 1. Sunshine Coast Timber Supply Area

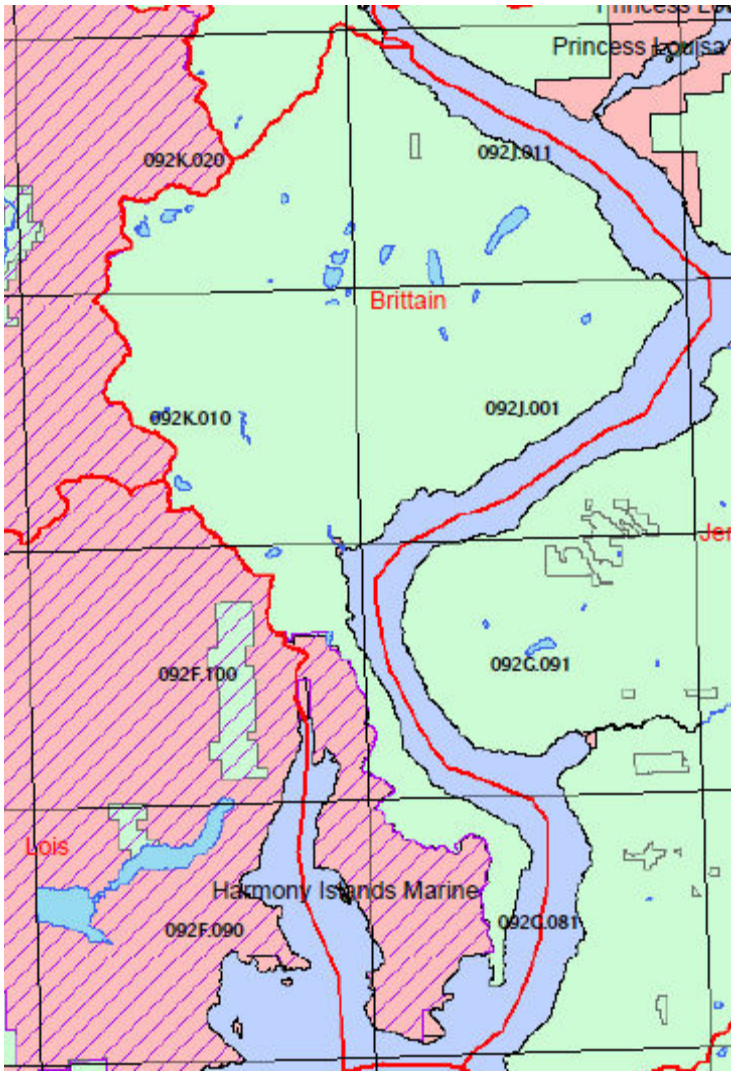

Figure 2. Brittain LU boundary overview

1.3.1.1 Biophysical Classification

There are two related systems for describing landscapes in BC. The Ecoregion Classification System is a hierarchical system that provides a broad view of geographical relationships (Demarchi 1996). The Biogeoclimatic Ecosystem Classification (BEC) system provides another hierarchical classification method from the landscape to the site level (Pojar et al. 1987). The BGC subzones, which are a hierarchical unit within this system, are unique to each ecosection.

The Brittain LU falls entirely within the Pacific Ranges Ecoregion (Figure 3). According to Demarchi (1996), this ecoregion includes the southern-most mountain range of the Coast Mountains in British Columbia. It includes the coastal islands, channels and fjords east of Queen Charlotte Sound; otherwise it lies east of the Georgia Depression Ecoprovince. The mountains are characteristically high and rugged throughout this ecoregion.

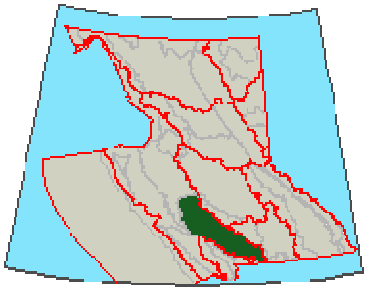

Figure 3. Pacific Ranges Ecoregion

The Pacific Ranges Ecoregion consists of four Ecosections. One of these, the Southern Pacific Ranges (SPR) Ecosection, is mapped within the Brittain LU.

The BGC subzones and variants mapped within the Brittain LU are described in Table 1. The elevation ranges and descriptions are adapted from Green and Klinka's (1994) A Field Guide for Site Identification and Interpretation for the Vancouver Forest Region: Land Management Handbook Number 28. Further descriptions and notes on the distribution of each unit, including the elevations at which each biogeoclimatic unit has been mapped for this project, are included in Section 3.

Table 1. Field Guide descriptions of the BGC units within the Brittain LU

Ecosection	BGC Unit	Name	Elevation Range (m)	Climate
Southern Pacific Ranges	CWHdm	dry maritime Coastal Western Hemlock subzone	0 – 650 m	warm, relatively dry summers and moist, mild winters with little snowfall
	CWHvm1	submontane very wet maritime Coastal Western Hemlock variant	0 – 650 m	wet, humid climate with cool summers and mild winters; relatively little snow
	CWHvm2	montane very wet maritime Coastal Western Hemlock variant	650 – 1000 m	wet, humid climate with cool, short summers and cool winters; heavier snow than vm1
	MHmm1	windward moist maritime Mountain Hemlock variant	Lower (800 to 1000 m); Upper (1100 to 1350 m)	long, wet, cold winters with high snowfall and short, cool , moist summers
	MHmmp1	windward moist maritime Mountain Hemlock parkland variant	above MHmm1	very long, wet, cold winters with high snowfall

1.3.2 Climate

The Brittain Landscape Unit is subject to a submaritime climate with warm, dry summers and cool, wet winters. The climate changes with elevation, however, as represented by the five (excluding the CMA zone) Biogeoclimatic subzones mapped within the landscape unit: CWHdm, CWHvm1, CWHvm2, MHmm1, and MHmmp1.

1.3.3 Hydrology

All of the water courses within the Brittain Landscape Unit drain into one of the three main reaches of Jervis Inlet: Queens Reach, Princess Royal Reach or Prince of Wales Reach. Major creeks and rivers within this landscape unit include, from south to north, Brittain River, Seshal Creek, Osgood Creek, Smanit Creek and Slane Creek. McCannell Lake, situated between Smanit Creek and Crabapple Creek, towards the northern end, is the largest lake in the landscape unit.

Given the abundance of steep, mountainous streams, there are currently four independent power project (IPP) applications within this landscape unit (http://www.ippwatch.info/cms/index.php). Hawkeye Energy Corporation has applications under varying stages of review for proposed projects on Slane Creek, Smanit Creek, Osgood Creek and Seshal Creek.

1.3.4 Topography and Soils

The topography of the Brittain LU is comprised largely of steep and gullied mountainous terrain, and is very typical of the terrain conditions observed across the inlet in the neighbouring Jervis Landscape Unit as well as in the other landscape units in the Earle Range (Figure 4). The steep, gullied terrain results in an abundance of exposed or shallow, rocky slopes at middle and high elevations and coarse-textured colluvial deposits (including colluvial cones and fans) along many of the lower slopes. Owing to its rugged nature, much of the landscape unit, especially at mid to high elevations) is largely inaccessible for ground-based field assessments (top to bottom ‘cross-elevation’ transect opportunities are rare).

Figure 4. Typical topography surrounding Jervis Inlet

There are several large meandering rivers within the Brittain LU, including the Brittain River, Smanit Creek and Seshal Creek (Figure 5), which is bound on both sides by steep forested slopes.

Figure 5. View to the northeast into the Seshal Creek valley

Most of the accessible valleys and slopes have extensive road systems and have been heavily harvested within the last 80 years (many of the existing TRIM roads are long overgrown and cannot be used for sampling access). Where road systems have not been built, the terrain is often extremely steep, gullied or rocky.

Podzols, characterized by red-brown B horizons dominated by accumulations of aluminum, iron and humified organic material, typically develop on coarse- to medium-textured, acidic parent materials. They are widespread on both glacial till and colluvium throughout the study area. Regosols occur in areas dominated by regenerating moraine deposits (recently deglaciated areas). Such areas occur throughout the landscape unit at higher elevations. Gleysols, typical of local wetter areas, are characterized by mottled grey colours due to prolonged saturation of the soils or fluctuating water levels throughout the year.

2 METHODOLOGY: ECOSYSTEM MAPPING

A full summary of the hierarchical framework of ecosystem mapping used in BC is described in Appendix 1.

The following project phases were completed within the fiscal 2008-2009 year:

- Field data collection,
- Data entry (Venus 5.0 and MS Excel),
- Edits to ecosystem polygons and refinement of the preliminary BGC lines following field sampling, as required,
- Ecosystem classification (polygon attribution),
- Third party Quality-Assurance of the final classification and mapping,
- Preparation of final digital (GIS) data, and
- Final reporting and data preparation.

The following Ministry of Environment-approved variances from a standard TEM project applied to this project:

- Pre-stratification of terrain polygons was not completed (not a standard 'bioterrain-based' approach).

- The field program consisted of a combination of ground inspections and visual inspections in a targeted ratio of 70% visual inspections and 30% ground inspections at a sampling density, within the productive forested land base, of one plot per 100 hectares.

- Detailed *FS882* (ecosystem) plots were not completed in the field.

- Structural stage attributes were not catalogued as these attributes are being concurrently described in a VRI program.

- The ecosystems within the CMA zone were neither delineated nor classified.

- The expanded legend did not provide a detailed vegetation list within each structural stage.

2.1 Polygon delineation: Non-standard approach

Although this project did not follow a standard approach to delineating the bioterrain polygons, it should be noted that the process to delineate the ecosystem polygons followed the same basic principles that are followed in the delineation of standard TEM bioterrain polygons (i.e. an initial stratification of the landscape according to the physical conditions that influence ecosystem development and expression).

The ecosystem polygons were delineated within the Brittain LU to capture the differences within the following criteria:

- surficial material types and texture (affecting soil drainage),
- surface expression (landform and thickness),
- slope position and gradient,
- topography,
- TEM aspect class (cool and warm), and
- geomorphologic process (gullying, avalanching, meandering river etc).

2.2 Field Planning

A preliminary sampling plan was developed prior to the commencement of field work. This plan identified the biogeoclimatic units and potential ecosystem units expected in the area and a working legend of expected map units was developed. In devising a preliminary plan, aerial photographs and overview maps were examined to identify accessible areas for potential field sampling. The potential sampling sites were selected to provide a cross section of the biogeoclimatic units and topographic relief present within the landscape unit.

2.3 Field Sampling

The targeted plot production was largely based upon the productive forest land base. In the digital netdown process (to estimate a productive forest land base), a final productive land base was estimated at approximately 24,000 hectares. Although ecosystem delineation and classification were completed for the MHmmp1 (parkland) variant, field sampling was largely focused on the productive forested land base within the CWH and MH zones.

Field sampling (Figure 6) within the Brittain LU was completed over several days in September 2008. Helicopter and boat access was required to sample within a range of elevations and ecosystem types. This landscape unit was slightly over-sampled on purpose to help account for the opportunities lost in the Jervis Landscape Unit due to frequent poor weather on the previous sampling trip. With very similar landscapes and

geomorphologic processes, the plots completed within the Brittain LU are deemed to be of value in understanding the ecosystems on similar slopes gradients and slope positions that could not be sampled within the neighbouring Jervis Landscape Unit.

Figure 6. Field sampling within the Brittain LU

The extent of steep, inaccessible slopes at all elevations within this landscape greatly limited the opportunities for ground-based assessments and cross-elevation transects, especially within the middle and higher elevation BGC subzones / variants. Although the field maps depict existing road locations throughout many valleys of the landscape unit, most of them are (often decades) old logging roads that have long since been deactivated and are too thickly overgrown to be used as an access point for TEM ground sampling. There was no vehicle access in the unit. While the crews were sampling in the area, road crews were repairing the road and bridge along the west side of the Brittain River.

A total of **279** field plots were completed within the Brittain LU study area, consisting of **83** ground inspections and **196** visual inspections. The location of all field plots and air calls were marked and recorded on the air photos or maps at the time of field sampling. Wherever possible, Global Positioning System (GPS) point locations were also recorded in the field. Where satellite coverage was insufficient for an accurate measurement, the field plot locations were marked directly onto air photos. Crews ensured, wherever possible, that the chosen sampling locations expressed homogeneous site, soil and vegetation characteristics. The *Field Manual for Describing Terrestrial Ecosystems* (Ministry of Forests and BC Environment 1998) provided a detailed methodology for data collection at the ground inspections locations. Standard TEM ground inspection forms (GIF) were used for the ground inspections and for some of the visual inspections. Other visual inspections and air calls were recorded as hand-written notes on field note paper.

2.4 Data Entry and Analysis

The ground inspection data was entered into the Ministry of Environment's VENUS 5.0 data entry program and the visual inspections were entered into a Microsoft Excel spreadsheet. Both of the databases are submitted with this project.

Upon completion of the field program, each of the project ecologists reviewed the field forms in the office for completeness and accuracy and to ensure that all plot locations were accurately transferred into the GIS spatial database.

2.5 Ecosystem Mapping

Following completion of the field sampling and subsequent review of the field data, the ecosystem polygons were digitized (via monorestitution). The polygons were assigned a unique number and plotted onto a base map that included contour lines and Terrain Resources Information Mapping (TRIM) hydrology features in preparation for ecosystem classification.

Each of the ecosystems were classified and entered into a Microsoft Excel TEM ecosystem 'polygon' database. The ecosystem unit labels were recorded by a project ecologist through manual examination of the air photos using a combination of a Sokkisha MS-27 mirror stereoscope, with 3X binocular attachment for enhanced resolution. The core data entered in the ecosystem database for each polygon includes:

- BCGS Mapsheet Number;
- Polygon number (ECP_Tag);
- Data source (Photo Interpreted, Ground Inspection, or Visual Inspection);
- Flight line (project specific) and photo number;
- Ecosection code;
- Biogeoclimatic zone, subzone, and variant;
- Ecosystem labels [decile, site series, modifier(s) and structural stage: recorded up to three times per polygon];
- User-defined field: Other "point-feature" habitat elements that are <20% of the polygon area (i.e. RO, TA, OW etc. that may be of importance for future habitat analysis);
- Polygon area (hectares); and
- Comments: additional information on the polygon, including some point wildlife and/or habitat observations.

Each of the ecosystem polygons has been classified as either a single ecosystem unit (simple label) or as a complex unit, with either two or three (maximum) ecosystem units per polygon. Each polygon includes a site series number (and TEM alpha map code) and has been described with up to three site modifier(s) where the conditions differ from the assumed conditions described in the provincial database for each site series. For the complexed units, only the ecosystems estimated to cover approximately 20% of the total polygon area have been recorded.

Draft ecosystem maps were created in ARC/INFO format by combining the base map coverage, polygon digital files and the ecosystem databases.

2.6 Expanded Vegetation Legend

A modified expanded vegetation legend was developed in Microsoft Word and is attached as Appendix 2. Whereas a standard legend has a detailed list of vegetation species for all potential structural stages, this legend does not differentiate between structural stages. The legend provides the following information for each mapped ecosystem unit (site series):

- a description of the typical situation in which the unit has been mapped,
- the assumed modifiers and typical soil moisture regime,
- the provincial, approved, site series (2-letter) map code,
- all mapped modifiers,
- the dominant vegetation species, by layer (tree, shrub, herb and moss layers),
- the associated vegetation species by layer (tree, shrub, herb and moss), and a
- list of the field plots established within each of the units.

For the units not confirmed with field plots, the typical situations and vegetation lists were derived from a combination of the provincial TEM map code database and the current Land Management Handbook for the Vancouver Forest Region: LMH28 (Green and Klinka 1994).

3 RESULTS: MAPPED BGC UNITS AND ECOSYSTEMS

A summary of the ecosystem units mapped in the project area is provided below. A full description of the plant associations within each ecosystem mapped in each of the BGC units is provided on separate tables found in Appendix 2.

3.1 Biogeoclimatic Units

Table 2 summarizes the number of polygons mapped within each of the BGC units within the Brittain Landscape Unit. Across the landscape unit, but excluding the unmapped CMA zone, the average TEM polygon size is **10.3 hectares**, slightly below the typical TEM polygon size range of 12 to 15 hectares.

Table 2. Summary of mapped polygons by BGC unit

BGC Unit	Name	# Polys	Area (Ha)
CWHdm	Dry maritime Coastal Western Hemlock subzone	540	8,040.8
CWHvm1	Submontane very wet maritime Coastal Western Hemlock variant	302	3,919.8
CWHvm2	Montane very wet maritime Coastal Western Hemlock variant	943	8,886.0
MHmm1	Windward moist maritime Mountain Hemlock variant	922	7,377.8
MHmmp1	Windward moist maritime Mountain Hemlock parkland variant	654	6,302.5
CMA	Coastal Mountain-heather Alpine zone	9	3,532.4

Following are descriptions of each of the biogeoclimatic (BGC) units mapped within the Brittain Landscape Unit.

3.1.1 CWHdm

The Dry Maritime Coastal Western Hemlock subzone (CWHdm) has been mapped at the lowest elevations throughout the landscape unit, primarily along the outer shorelines. Confirmed in the field, it has been mapped to an elevation of approximately 650 metres, below the CWHvm2 variant. The CWHdm subzone is replaced by the CWHvm1 variant at elevations below 650 metres within the Smanit Creek and Brittain River valleys.

With 540 TEM polygons mapped within the CWHdm subzone, the average polygon size is **14.9** hectares (Table 3). Where applicable, any map units that have been borrowed from other BGC units (as listed in the user-defined deliverable), have been noted within the table.

Table 3. Vegetated site series mapped within CWHdm

Site Series	Map Code	Site Series Name
01	HM	Hw - Flat Moss
02	DC	FdPl - *Cladina*
03	DS	FdHw - Salal
04	DF	Fd - Sword Fern
05	RS	Cw - Sword Fern
06	HD	HwCw - Deer Fern
07	RF	Cw - Foamflower
09	CD	Act - Red-Osier Dogwood
12	RC	CwSs - Skunk Cabbage
00	AA	Ba – Alaskan Blueberry (MHmm2)
00	BT	Brushy Talus
00	FS	Carex Fen (CWHvm1)
00	RM	Cw - Fern Bluffs
00	SA	Sitka Alder - Salmonberry Avalanche Chute

3.1.2 CWHvm1

The Submontane Very Wet Maritime Coastal Western Hemlock variant replaces the CWHdm subzone (at elevations below 650 metres) in valleys that are subject to a wetter and cooler climate than the CWHdm subzone. The areas mapped as CWHvm1 typically contain a component of *Abies amabilis* in the tree (A) and shrub (B) structural layers. As per the CWHdm subzone, the CWHvm1 variant has been mapped from valley bottom to approximately 650 metres elevation within this landscape unit, also below the CWHvm2 variant. The CWHvm1 variant has been mapped within the Smanit Creek and Brittain River drainages.

With 302 TEM polygons mapped within the CWHvm1 variant, the average polygon size is **13.0 hectares** (Table 4). Where applicable, any map units that have been borrowed from other BGC units (as listed in the user-defined deliverable), have been noted within the table.

Table 4. Vegetated site series mapped within CWHvm1

Site Series	Map Code	Site Series Name
01	AB	HwBa - Blueberry
02	LC	HwPl - *Cladina*
03	HS	HwCw - Salal
04	RS	CwHw - Sword Fern
05	AF	BaCw - Foamflower
06	HD	HwBa - Deer Fern
07	AS	BaCw - Salmonberry
09	SS	Ss - Salmonberry
10	CD	Act - Red-Osier Dogwood
14	RC	CwSs - Skunk Cabbage (Ws54 - CwHw - Skunk Cabbage)
00	AA	Ba – Alaskan Blueberry (MHmm2)
00	AW	Red Alder - Fern
00	BT	Brushy Talus
00	FS	Carex Fen
00	IF	Indian Hellebore - Fern
00	RM	Cw - Fern Bluffs
00	SA	Sitka Alder - Salmonberry Avalanche Chute

3.1.3 CWHvm2

The Montane Very Wet Maritime Coastal Western Hemlock variant has been mapped above the CWHdm subzone and CWHvm1 variant throughout the landscape unit. It has been mapped between approximately 650 metres and 1000 metres (slightly higher on warm aspects), above which the MHmm1 variant has been mapped.

With 943 TEM polygons mapped within the CWHvm2 variant, the average polygon size is **9.4 hectares** (Table 5). Where applicable, any map units that have been borrowed from other BGC units (as listed in the user-defined deliverable), have been noted within the table.

Table 5. Vegetated site series mapped within CWHvm2

Site Series	Map Code	Site Series Name
01	AB	HwBa - Blueberry
02	LC	HwPl - *Cladina*
03	HS	HwCw - Salal
04	RS	CwHw - Sword Fern
05	AF	BaCw - Foamflower
06	HD	HwBa - Deer Fern
07	AS	BaCw - Salmonberry
09	YG	CwYc - Goldthread
10	LS	Pl – Sphagnum (Wb51 – Plc – Black Crowberry - Tough Peat-Moss)
11	RC	CwYc - Skunk Cabbage
00	AA	Ba - Alaskan Blueberry (MHmm2)
00	AW	Red Alder - Fern
00	BT	Brushy Talus
00	FS	Carex Fen
00	HW	Shrub Carr
00	IF	Indian Hellebore - Fern
00	MK	Mountain Hemlock - Krummholz
00	RM	Cw - Fern Bluffs
00	SA	Sitka Alder - Salmonberry Avalanche Chute
00	YB	HmYc - Blueberry - Mountain Heather

3.1.4 MHmm1

Throughout the landscape unit, the Windward Moist Maritime Mountain Hemlock variant has been mapped above the CWHvm2 variant. It has been typically mapped to approximately 1200 metres on a variety of aspects (slightly higher on some steeper warm aspects).

With 922 TEM polygons mapped within the MHmm1 variant, the average polygon size is **8.0 hectares** (Table 6). Where applicable, any map units that have been borrowed from other BGC units (as listed in the user-defined deliverable), have been noted within the table.

Table 6. Vegetated site series mapped within MHmm1

Site Series	Map Code	Site Series Name
01	MB	HmBa - Blueberry
02	MM	HmBa - Mountain Heather
03	MO	BaHm - Oak Fern
04	AB	HmBa - Bramble
05	MT	BaHm - Twistedstalk
06	MD	HmYc - Deer Cabbage
07	YH	YcHm - Hellebore
08	YS	HmYc - *Sphagnum*
00	AA	Ba - Alaskan Blueberry (MHmm2)
00	BT	Brushy Talus
00	FS	Carex Fen
00	HM	Heather Meadow
00	IF	Indian Hellebore - Fern
00	LD	Arctic Lupine - Subalpine Daisy
00	MH	Hm - Mountain Heather Parkland / Heath
00	MK	Mountain Hemlock - Krummholz
00	MR	Mountain-Heather - *Racomitrium* Scrub
00	SA	Sitka Alder - Salmonberry Avalanche Chute
00	SL	Sedge - Leatherleaf Saxifrage
00	SS	Sedge Parkland Meadows (MHmmp1)
00	TS	Non-Forested Wetland
00	YB	HmYc - Blueberry - Mountain Heather
00	YM	Yellow Cedar - Mountain Hemlock Cliff
00	YR	Yc - *Racomitrium* Bluffs

3.1.5 MHmmp1

The Windward Moist Maritime Mountain Hemlock Parkland variant has been mapped above the MHmm1 variant throughout the landscape unit. It has typically been mapped to approximately 1500 metres on warm aspects and to 1400 metres (or lower) on cool aspects, above which the Coastal Mountain-heather Alpine (CMA) Zone has been mapped. Within the MHmmp1 parkland variant, the summers are short and cool, with snow cover lasting well into early summer, and the winters are long and cold with deep snow accumulations.

With 654 TEM polygons mapped within the MHmmp1 parkland variant, the average polygon size is **9.6 hectares** (Table 7). Where applicable, any map units that have been borrowed from other BGC units (as listed in the user-defined deliverable), have been noted within the table.

Table 7. Vegetated ecosystem units mapped within MHmmp1

Site Series	Map Code	Site Series Name
00	AA	Ba - Alaskan Blueberry (MHmmp2)
00	BT	Brushy Talus
00	HM	Heather Meadow
00	IF	Indian Hellebore - Fern
00	LD	Arctic Lupine - Subalpine Daisy
00	MB	Mountain Hemlock - Amabilis Fir - Blueberry
00	MD	Mountain Hemlock - Yellow Cedar - Deer Cabbage
00	MH	Hm - Mountain-Heather Parkland / Heath
00	MK	Mountain Hemlock Krummholz
00	MR	Mountain-Heather - *Racomitrium* Scrub
00	SA	Sitka Alder - Salmonberry Avalanche Chute
00	SS	Sedge Parkland Meadows
00	YB	HmYc - Blueberry - Mountain Heather (MHmm1)
00	YM	Yellow Cedar - Mountain Hemlock Cliff

3.1.6 Non-vegetated units

The following non-vegetated units (Table 8) have been mapped throughout the Brittain Landscape Unit:

Table 8. Non-vegetated units mapped within the Brittain LU

Site Series	Map Code	Site Series Name
00	CL	Cliff
00	ES	Exposed Soil
00	GB	Gravel Bar
00	LA	Lake
00	MN	Moraine
00	OW	Shallow Open Water
00	PD	Pond
00	RI	River
00	RO	Rock Outcrop
00	TA	Talus

4 QUALITY CONTROL

4.1 Internal Quality Control

Internal quality control was undertaken through all phases of this project. This included internal reviews of preliminary ecosystem delineation, review of preliminary BGC boundaries, especially in placement of parkland and alpine boundaries, and a final review of all field forms for logic and completeness of data.

The final deliverables were subject to a quality control process before final submission of the deliverables. In this process, Timberline's project manager:

1. deleted all small 'sliver polygons' (typically < 1ha);
2. checked the spatial and non-spatial data to ensure a 1:1 link of the polygon data;
3. reviewed the database to ensure all deciles of complex map units sum to 100%;
4. reviewed the database to ensure the correct application of site modifiers (for the assumed and mapped modifiers);
5. reviewed the database to ensure that the provincial standard TEM codes have been applied to the ecosystems;
6. reviewed the database to ensure that no duplicate or blank fields remain for any of the polygons;
7. visually assessed the final dataset to ensure that every polygon within a specific BGC unit has been mapped appropriately (for example, to ensure there are no CWHvm1 labels within the MHmm1 BGC variant); and
8. completed a final review of the Venus and Excel databases for overall completeness.

4.2 External Quality Control

An independent assessment of mapping quality was completed by Helen Reid, R.P.Bio. The QA report has been provided to the Sunshine Coast Licensee Group.

5 REFERENCES

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APPENDIX 1: ECOSYSTEM UNIT MAPPING - BACKGROUND

Ecosystem mapping is based on the three level ecosystem classification framework defined by BC's Resource Inventory Committee (RIC 1998). This framework consists of ecoregion units, biogeoclimatic units and ecosystem units. Ecosystem unit labels consist of three components: site series, site modifier(s) and a structural stage. Site series are defined within the existing Ministry of Forests and Range (MoFR) biogeoclimatic ecological classification system.

Non-forested ecosystem units (i.e. avalanche units, parkland forest, heathland, and wetlands) may also be encountered that are presently not included in the MoFR site series classification. Definitions and codes for these units may be selected from the Ministry of Environment Provincial Site Series Code list.

Ecoregion

The ecoregion classification system is used to stratify BC's terrestrial and marine ecosystems into discrete geographical units. This system describes areas of similar climate, physiography, oceanography, hydrology, vegetation and wildlife potential (Demarchi 1993). Ecosection boundaries are delineated on 1:2,000,000 and 1:50,000 terrestrial ecosystem maps. There are five levels of classification. The two highest levels, Ecodomains and Ecodivisions, place BC in a global context. The three lowest levels, Ecoprovinces, Ecoregions and Ecosections, relate segments of the province to one another.

Biogeoclimatic Subzones

Within each ecoregion unit, biogeoclimatic (BGC) units are used to identify zonal climates and ecosystems. A zonal site is one that best represents the regional climate of an area. Subzones are subsets of zones and consist of unique sequences of geographically related ecosystems (Meidinger and Pojar 1991). Figure 1 below depicts the ecosection and biogeoclimatic unit labels as they appear on typical ecosystem maps (RIC 1998).

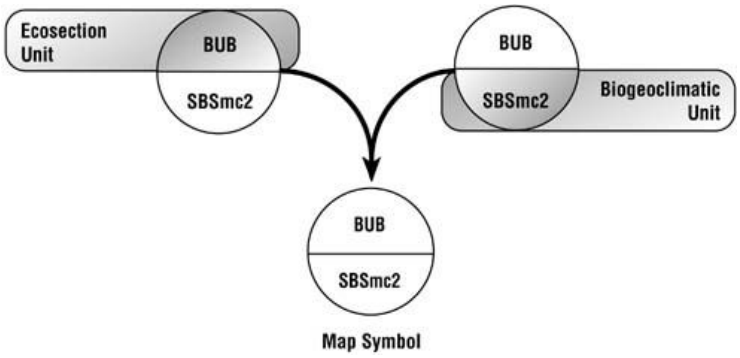

Figure 1. Symbols for Ecosection and Biogeoclimatic Units

Biogeoclimatic Variants

The BGC variants are a subdivision of a subzone. Because each subzone has considerable variability, variants are used to further reflect differences in climate. These climatic variations give rise to changes in vegetation, soil and ecosystem productivity (Meidinger and Pojar 1991). Figure 2 below (RIC 1998) illustrates the symbols used for biogeoclimatic units.

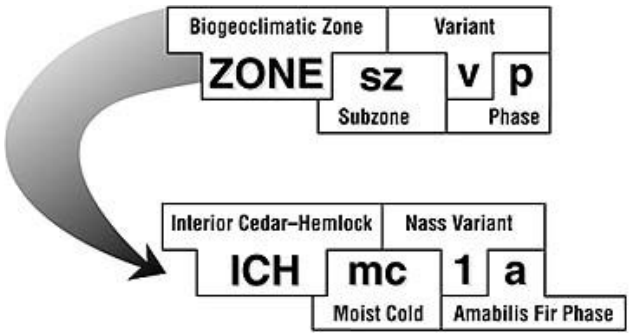

Figure 2. Symbols for biogeoclimatic units

Ecosystem Units

Ecosystem units incorporate the site series of biogeoclimatic classification 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. Ecosystem units are typically composed of three components: site series, site modifiers, and structural stage. Ecosystem units have also been developed for non-forested ecosystems presently not included in the MoFR's site series classification system.

Site Series

Site series are the first component of an ecosystem unit. Site series have been developed to describe variation at the site level within the BGC units (RIC 1995, 1998). The site series describe all land areas capable of supporting a specific climax plant association and reflecting a specified range of soil moisture and nutrient regimes within a subzone or variant (RIC 1995, 1998). A two-letter symbol (map code) is assigned to each site series and each map code is unique to each BGC subzone and variant.

Site Modifiers

Site modifiers are used to refine each site series into more specific ecosystem units based upon distinguishing site, soil and terrain characteristics. Typical (or assumed) environmental conditions (modifiers) have been defined for each site series within the MoFR's BGC classification system (RIC 1998). Site modifiers are used to describe sites that differ from the typical conditions.

Table 1 below lists the mapped site modifiers, as defined by the BC Resource Inventory Committee (1998). Within the CWH and MH zones, aspect modifiers apply to slopes greater than 35%.

Table 1. Site Modifiers

Code	Criteria
Topography	
a	active floodplain[1] – the site series occurs on an active fluvial floodplain (level or very gently sloping surface bordering a river that has been formed by river erosion and deposition), 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 (optional modifier) – the site series occurs on hummocky terrain, suggesting a certain amount of variability. Commonly, hummocky conditions are indicated by the terrain surface expression but occasionally they occur in a situation not described by terrain features.
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 (most common), 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°).
Soil	
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**.
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

APPENDIX 2: EXPANDED LEGEND – BRITTAIN LU