Lillooet TSA Predictive Ecosystem Mapping
Final Report

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Lillooet TSA PEM Final Report

Abstract:

The following is the final report for the Lillooet PEM project that began in 2000. During the first year, we completed the data preparation of all input data layers, the bioterrain mapping, and the satellite imagery analysis. During the second year, 2001-02, we completed the first phase of the fieldwork portion for 9 BEC subzones, created the knowledge tables for these, and produced the first set of PEM maps. During the third year, 2002-03, we completed the fieldwork and knowledge tables for 15 more BEC subzones and produced the PEM maps for the northern half of the TSA. During this final year, 2003-04, we completed the fieldwork and knowledge tables for the remaining 21 BEC subzones. The finalized 1:20,000 scale BEC linework was provided by Dennis Lloyd, Regional Ecologist in the summer of 2003. The entire TSA was re-processed with the new BEC linework during the winter of 2003. All deliverables were provided by the end of March, 2004.

We were very pleased with the outcome of this PEM project. We achieved the high scores that we were anticipating. We had the opportunity to use a few new input layers in this project that helped to improve the accuracy of the PEM. The Satellite Imagery analysis was very useful for identifying open-canopy stands and non-forested units, particularly in the parkland and alpine. The Bedrock Geology layer was useful for those areas with granitic substrates since the soil mantle was typically shallow thus allowing the poor nutrient quality of the bedrock to affect the ecosystem development. The TRIM 2 base provided more information about the locations of cliffs and ridges. The Bioterrain layer contributed the most around fluvial, lacustrine, glaciofluvial, eolian, alluvial fan and organic deposits. In general, the TRIM DEM and the Forest Cover mapping were quite good and contributed the most to the accuracy of this PEM.

The high level of ecosystem complexity in this area due to the confluence of three major climatic zones (the Chilcotin Plateau, the Interior Dry Belt, and the Coastal Mountains), led to a large (46) number of BEC subzones which had to be patterned and mapped. This factor led to the length of time required to complete this project. Nevertheless, we accomplished the task under a competitive budget and were able to keep the costs on par with other PEM projects around the province that have fewer BEC subzones to deal with.

In additions, we had Cam Brown, a Strategic Analyst of Foresite Consultants (formerly of Silvatech Consulting) review the PEM output for it applicability in a Site Index Adjustment analysis. Cam was pleased with how easy it was to use these PEM results and sent us a letter with his review comments (included in this report).

We are pleased to have had the chance to complete a PEM in the Lillooet area and proudly offer this product. We look forward to future opportunities to work with the Lillooet TSA Steering Committee again.

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1. Introduction

The following report is submitted jointly by Shamaya Consulting and Silvatech Consulting Ltd., for the completion of the Lillooet Predictive Ecosystem Mapping (PEM). In 2000, the Lillooet TSA Steering Committee expressed their need for TSA-wide ecosystem mapping that will enable them to complete site index adjustment and wildlife habitat mapping, in particular for grizzly habitat. In addition, they would like to use the PEM maps for other strategic analyses such as landscape level planning, hydrological analyses, First Nations Planning, and so on. PEM maps have commonly led to an increase in allowable cuts due to the more accurate accounting of productive growing sites in the region. This has allowed Foresters to better predict the regeneration potential of the cutblocks and manage the new stands accordingly. With these objectives in mind, we were contracted to create the best PEM map possible.

The Lillooet TSA area covers 1,161,326 hectares, and includes 46 Biogeoclimatic Subzones spanning across the Pavillion Ranges, Southern Chilcotin Ranges and Leeward Pacific Ranges Ecosections (see Figure 1). The Lillooet TSA lies at the confluence of three major climatic zones: the cool, dry Chilcotin Plateau, the Interior Dry Belt and the moist Coastal Mountains. Because of this, the Lillooet TSA has the highest number of BEC subzones of all the Forest Districts in the province. The BEC subzones often occupy small areas of land, changing from one valley to the next. This made the BEC refinement task for Dennis Lloyd and crew very difficult. This PEM project was being developed simultaneously to the BEC refinement project, which resulted in our having to re-do some of our work when Dennis revised his work further.

Each PEM project has its own set of unique issues that we encounter during the development of the PEM maps. These issues do not affect the usage or accuracy of the PEM, but are useful to help explain situations that we found with the data and may be useful to Ainsworth for other projects. The issues for the Lillooet PEM are described below.

As part of this contract, we sent the output data to Cam Brown of Foresite Consultants Ltd. of Salmon Arm to review for its applicability and ease of use for Site Index Adjustment purposes. The results of this review are included in a letter from C. Brown, included in this report.

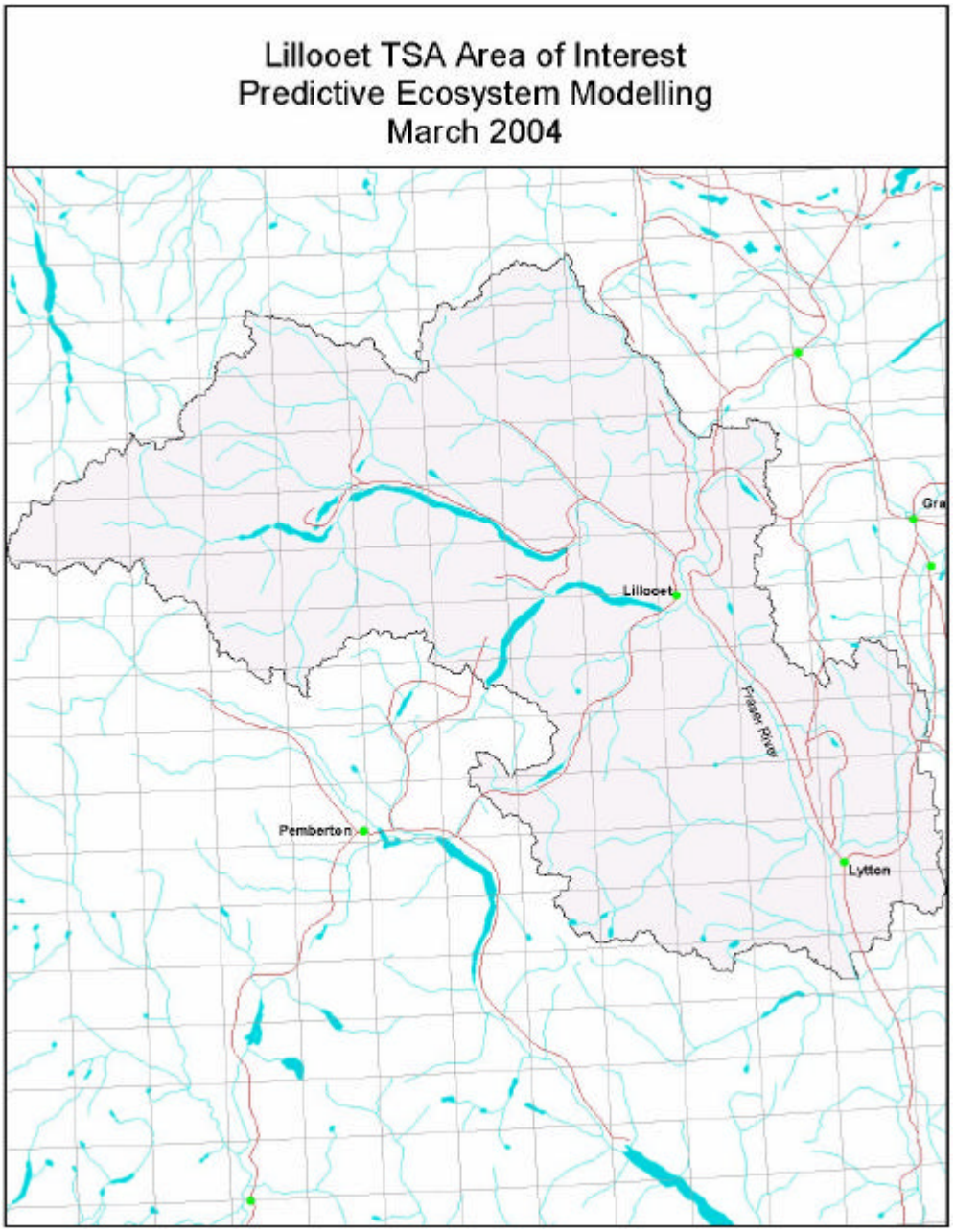


Figure 1 – Lillooet PEM Project Area

The internal Quality Assessment statistics are included in this report. In total, we ground sampled 4580 PEM polygons. Though there are numerous versions of the statistics in this report as required by the new "Protocol for Accuracy Assessment of Ecosystem Maps" (Meidinger, 2003), the gist is that the maps achieved a very high QA score (See Table 1 below). Other statistics calculated for this PEM are the PEM Entity Proportions graph and the Map Area Overlap score; these are included in the report below.

Table 1 – Summary of the Internal QA Results of the Lillooet PEM									
		Scored by Number of Poly's in Sample Set				Weighted by Area within each Polygon			
	No. of Poly's	Dom. Correct	½ Score Accept.	Overlap Propor. Correct	Overlap Propor. Accept.	Dom. Correct	½ score Accept.	Overlap Propor. Correct	Overlap Propor. Accept.
Weighted average of all datasets combined	4580	82%	88%	68%	79%	88%	93%	76%	85%

Please see the "Statistics" section of this report for an explanation of these scores.

The PEM methodology used in the Lillooet PEM project is described below in the Methodology section. Please refer to the previous Year-End reports, in particular the 2002 report, (included on the attached CD) for a description of how the input data layers were utilized and the work done in each year.

The Lillooet PEM area was divided into 22 Landscape Units (designated by Ainsworth et. al.) due to the size of the databases and limitations on our computer capacities. Figure 2 shows the 22 Landscape units. Figure 3 shows the areas that were completed in each year of the project. And lastly, Table 2 outlines the list of BEC subzones in the Lillooet PEM.

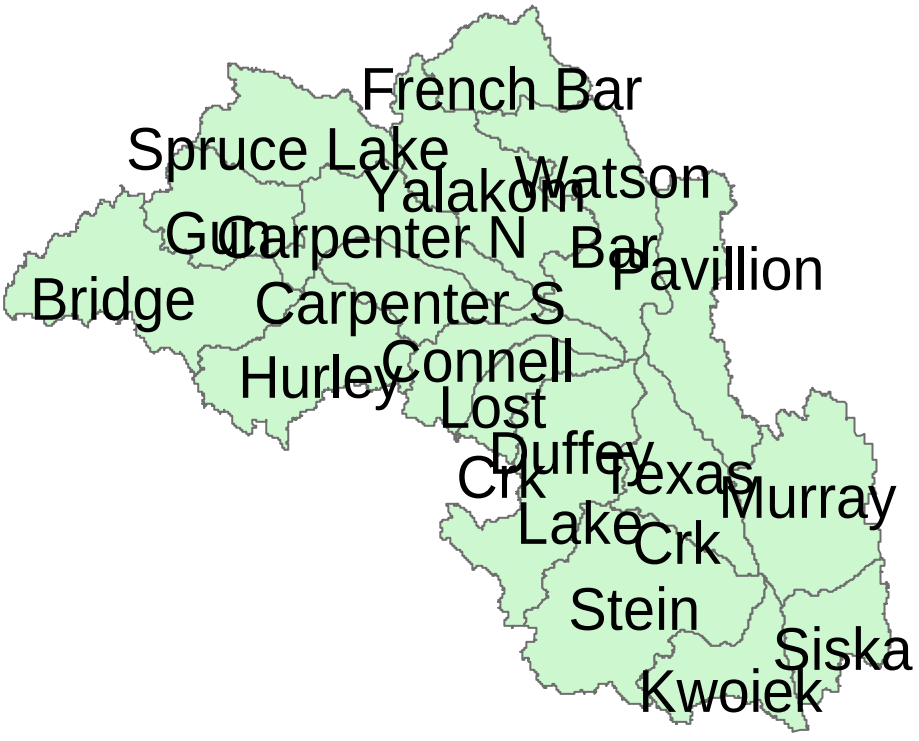


Figure 2 – Landscape Units in the Lillooet TSA

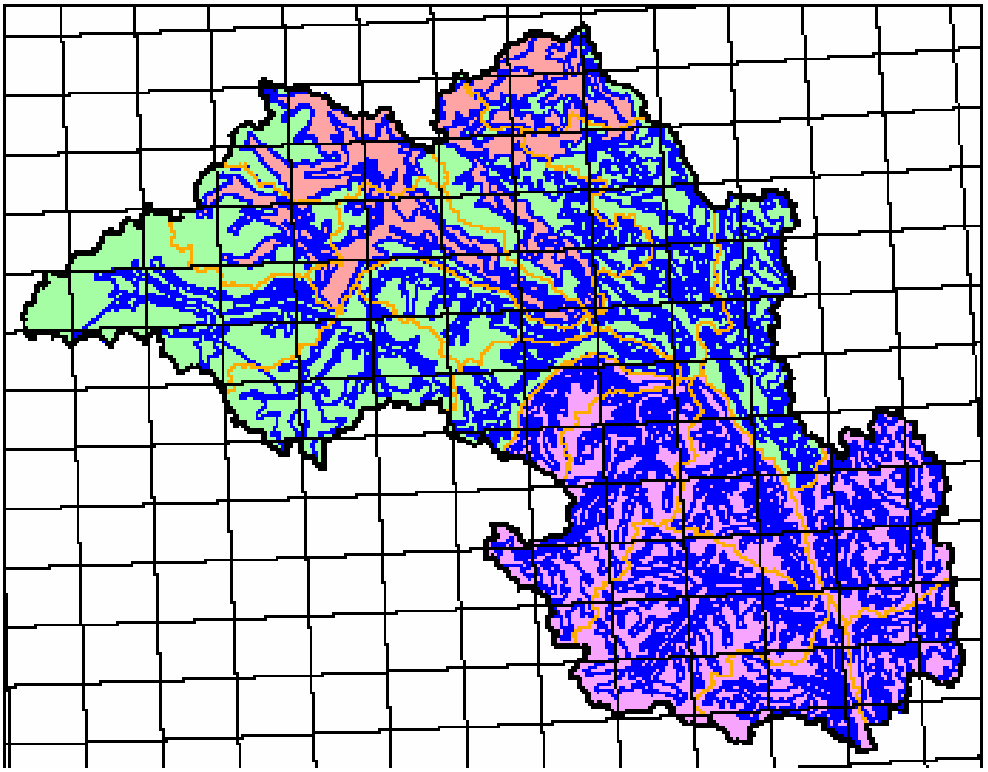


Figure 3 – Area of the TSA completed each year of the project
(Year 1 in red-brown; year 2 in green; year 3 in purple)

Table 2 – List of BEC Subzones in the Lillooet TSA PEM

Year of the Project	Biogeoclimatic (BEC) Subzone	Landscape Units
2001 - 2002 (9 BEC subzones)	IDFxm IDFdk3 MSxv2 ESSFxv2 ESSFxv2a IDFdk2 (north of Carpenter Lake) MSdc2 ESSFdv2 ESSFxc4	French Bar Watson Lake Yalakom Carpenter Lake – north Spruce Lake Gun These are incomplete and were finished off in Year 2
2002 - 2003 (15 BEC subzones)	BGxh2 BGxh3 BGxw2 IDFxh2/2a IDFxh3 IDFxw IDFdk1 IDFdk2 (south of Carpenter Lake) PPxh2 MSxk3 MSdc1 ESSFxc3 ESSFdv1	French Bar Watson Lake Yalakom Carpenter Lake – north Carpenter Lake – south Spruce Lake Gun Bridge Hurley Pavillion

	Parkland – north half of District Alpine – north half of District	
2003 - 2004 (29 BEC subzones)	CWHms1 IDFdk2 IDFww2 MSdm2 MSxk MSmw ESSFdc2 ESSFmw ESSFdcp ESSFdcu ESSFdv1p ESSFdvu1 ESSFdv2p ESSFdvu2 ESSFxc3p ESSFxcu3 ESSFxcu4 ESSFxc4p ESSFxvp ESSFxvp2 ESSFxvu2 ESSFmwp ATdc ATdv ATxc3 ATxc4 ATxv1 ATmw ICE	Lost Creek Duffey Lake Texas Creek Murray Stein Kwoiek Siska Connell Creek Hurley Carpenter South

2. Issues in this PEM

The following is a listing of items of note that we encountered during the development of the PEM. These pieces of information may be useful to Ainsworth for other Forest Planning activities.

1) Because the BEC refinement project was being completed at the same time as this PEM project, the numbering system used for the site series in the BEC subzones changed from one edit version to the next. This made it very difficult to understand our field notes – to remember which version we were using at the time. To avoid this problem, we created a standardized numbering system to represent the ecosystems on the field maps. This standardized scheme was transferable to all the BEC subzones. For example, a 04 was always a moderate south slope, the 07 always a moderate north slope and the 10 always a horsetail flat. At the end of the PEM development, we translated the site series numbers in the knowledge tables (KB's) to those named by Dennis. You will see reference to the standardized number scheme throughout this report.

2) The BEC linework map was revised each year during this PEM project. We re-processed the PEM polygons using the most recent BEC layer each year. This resulted in a lot of extra processing and changes to the PEM polygons and tag numbers. The final BEC layer

was provided by D. Lloyd et. al in Jun3, 2003. It was entered into the EcoPrep process and the entire TSA was re-run for the final PEM maps.

3) The ecosystem units we recorded in the field were seldom clean fits to the vegetation summaries provided by D. Lloyd. However, the patterns of the ecosystems we saw in the field were very clear and consistent. The PEM Entities Legend (Appendix 3) describes the consistencies of ecosystem patterns that we identified and build the KB's around. It is possible that the discrepancies in the vegetation charts were due to the sorting process, i.e. the north-slope ecosystem units accidentally being included in south slope classes based on the abundance of Pinegrass – however if the sorting process first grouped by moss abundance, these north slopes would not be put with the south-slope units.

4) The avalanche paths were one of the main reasons for developing this PEM because of their rich forage value for grizzlies. We are very pleased with the outcome of how the PEM identified these avalanche paths. The PEM was able to distinguish between the sections of the avalanche paths that are bare rock, the mid slide sections and the toes. The PEM was further able to distinguish between the toes that are the moist herbaceous/alder swales and shrubby wetlands.

5) Though the BGxh3 from the Ray Coupé is quite complicated to reproduce in a KB, the version created by D. Lloyd changed too much in the last version and no longer matched what we saw on the ground. So we stuck with the Cariboo version for the KB.

6) The IDFxm was mapped as part of the French Bar landscape unit during years 1 to 3 of this project, but it was removed from the revised BEC linework by D. Lloyd in 2003.

7) The ESSFxv2 in the upper Yalakom valley is distinctly drier than the French Bar version of this subzone. After discussing this with Dennis, we delineated it out and named it ESSFxv2a. However, in the final BEC linework from Dennis it was not included. As a result, the patterns of ecosystem development from the French Bar area are applied to this valley as well. We know that there are errors resulting from this since many of the topographic positions have a drier ecosystem unit on them, than in "normal" ESSFxv2 areas, but we cannot accommodate this shift without the BEC line distinguishing it.

8) The ESSFxc3 was ESSFxc4 during the first three years of the project. These two subzone labels were reversed in the final BEC linework.

9) The MSxk and the MSxk3 are the same on the ground in the Lillooet TSA. There is no difference in the ecosystem development between these two subzones as suggested by their names. The classification for MSxk matches what we saw on the ground, so this was the template that we used for both. The MSxk3 classification changed dramatically from the first three years and now doesn't match what we saw on the ground.

10) The Kwoiek valley has a bizarre ecosystem development pattern due to the heavy rock fall and talus deposits. Many of the ecosystems on these talus piles are in early successional stages due to the lack of, or shallow, soils. The IDFww2 and MSmw both have unusual ecosystem patterns in the valley bottom, but these patterns became "normal" on the slopes just above the talus piles.

11) The BEC linework layer used in this PEM was created by Dennis Lloyd et. al. Though we noted that some of the BEC lines were not in exactly the correct location, it was not

our responsibility to change these. For example the IDFww2 is mapped along the north shore of Anderson Lake, however the eastern half of this is actually IDFxh3, with the IDFww2 coming in only on the western half. However, there is always a degree of flexibility with these lines – they indicate the location of the BEC change but do not mark its exact location. Also, a BEC line denotes the transitional merging of the two rather than a distinct line.

12) The labels in the BEC linework map were inconsistent in their naming conventions. Though this poses no problem for users reading the labe ls, it does pose a problem for the computer reading the labels. As such, we had to create a unique EcoGen support table – the SiteSeries table - for each landscape unit in order to use the EcoNGen processor, rather than being able to re-use the same table for each LU.

13) The BEC linework map has the subzone "ICE" for which we used the alpine KB. There were in fact vegetated ecosystem units within this "BEC Subzone".

14) The CWHms1 is an erroneous classification for this area. The ecosystems on the ground do not match the CWHms1 field guide (Vancouver Region). It was, however, quite similar to the IDFww2 classification in terms of the ecosystem patterns of development. So we adapted the IDFww2 KB to fit the ecosystem patterns in this area. We used the same site series names and codes from the IDFww2 for the CWHms1.

15) We used the same KB's for the parkland BEC subzones and the alpine subzones due to the fact that we have only TRIM and satellite imagery to identify the ecosystem category.

16) The slopes around the old mining town of Bralorne have been burnt so frequently by human-caused fires (gold rush days) that the typical 04 south slopes changed into the drier 03 slopes. This is likely due to the intensity of the fires which burned the roots and many of the seeds in the upper soil layer. As a result, the normal ecosystem was not able to re-establish itself; instead a drier ecosystem of sparser vegetation developed.

17) The bedrock geology, in particular the granitic bedrock, did play a role in shifting ecosystem units to one unit drier on sloping positions. We used this information to cause a shift in the KB's to drier ecosystem units on slopes in the southern landscape units. Appendix 1 shows the delineation of the different bedrock categories in the Lillooet TSA.

18) TRIM 2 was used in this project which actually entailed only the further identification of ridges and cliffs, not the improvement in the DEM data points. The accuracy of the ridges and cliffs varied depending on the mappers. Images of the TRIM 2 ridge/cliff capture are shown in Appendix 1. Some mappers over-typed these features, while others under-typed them. This inconsistency meant that we had to deal with these features differently in each landscape unit.

19) We used full Bioterrain mapping (June Ryder and Associates) for this PEM. However, due to the problems of using complex labels, we chose to use only those bioterrain polygons that had labels in which the first component was 70% or greater of the polygon area (this narrowed down the database to those "near-pure" polygons). Of those polygons selected, the most useful ones were those that identified Organics, Fluvials, Lacustrines, Glaciofluvials, Glaciolacustrines and Alluvial Fans (in other words the unusual terrain types). The colluvials and morainals were of little use due to the large schism between the

scale of the large bioterrain polygons and the small PEM polygons. The bioterrain polygons are simply too big and accidentally cross over the full range of ecosystem units. For example, a morainal blanket bioterrain polygon can literally have every site series possible within it. In the TEM process, the mappers ignore these small ecosystem intrusions and therefore the morainal blanket is useful to identify the circum-mesic site series. However, in the PEM process, the computer specifically identifies these small ecosystem units and therefore the large morainal blanket polygon is of little value. Most PEM practitioners now are using a form of focussed bio-terrain mapping to identify only those terrain types that help in the PEM process and omit morainal and colluvial types. Some PEM projects are bypassing the bioterrain layer all together and still achieving acceptable scores.

20) The satellite imagery was quite useful particularly for the non-forested ecosystems. There are lessons we learned from this project, however, that have improved the reliability of the satellite imagery analyses. Satellite imagery is now proving to be more useful than the bioterrain layer as a PEM input.

21) The Forest Cover layer was quite good for this area and proved to be very useful in the PEM accuracy. However, there was one FC polygon that was labelled wrong and caused many errors. In the Duffy South landscape unit, mapsheet 92J 049, polygon 225 was mislabelled as a productive stand (SeFdPl 8135) when it is actually a non-forested alpine polygon. This polygon is very big spanning across the mountain top and sending many fingers of avalanche tracks down the mountain sides. The erroneous label resulted in all the alpine and avalanche tracks being mis-classified in the PEM. Rather than trying to re-label the forest cover polygon, we countered it's error in the KB's in order to allow the other information in the database to come through and provide the correct PEM label.

22) An error was noted on the PEM maps after the KB's had been finished. In the Texas Creek landscape unit, in the ESSFdv1, two of the cutblocks were erroneously labelled as meadow forests. This was due to the satellite code of "krummholtz" coming out over the cutblocks. Since this was a rare occurrence, we did not go back to fix it.

23) The ground points from the first year of the fieldwork were not digitized since this was optional in the PEM standards. We did, however, digitize the ground points from the fieldwork in year's two and three. The digitized points are provided in the metadata for this PEM project. The points from the first year are recorded by their PEM tag number only. Unfortunately, the re-processing of the PEM in order to include the revised BEC linework resulted in a change to all the PEM tag numbers. So it is no longer possible to look up the PEM tag numbers from these original ground points.

3. SIBEC Acceptability Letter

As part of this contract, we wanted to ensure that the output labels were in a format that is easy to use for Site Index Adjustment and other Landscape Analyses. We contracted Cam Brown, now of Foresite Consultants Ltd. of Salmon Arm, to go over the output data files and run a short test using these in a strategic analysis. Attached is the letter from Cam Brown recording his findings.

4. Statistics

This section reports the results of the various statistical evaluations of the PEM according to the new Protocol for Accuracy Assessment of Ecosystem Maps (Meidinger, 2003).

To begin with, here are a few basic statistics for this project:

1. Size of the project area = 1,161,326 ha
2. Number of PEM polygons in the Lillooet project = 2,124,395
3. Average polygon size = 0.55 ha
4. Number of BEC subzones = 46
5. Ground checked polygons = 4580
6. Sample size confidence level: 95% with +/- 1.5% error and 0.5 probability of random point correctly classified.
7. Survey intensity level 4 = all polygons were checked by ground inspection or air calls
8. Percentage of single label polygons = 84%
9. Percentage of tied label polygons = 16%
10. The area (ha) of each BEC in the TSA is shown in the graph below:

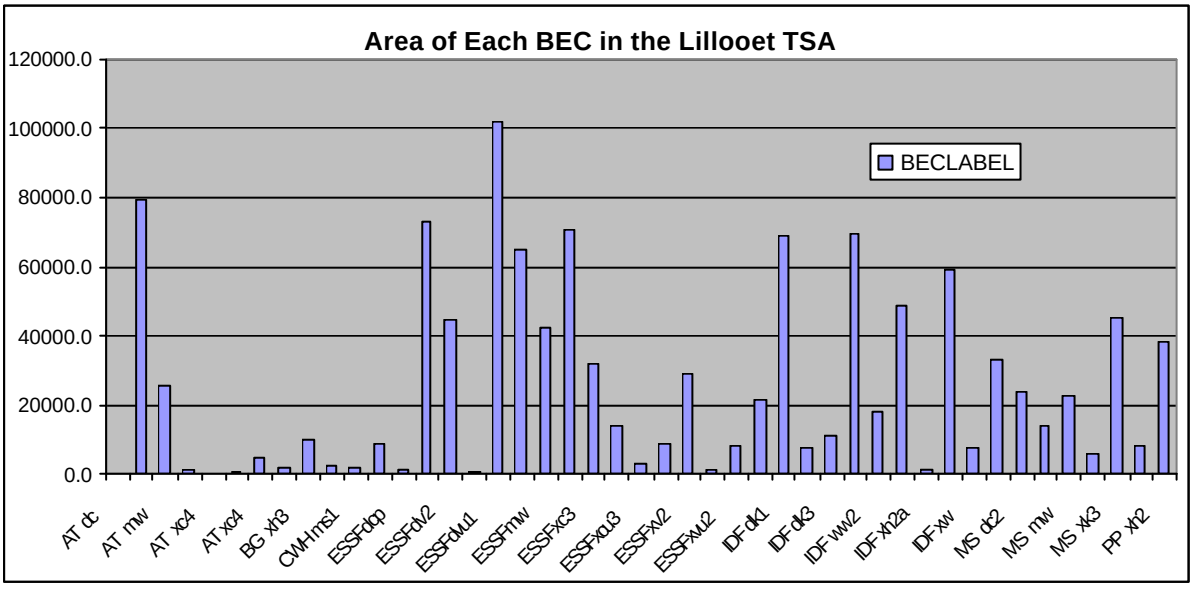


Table 3 below shows the scores for the Dominant Correct and Overlap calculations. Please refer to the file "Lillooet PEM Final Results" on the attached CD for more information on how the values were calculated. The first values are scored against the total number of polygons in the sample, whereas the second set of values are scored against the area within each polygon.

Table 3 – Lillooet PEM Internal QA Results

				Scored by Number of Polygons in Sample Set				Weighted by Area within each Polygon			
Landscape Unit	**BEC Label**	**No. of Poly's**	**Area (ha) of samples**	**Dominant Correct**	**½ Score Accept.**	**Overlap Propor. Correct**	**Overlap Propor. Accept.**	**Dom. Correct**	**½ score Accept.**	**Overlap Propor. Correct**	**Overlap Propor. Accept.**
Murray	BGxh2	146	505.01	84%	88%	71%	80%	96%	97%	80%	94%
Pavillion	BGxh3	68	119.10	81%	85%	71%	79%	84%	89%	79%	86%
Watson Bar	BGxh3	88	239.46	91%	93%	76%	81%	98%	98%	87%	88%
Watson Bar	PPxh2	105	238.38	78%	87%	64%	80%	84%	90%	71%	83%
Pavillion	PPxh2	9	6.58	89%	89%	87%	88%	96%	96%	90%	93%
Murray	IDFxh2	39	68.60	80%	88%	64%	79%	83%	89%	64%	78%
Murray	IDFxh2	92	244.71	87%	92%	68%	79%	75%	82%	65%	80%
Pavillion	IDFxh2	169	457.23	74%	82%	65%	76%	85%	90%	78%	84%
Watson Bar	IDFxh3	167	301.20	76%	85%	65%	76%	80%	87%	67%	79%
Watson Bar	IDFxw	46	82.43	89%	95%	72%	83%	99%	99%	87%	92%
Watson Bar	IDFdk1	131	668.89	80%	88%	68%	80%	94%	97%	87%	91%
Murray	IDFdk1	118	199.90	82%	89%	69%	79%	90%	94%	82%	89%
Carpenter North	IDFdk2	129	n/a	85%	91%	67%	79%	n/a	n/a	n/a	n/a
Pavillion	IDFdk3	88	241.22	82%	89%	67%	79%	83%	90%	62%	77%
French Bar	IDFdk3	114	n/a	80%	87%	65%	78%	n/a	n/a	n/a	n/a
Watson Bar	IDFdk5	31	86.35	75%	85%	61%	76%	78%	89%	66%	80%
Hurley East	IDFdk5	138	190.27	76%	83%	62%	73%	80%	85%	70%	78%
Connell Creek	IDF ww2	116	154.28	92%	96%	82%	88%	92%	96%	82%	89%
Kwoiek	IDF ww2	228	348.85	84%	90%	74%	83%	86%	91%	73%	83%
Duffy South	CWH ms1	118	266.23	86%	90%	72%	82%	90%	94%	74%	83%

Texas Creek	MSdc1	90	119.23	94%	96%	79%	86%	96%	98%	85%	91%
Hurley East	MSdc1	96	161.88	83%	90%	66%	78%	83%	91%	65%	80%
Hurley West	MSdc1	45	74.87	81%	86%	64%	74%	70%	75%	56%	64%
Spruce Lake	MSdc2	138	n/a	81%	88%	63%	78%	n/a	n/a	n/a	n/a
Murray	MS dm2	287	414.48	85%	90%	69%	79%	92%	95%	77%	85%
Watson Bar	MSxk /xk3	124	290.40	80%	85%	66%	76%	93%	94%	82%	86%
Murray	MSxk /xk3	103	155.09	80%	89%	66%	79%	88%	93%	78%	86%
French Bar	MSxv	97	n/a	80%	86%	67%	78%	n/a	n/a	n/a	n/a
Duffy South	MSmw	169	202.50	84%	89%	72%	81%	87%	89%	77%	81%
Texas Creek	ESSF dv1	132	184.88	83%	90%	72%	82%	85%	92%	70%	80%
Carpenter South	ESSF dv1	117	115.10	85%	92%	69%	82%	88%	94%	72%	83%
Watson Bar	ESSF dv2	53	101.42	82%	89%	67%	78%	90%	93%	74%	80%
Gun Lake	ESSF dv2	98	n/a	85%	89%	75%	81%	n/a	n/a	n/a	n/a
Murray	ESSF dc2	68	81.09	84%	90%	67%	79%	94%	97%	63%	79%
Watson Bar	ESSF xc3	126	173.23	84%	90%	68%	79%	92%	95%	78%	84%
Spruce Lake	ESSF xc4	121	n/a	78%	86%	62%	75%	n/a	n/a	n/a	n/a
French Bar	ESSF xv2	58	n/a	79%	87%	63%	78%	n/a	n/a	n/a	n/a
Yalakom	ESSF xv2	104	n/a	75%	84%	63%	76%	n/a	n/a	n/a	n/a

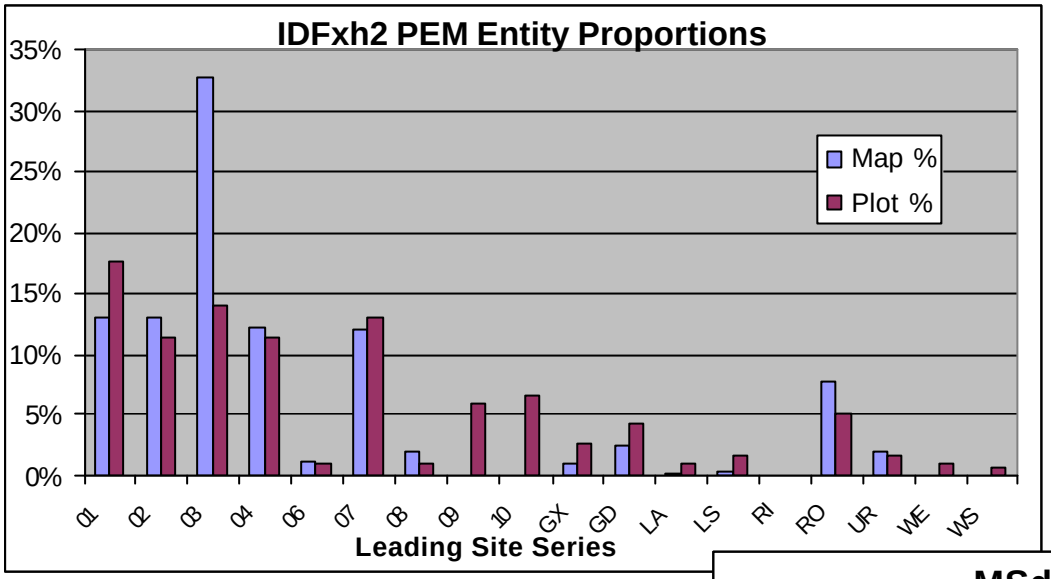
Duffy South	ESSF mw	183	390.75	82%	87%	73%	81%	92%	94%	80%	86%
Watson Bar	parkland/ AT	83	122.23	71%	85%	58%	78%	75%	88%	62%	80%
Duffy South	parkland/ AT	57	70.97	71%	79%	59%	72%	76%	84%	55%	72%
Texas Creek	parkland/ AT	8	5.83	50%	69%	38%	63%	30%	55%	20%	50%
Carpenter South	parkland/ AT	83	224.54	80%	88%	71%	83%	96%	98%	92%	96%
	total:	**4580**	**7307.19**								
Weighted averages for all areas:				**82%**	**88%**	**68%**	**79%**	**88%**	**93%**	**76%**	**85%**

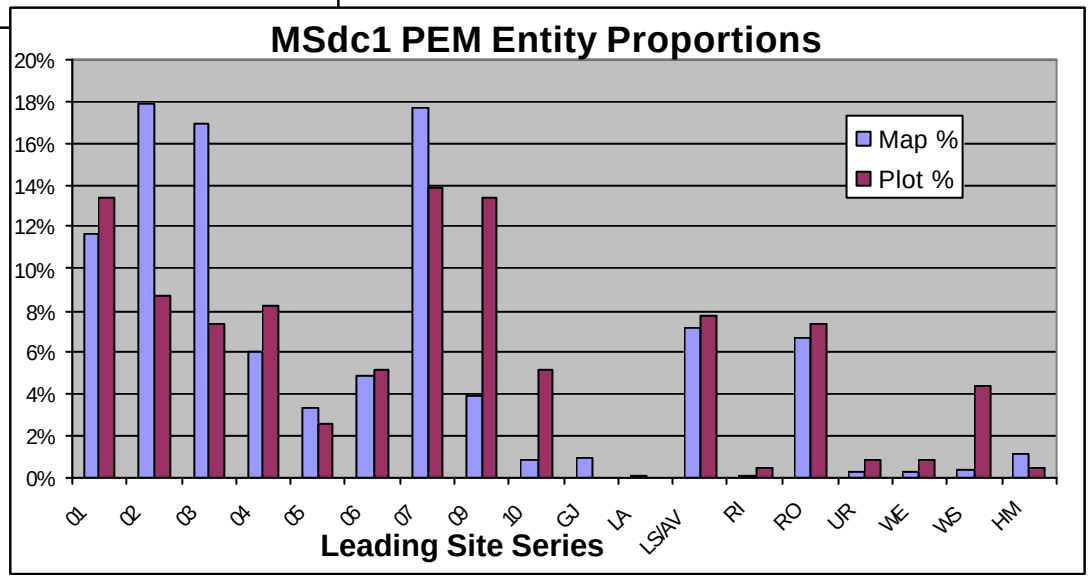
We consider the first set of numbers more relevant since in this PEM process, we treat all the polygons equally regardless of their size. We cannot play a preference for the large polygons and overlook the smaller ones. As such, in the EcoGen methodology, a polygon label is recorded as right or wrong regardless of its size. The weighted by area scores can go up or down randomly depending on the size of the polygons in the dataset. This can be seen by looking at the values for the 4 datasets shown. Sometimes the values went up, sometimes they went down, but the real judgement can be made from the static scores based on the number of polygons in the dataset. This random fluctuation can be seen more readily in other PEM projects that have more BEC subzones. Nevertheless, the government likes these weighted-by-area values.

In addition, we focus on getting the dominant label correct when compared to the ground answer. Unlike a TEM which has very large polygons (ave. size of 20-30 ha) and multiple labels, these PEM polygons are very small (ave. size of 0.55 ha) with the specific intent of identifying the location of unique ecosystem units. We do not attempt to identify the lesser ecosystem units of the polygon. The overlap scoring procedure was devised to record the accuracy of the TEM maps with multiple labels. TEM's are thus given credit for identifying the second and third ecosystem units, whereas PEM's are docked points for not identifying second and third units. In addition, a TEM is evaluated against the top 3 ecosystem units throughout the 30 ha polygon ignoring all the small intrusions of other ecosystem units, whereas the PEM is evaluated against all the small ecosystems intrusions of a few square meters. Since the TEM's are essentially evaluated against the dominant 3 ecosystem units, the PEM's should be evaluated against the 1 dominant ecosystem unit. This would be the closest comparative match when discussing the accuracy of PEM versus TEM.

Figure 4 below shows two examples of comparisons between the range of site series we sampled versus the range of site series mapped for that BEC subzone. In addition, Table 4 shows the corresponding Percent Overlap between our sample set and the number of ecosystem units we sampled in comparison to the in the PEM map for the BEC subzone. Both of these analyses use the first of the ground or PEM label in the case of ties. A PEM Entity Proportions Graph and Percent Overlap for Map Area Table have been produced for each BEC subzone in this PEM. Please refer to the attached CD in the "Lillooet PEM Final Results" file to view each one of these.

Figure 4 – PEM Entity Proportion Graphs





Percent Overlap for Map Area - IDFxh2 & 2a					
Map Entity	Area (ha)	Map %	Plots (n)	Plot %	Overlap %
01	8546.232	14%	53	18%	14
02	6371.813	11%	34	11%	11
03	19347.42	32%	42	14%	14
04	7617.377	13%	34	11%	11
06	521.4095	1%	3	1%	1
07	7618.411	13%	39	13%	13
08	1260.127	2%	3	1%	1
09		0	18	6%	0
10		0	20	7%	0
GX/GJ	764.9844	1%	8	3%	1
GD	2437.147	4%	13	4%	4
LA	319.5426	1%	3	1%	1
LS/AV	222.2803	0%	5	2%	0
RI	14.91775	0%		0%	0
RO	3387.14	6%	15	5%	5
UR	1612.193	3%	5	2%	2
WE	86.21802	0%	3	1%	0
WS	40.92614	0%	2	1%	0
	60168.13		300		78%

Percent Overlap for Map Area - MSdc1					
Map Entity	Area (ha)	Map %	Plots (n)	Plot %	Overlap %
01	4218.935	13%	31	13%	13
02	5251.01	16%	20	9%	9
03	5455.717	16%	17	7%	7
04	2371.445	7%	19	8%	7
05	1137.98	3%	6	3%	3
06	1575.032	5%	12	5%	5
07	6995.124	21%	32	14%	14
09	1431.96	4%	31	13%	5
10	317.1536	1%	12	5%	1
GX/GJ	248.3761	1%		0%	0
LA	67.40367	0%		0%	0
LS/AV	1722.165	5%	18	8%	5
RI	167.7964	0%	1	0%	0
RO	1700.008	5%	17	7%	7
UR	72.67647	0%	2	1%	1
WE	255.8672	1%	2	1%	1
WS	231.2107	1%	10	4%	4
HM	409.3923	1%	1	0%	0
	33629.25		231		82%

Table 4 – Percent Overlap for Map Area Calculations

At times, the PEM label will have a tie for cases when both units are likely to exist in that location, or there is not enough information to distinguish one unit over the other. In these cases, either unit may be the dominant label or they may both be there. For site index analyses, however, the ties have been given a standardized decile proportion of 50-50 for two-way ties and 40-30-30 for three-way ties. Regardless, the Lillooet PEM has a very low proportion of ties anyway.

Confusion matrices are optional according to the AA Protocol. These tables show how often PEM labels were classified as wrong ecosystem units – the committed error, and how often the labels were not classified as the right ecosystem labels – the omission error. Due to a lack of time, we did not create these confusion matrices for the 46 BEC subzones. The CRITBINOM calculation identifies the upper and lower limits of the confidence interval for the accuracy of the map.

Table 5 – CRITBINOM Calculations		Upper Limit	Lower Limit
82% Dom. Correct by # of Polygons	For the 80% & 95% confidence interval level:	82%	82%
88% Weighted Dom. Correct	For the 80% & 95% confidence interval level:	88%	88%
The CRITBINOM calculation produced a "Null" answer due to the size of the sample set being so large (4580 polygons). As such this calculation states that there is likely no error in these scores – no range of possible error in this confidence interval.			

5. Methodology

The PEM methodology used in the Lillooet PEM project is "EcoGen", originally developed by the BC Ministry of Forests Research Branch and Prince Rupert Forest Region (developed with Shamaya Consulting). EcoGen (Ecosystem Generator) is an automated program that combines existing land base inventories with expert knowledge tables to produce ecosystem maps over large areas. The EcoGen methodology has since been adjusted in recent years to accommodate more inventory input layers such as bioterrain mapping, satellite imagery, solar insolation analysis, bedrock geology mapping, and soils mapping. The most recent update of EcoGen has been called the "Shamaya/Silvatech Version". Both the previous version of EcoGen PEM and the current revision have been used successfully in Timber Supply Analyses. The original EcoGen PEM maps were used in a Timber Supply Analysis by Gerrard Olivotto and Del Meidinger "Development of EcoYield – A Conceptual Model for Timber Supply Analysis Using Predictive Ecosystem Mapping and Site Index – Ecosystem Relationships", EcoNote 2001-01, Ministry of Forests - Research Branch. In addition, the revised EcoGen PEM maps were also utilized by Cam Brown of Silvatech (2002) in a test of the Timber Supply Analysis capability.

The ecosystem is a fundamental unit of resource management in British Columbia. In British Columbia, the Biogeoclimatic Ecosystem Classification (BEC) system provides a common language to describe the plant species and relative abundance, the soil types and moisture/nutrient regimes, and the general climatic and geomorphological influences on natural ecosystem units.

Maps that spatially display these ecological units are effective integrated planning tools providing a record of the location and distribution of ecosystems within a management area. (see Figure 1 for an example of a PEM map). They create a framework for developing various landscape or site-specific management plans. Ecosystem maps take into consideration the productivity, species richness, fragility, and regenerative potential of the site, which can be interpreted into its "value" for timber production, wildlife habitat, unique plant communities, restoration, and so on. By using ecosystem maps as a tool during the resource planning phases, forest managers can predict "the consequences of their decisions, thus enabling them to practice forestry as applied ecology"[1].

One PEM methodology developed by the BC Ministry of Forests to create ecosystem maps efficiently and cost-effectively over large areas is the GIS-based computer program "EcoGen"[2]. The strength of EcoGen is its use of existing inventory maps produced for BC's forested areas, combined with leading-edge computer technology to derive reliable ecosystem maps. Features from these inventories are extracted and derived to reflect vegetative and landform characteristics. Knowledge tables are then created capturing expert ecological knowledge about the patterns of ecosystems across these landscapes. EcoGen then processes the GIS databases and knowledge tables together to produce the Ecosystem Maps. The maps can be displayed in hardcopy form using color schemes to represent the ecosystem units, or in digital form to enable large-scale viewing of specific sites. In the digital format, the maps can be readily queried to extract a variety of information needed by the resource managers.

[1] Pojar, J., K. Klinka and D.V. Meidinger. 1987. Biogeoclimatic Ecosystem Classification in British Columbia. in *Forest Ecology and Management*, 22 (1987) 119-154, Amsterdam

[2] For more information about EcoGen, see the MoF Research Branch webpage at www.for.gov.bc.ca/research/ecogen/

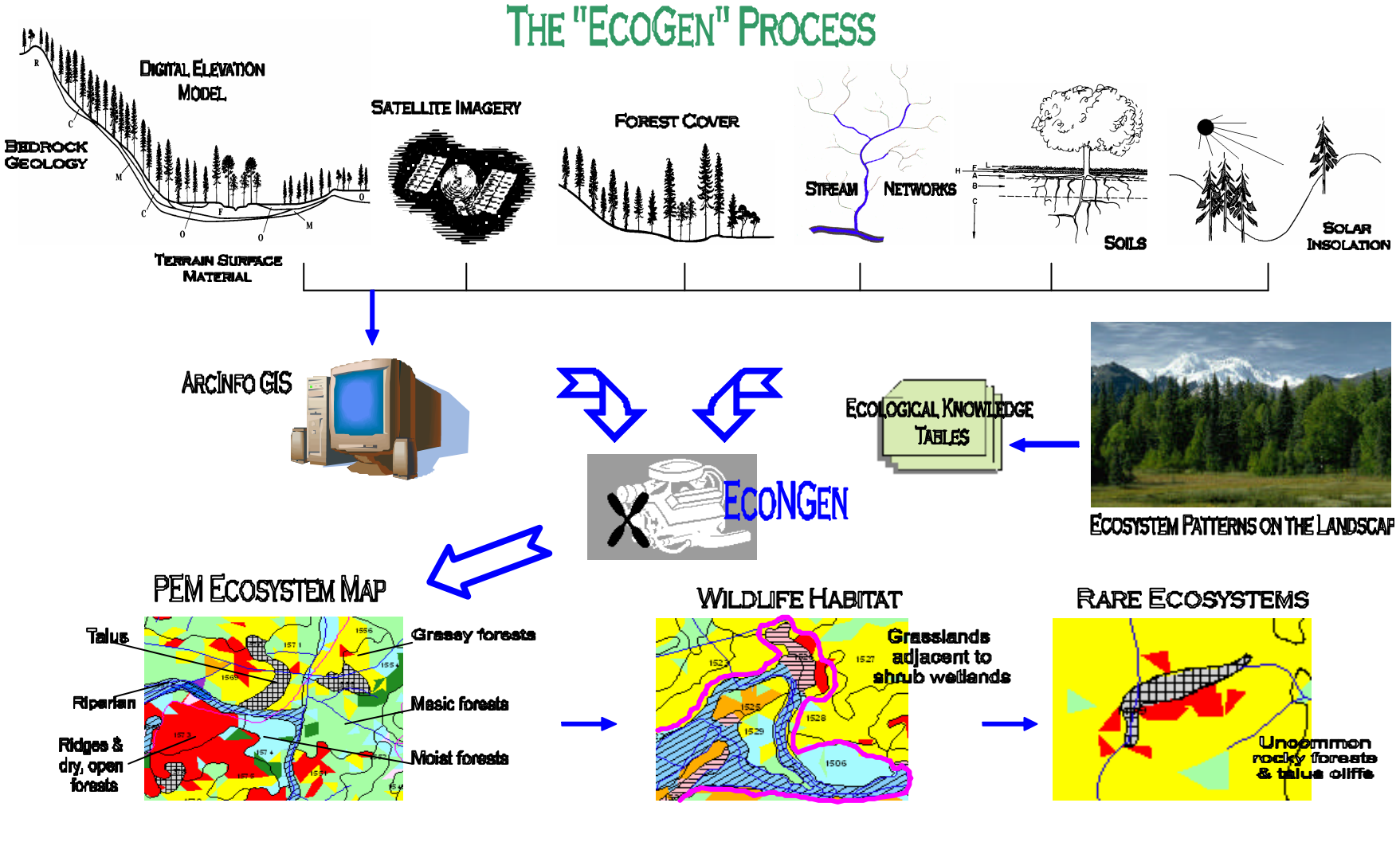


Figure 5 – EcoGen Process for Creating a PEM Map

5.1. EcoPrep – PEM Database Creation

EcoPrep involves the extraction of attributes and the manipulation of digital data layers in preparation for input into the model. The following steps are undertaken in the EcoPrep phase:

a) Biogeoclimatic Subzones lines are enhanced to the 1:20:000 scale in order to mesh with other inventory databases in this process. In the Lillooet PEM project, the revised linework is being completed by Biome Ecological Consultants (2002).
b) Digital data layers (TRIM, forest cover, terrain, terrain stability, satellite imagery, solar insolation, and bedrock geology) are checked for reliability and spatial accuracy.
c) PEM polygons are created using photo-interpreted base polygons that are further subdivided by BEC linework, slope and aspect classes. These polygons form the basis of the PEM attribute database. In the Lillooet PEM, we will also use the focus terrain mapping to further divide the PEM polygons along ecologically-meaningful boundaries.
d) Attributes of each digital layer that have predictive capability in the determination of site series, are selected and added to database. See Table 3 for the attributes selected from each inventory layer.
e) Some inventory layers are manipulated to derive new data layers, such as of ridges or toe slopes using the Digital Elevation Model (DEM) from TRIM. These new attributes are added to the database.

Table 6 – Data Attributes Derived or Extracted from each Inventory Layer

TRIM 1 Digital Elevation Model – derived attributes:	• Slope class (used in deriving PEM polygon) • Aspect class (used in deriving PEM polygon) • Density of streams in each PEM polygon • Riparian benches off of lakes and wetlands • Fluvial benches off of rivers • Glaciofluvial terraces off of rivers • Gullies and influence of gullies • Hilltops and influence of hilltops • Ridges and influence of ridges – both large and small ridges • Toes of slopes • Elevation classes • Adjacency to features • Solar Insolation analyses – calculated for three categories of solar intensity
TRIM 1 – extracted Attributes:	• Eskers, cliffs, scarps, slides, ridges, pits • Beaver dams, flooded areas, springs, islands, sandbars • Moraine, skree, lava flows • Glaciers, snow fields, ice caps • Lakes, marshes, swamps, creeks, and rivers
Forest Cover – extracted Attributes:	• Non-productive (or Basic Class) forest codes such as alpine, non-productive brush, or clay banks • Forest species – only the first three listed in the files are used • Canopy descriptions: tree height, crown closure, stand age • Disturbance history – in some areas the burn category is used

Terrain and Terrain Stability – extracted Attributes:	• Terrain surface material • Surface expression • Subsurface material • Geologic process • Drainage, and • Texture • Unstable slopes
Bedrock Geology – extracted Attributes:	• Granitic or Igneous bedrock material • Gneissic and diorite material • Metamorphic bedrock material • Sedimentary bedrock material • Undifferentiated bedrock material (this category is identified but does not contribute to the ecological site series)
Satellite Imagery Analysis completed by K. Whitehead of Earth Imaging Inc.	• Forest – closed • Open Forest – Fescue Grassland mix • Open Forest – Pinegrass Grassland / Deciduous Shrub • Grassland • Krumholtz-Parkland Forest • Alpine Heathland • Herbaceous Meadow (Alpine) • Landslide • Exposed Rock • Wetland class – graminoid (sedge) dominated • Snow • Water • Unclassified

5.2. Ecological Knowledge Tables

Following the EcoPrep phase of the PEM project, the Ecologist prepares the knowledge tables for the creation of the resultant file of predicted ecosystem labels:

a) The Ecologist completes fieldwork in order to understand the patterns of the ecosystems as they lay on the landscape, given the topographic, climatic, and geologic influences.
b) Ecological knowledge tables use these GIS database attributes that represent ground effect influences, alone or in combinations, to create meaningful statements that can be assigned a likelihood of a particular ecosystem unit. For example, a pine species in the stand, combined with short tree height and an open canopy cover.
c) Ground plot data are correlated with the new PEM polygons for comparison between the predicted ecosystem unit and the true ground label.
d) The PEM polygon database and knowledge tables are then run together through the EcoNGen processor, to produce the resultant output file of predicted ecosystem labels for each PEM polygon.
e) The Ecologist compares the resultant labels to the ground labels, then edits the knowledge tables accordingly to improve the accuracy. This is the calibration phase of the knowledge tables, and typically requires 3 or more iterations.

f) When the Ecologist is satisfied with the resultant scores, the final output file is returned to the GIS Analyst to re-connect it to the PEM map.
g) The ecosystem labels are displayed via a color legend, and the forest cover polygon is re-overlayed for visual effect.

Ecological Knowledge Tables (or knowledge bases – KB's) are created by the project Ecologist utilizing all of the feature attributes derived or extracted by the GIS Analyst. The KB's identify the attributes or attribute strings that will contribute towards the determination of the most likely ecosystem unit for each PEM polygon. The following excerpt was taken from the EcoGen EcoNote 2000-03 (www.for.gov.bc.ca/research/ecogen/) - for more information, please refer to the entire document.

> "Once the attributes and their values are determined and the basic format of the knowledge table has been created, the ecological weightings are entered. The basic coding is 0 to 3, whereby 0 equals no chance of occurrence, 1 = slight chance of occurrence, 2 = average chance of occurrence, and 3 = high chance of occurrence. For each statement in the knowledge table, the ecologist must evaluate the likelihood of each ecological unit for that biogeoclimatic unit occurring in a location with that attribute value or values….
>
> The result for a polygon is determined by a cumulative tally method, i.e., adding up the weightings for the set of attribute statements found in the polygon data. In some cases, the basic weighting of 0 to 3 is insufficient to achieve the intended ecological outcome. In order to ensure that obvious, unintended outcomes are impossible, an extreme weighting, e.g., "-100", is used. …
>
> When testing the knowledge table against known data, other possible unintended outcomes could occur. Adjusting the knowledge table weightings can usually "correct" these problems. Small negative weightings can be useful at this time for separating out ecological units. In one knowledge table, we used a " -1" weighting in an elevation attribute value to separate two grassland units in which one is commonly at higher elevations than the other." (Jones and Meidinger, EcoGen EcoNote#3)

In most cases, no lumping of site series will be done. The Ecologist will strive to identify unique site series in the knowledge tables. Lumping will only occur in cases where it is impossible to separate out closely-related site series given the data inputs available. If any lumping must take place, this will be discussed in advance with the Regional Ecologist.

5.3. EcoNGen Processing and Knowledge Base Calibration

The EcoGen model engine, EcoNGen version 1.0c, is available from the MoF Research Branch EcoGen web page, and will be used to process data for the Lillooet PEM project. EcoNGen was written by Bruce Enns (formerly of MoF Research Branch, now of Cominco, Trail).

The EcoNGen is the processor that works like the venturi of a carburetor. The fuel is the GIS database that provides the foundation for the map, the air is the knowledge table that

provides the ecological meaning. The resulting power output is the EcoMap showing the location of the variety of ecosystems across a landscape.

A series of interface programs were written to assist in the preparation of the knowledge tables to mesh with the PEM database, prior to running through the EcoNGen program. These interface programs are Matrix Summary and SSORT. The original versions were written by Russell Klassen (Smithers, BC). Due to the introduction of new inventory datasets, Matrix Summary has been revised by G. McGregor to accommodate the changes. Matrix Summary serves to further summarize the data into new classes, such as "m" for mature stands between the age classes of 4 and 9, and serves to calculate the percent of area that selected features occupy within the PEM polygon. This information simplifies the coding used in the knowledge tables, and clarifies how much influence a feature has on the particular PEM polygon. The SSORT program was not revised in this PEM project. It quickly creates the Site Series and Process Order tables required to run with EcoNGen.

The KB's are run through the EcoNGen to derive the first round of results. These are then compared to the answers of known ground points. The KB's are then adjusted to achieve accurate answers for these ground points. The calibration phase typically requires 3 or more iterations with adjustments to the KB's. When the Ecologist is satisfied, this process is ended.

6. Field Data Collection Method

The field work methodology used by Shamaya Consulting is faster and more efficient than the traditional TEM methodology. We rely primarily on visual ecosystem calls accurately located on the base maps, with a few Ground Inspection Forms completed in areas of uncertainty or high complexity. No Full Plot (FS882) forms are completed. This method enables the Ecologists to gather a large number of ground data points in a short time, with the information collected being directly applicable to the PEM knowledge table development.

The Ecologists spend two days per BEC subzone covering the full variety of ecosystem units in a wide range of locations within the project area. We anticipate that more than 500 ground points will be gathered during the field work to be utilized both in the knowledge table development and calibration. Two Ecologists work together in the coastal forests due to the difficulty and danger of movement through the forests. In order to improve the efficiency of the team, they can travel parallel to each other thereby covering more area in the same amount of time. The Ecologists start off each morning together to ensure that they are calling the ecosystem units by the same label and characteristics. By late morning, the Ecologists move apart where topography allows and gather ground data on their own. This essentially results in a doubling of man-days for data collection.

The Ecologists specifically look for areas of topographical diversity in order to capture the range of site conditions for ecosystem units, in forested and non-forested ecosystems, in order to record the changes from one ecosystem unit to the next. The ecosystems do, in fact, follow a pattern on the landscape that is predictable. It is up to the Ecologists to recognize these patterns and all of the climatic and biophysical influences that led to these patterns. Traversing across many areas is required to distinguish between the normal patterns as opposed to variations in these patterns.

This is the fundamental difference between our field work methodology and simply using existing field plot data. By walking through areas of diversity, the Ecologist is able to see how the ecosystem units interact with each other and why they change. Existing plot data records only what is within the 0.10 ha plot, and little or nothing about the ecosystems surrounding the plot. Nor do they record where the boundaries of the adjacent ecosystem units lie, or any contributing influences which led to the changes. This missing information is vital to the accuracy that can be achieved in the knowledge tables.

For all forested BEC subzones, we ensured that we gathered more than the 30 polygon minimum required by the PEM Inventory Standards (section 4.6.1.1, 1999). For the calibration purposes, we needed at least 100 polygons per BEC subzone. This high number allows us to see the variations in polygon features that must be calibrated to the correct labels. In the Lillooet PEM we far exceeded the minimum sample size with a total of 4580 checked polygons.

The field work was completed prior to the PEM polygon creation. We used Forest Cover polygons with labels super-imposed over the TRIM base map to record ground information. Strict control over our location with respect to the Forest Cover polygons and TRIM topography was maintained and repeatedly verified, in order to place our ground information in the correct location. GPS was not relied upon due to its inherent inaccuracy in dense coastal forests and due to its normal range of error between 10 and 40 meters depending on site conditions. The ground points must be accurately placed in relation to the TRIM and Forest Cover inventories since these are the foundations of the PEM program. This is an under-stated crucial point for creating a PEM map. Airphoto points and GPS locations are insufficient as ground locations to be used in the PEM calibration and independent QA. These references allow too many chances of incongruity with the TRIM base of the PEM. Ground information must align with the TRIM base. Ground Inspection Forms were completed periodically when we came across a new ecosystem unit that we had not yet encountered. The GIF's provided a pause opportunity to verify the ecosystem unit and provide documentation of the units for future reference during the calibration phase. Photocopies of all GIF plots are included in Appendix 9.

7. Digitized Point Files

The ground plot and point data collected for this PEM project have been digitized in ArcView 8.2 and have been included as Shapefiles in the digital package for this project. The accompanying attribute tables (dbf files) record the Point Number, Ground Label and PEM_TAG. This attribute table was exported into ACCESS in order to run it with the ScoreOne program to determine if the PEM label is correct and to calibrate the knowledge tables.

8. Transfer to PEM Polygon Method

The transfer of ground points to the correct PEM polygon is a difficult process and cannot be under-stated. The direct transfer of a point to the PEM map from an airphoto or worse GPS coordinate is insufficient and inaccurate in the PEM domain. We know that the TRIM base is

skewed from true ground locations and that this skew varies from one edge to another on the same mapsheet. TRIM has been georectified as well as is possible and meets our expectations and requirements. We have accepted the errors in TRIM and have spatially reconciled all other inventories to this base (PEM and TEM RISC Digital Data Capture Standards). Ecologists and Foresters have never had to deal with the reality that TRIM maps may be shifted off the true georectified position, until now. To say that you was standing exactly here on the airphoto or with a GPS reading, with this slope and aspect, next to this reference feature, but the PEM map shows those site characteristics are in a different polygon…. therefore the PEM maps are wrong.... is futile. This is a statement that TRIM is wrong rather than the transfer of your ground points. It would follow then that all work done from the TRIM is also wrong – all forest development planning, wildlife habitat mapping, terrain mapping and so on. Everyone using the TRIM base for their work is also wrong. In reality, however, if we all align our maps on the same TRIM base, the errors in the TRIM become moot – they don't exist. The QA must fall in line with the PEM standards of using the thematic TRIM base in order to locate the PEM polygon on the ground. This thematic positioning applied to Forest Cover as well; the QA person must use the thematic information to confirm the location of the ground polygon. In the words of Del Meidinger, MoF Research Branch (personal conversation, March 2004) "it is the QA person's responsibility to assess the same piece of ground as the PEM polygon they are evaluating".

It is crucially important to match the ground point site characteristics to the PEM polygon with the equivalent site characteristics. When you're working with a PEM map, you have to accept the TRIM representation of the world. There's no point in arguing that the ridge is in the wrong spot. When it comes to slope breaks, this same frame of mind comes into play but it is more subtle. All possibilities must first be exhausted, that the correct PEM polygon is in the vicinity of where you think the ground point belongs. All database features of every PEM polygon in the vicinity must be checked in order to find the one that matches the site characteristics of the ground point. The following questions help to guide the placement of the ground point into the correct PEM polygon:

1. The Forest Cover polygon is correct (an obvious first point, but necessary to repeat)
   - if you were standing in a closed canopy spot, adjacent to an open canopy polygon, ensure that your point is located in the correct closed-canopy forest cover polygon - regardless of your GPS coordinate and regardless if you think the Forest Cover Mapper drew the boundary in the wrong location

2. The slope/aspect doesn't match but a correct match exists in the next PEM polygon:
   - if you know where you were standing and it was a gentle slope, but the computer calls it a steeper slope, move your point over to the polygon with the correct slope;
   - if the distance is close (within 50 m say), the ground point is moved to that polygon;
   - if the distance is far, and the slope width of your ground point was small, it's possible that the DEM didn't pick up this blip - in which case your ground point is only one portion of the rest of that PEM polygon, not a dominant ecosystem unit.

3. The features of gully, ridge, hill, toe don't match but a correct match exists in the next PEM polygon:
   - Only the toes are questionable. If you were standing on a ridge, and that ridge is recorded in another PEM polygon, move the ground point accordingly;
   - Toes can be difficult since the programming doesn't always pick them up. However, you can verify that you are looking at the base of the hill by checking the slope/aspect of the

polygon above and comparing it to the slope/aspect of the one below. There will be a break in the polygons at the slope change.
- Find the feature in the PEM map that you used as ground reference, now reference your distance from this feature accordingly. If you were mid-slope, you will also need to locate the bottom of the slope that should be shown as a different PEM polygon. Be careful, there are many mid-slope PEM polygons that are broken by aspect changes or small benches, these shouldn't be confused with the true toe of the slope further down.

4. TRIM streams will always be there on the ground, but many smaller streams will be missed on the TRIM maps:
- if the water content of the PEM polygon says 0 but you are standing next to a small stream, you may still have the correct PEM polygon... ensure all other features match,
- if the water content of the PEM polygon says a stream is present, but you didn't see any on the ground, search the adjacent PEM polygons for the correct match.

Only if there are no PEM polygons in the area with the matching site characteristics, do you consider that TRIM was too coarse to pick up this plot location. The following questions help to guide this situation:

1. Was the slope band you were standing on small enough or narrow enough that it could have been missed by the DEM?
2. Expand your reference, does the map show the grander slope changes around your ground point? Does it show the slope transition (that you were standing on) in correct relation to these grander slope changes?
3. Which polygon(s) have the features you were using as your ground references? Relocate your ground point by referencing your distance from these features on the PEM map.
4. At this point, if you've searched all around the PEM polygons and the slope/aspect/water site you were standing in does not have its own polygon and was not picked up in relation to features you saw (also represented in the PEM), you have a case where the DEM did not pick up this spot.
5. You now have to decide in which polygon does this ground point belong? Again, locate the features on the map that you used to locate yourself on the ground, and reference the distance away from these features. Ensure that all features within this selected PEM polygon are correct for that site. Go back to your notes and determine what other ecosystem units were in the location of this PEM polygon. Your ground point is likely a small portion of the rest of the polygon and may not reflect the other ecosystem units.

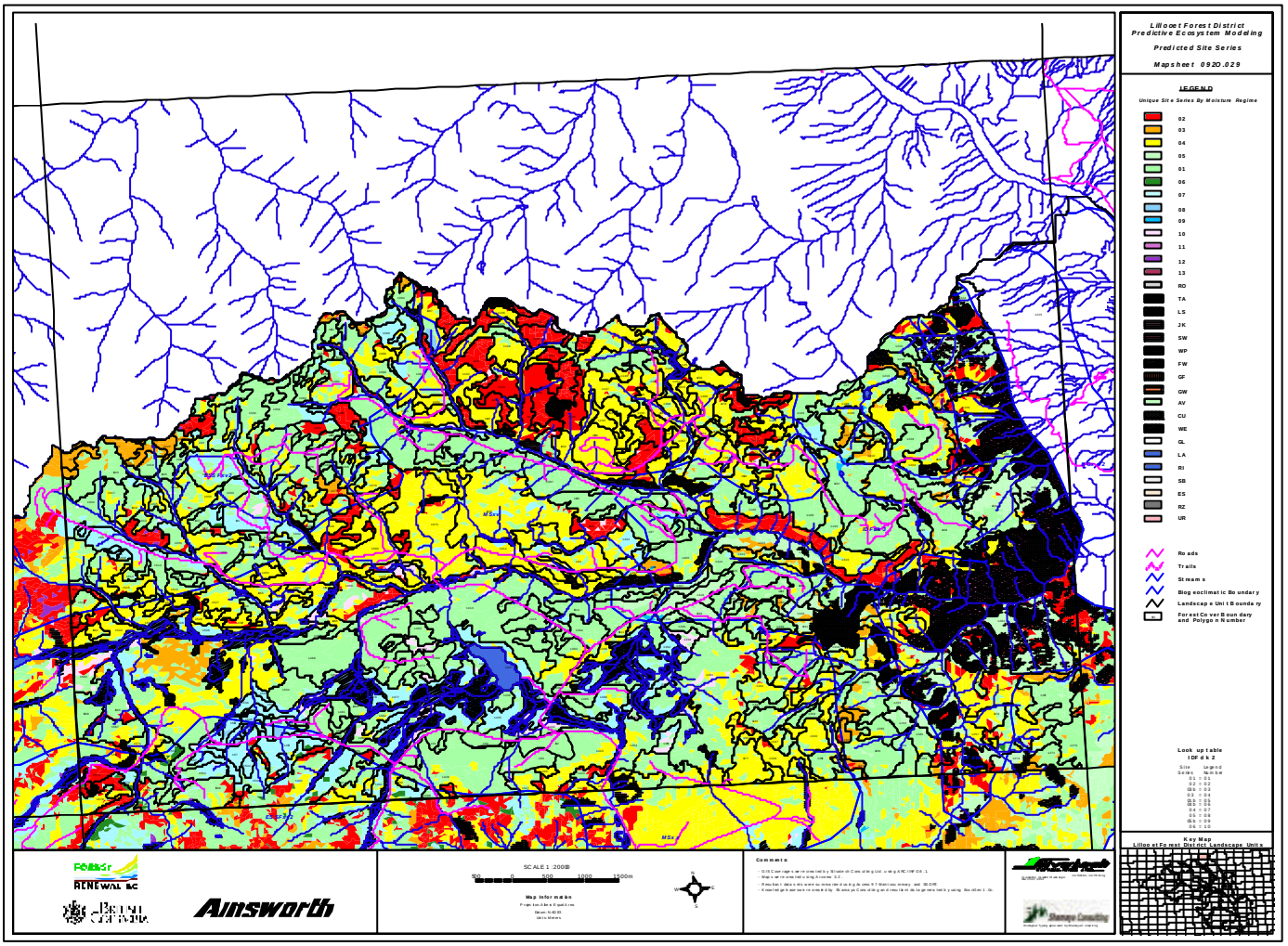
This challenge of locating the correct PEM polygons has been a surprise to all TEM Mappers and Ecologists, no matter how good they are. However, it is just a learning curve. Once they've been through this process a couple times, it becomes much easier and PEM maps themselves become easier to use. This is valuable for anyone using a PEM map in the future for other work.

9. The Resultant PEM Maps

The EcoMap module is the final step in the production of the ecosystem maps. The resulting output file from the EcoNGen is re-attached to the polygon database. The color legend shown

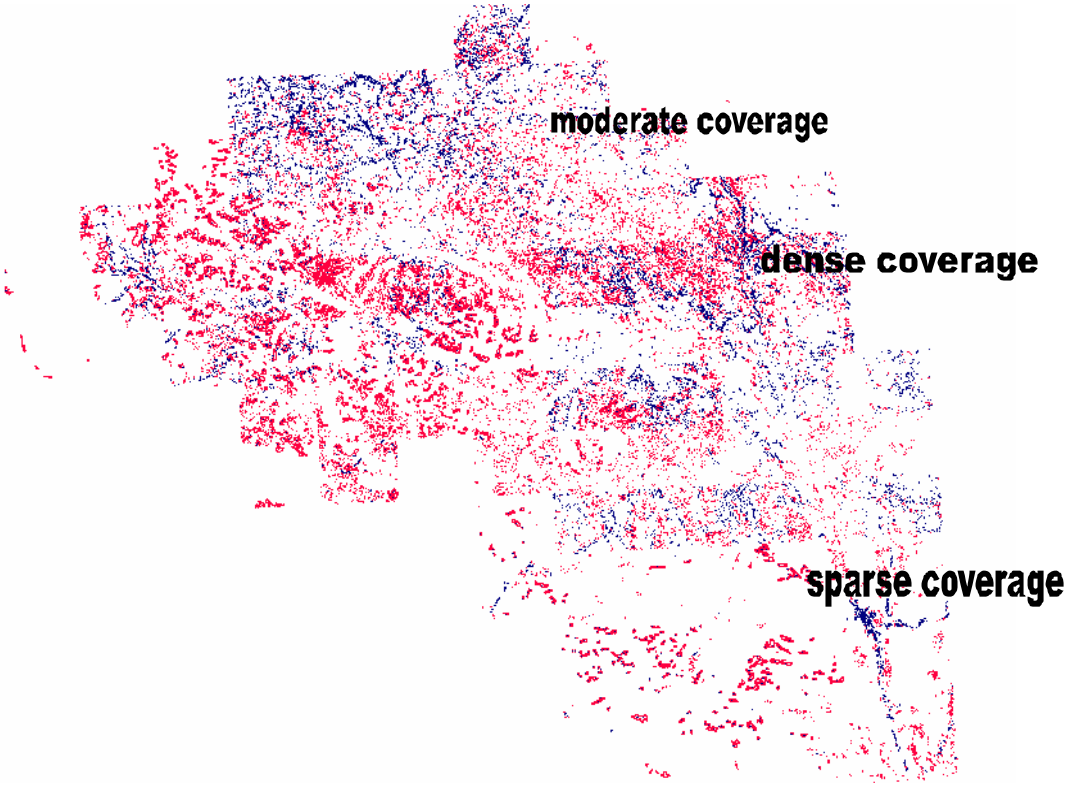
above in the Map Entities Table 1 is used to display these ecosystem units rather than labels, due to the small size and quantity of the polygons. The colors range from reds representing the driest ecosystems, through yellows and greens representing circum-mesics, to blues and purples representing the wettest ecosystems. The original forest cover polygon and tag number is re-overlaid on the map to show context and location of the ecosystem units. Roads and water networks are also displayed on the maps for georeference. Figure 1 shows an example of a PEM map for the French Bar landscape unit in the north of the Lillooet District.

Figure 6 – Example PEM Map for the French Bar Landscape Unit

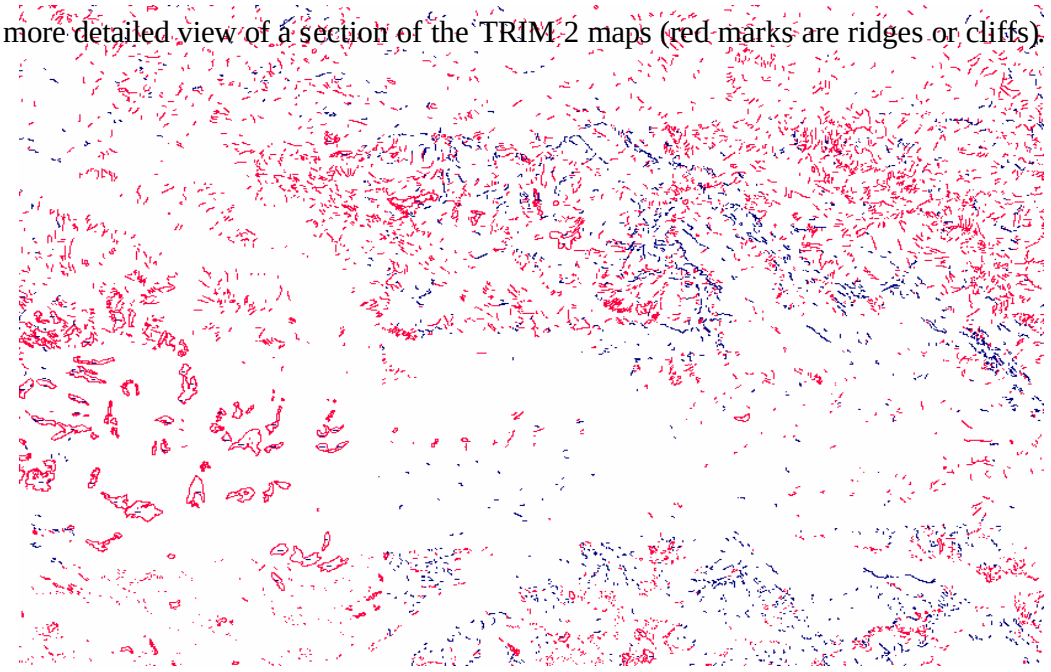


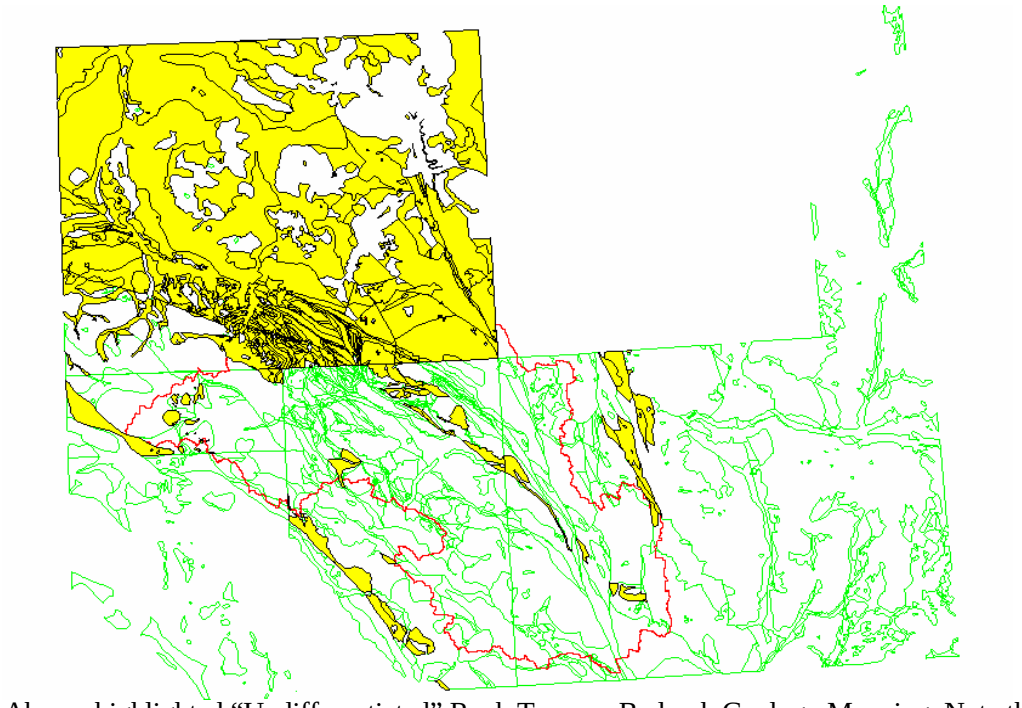
Appendix 1: Illustrations of TRIM 2 and Bedrock Geology

The following is an illustration of the differences in the numbers of identified cliffs and ridges by the TRIM 2 mappers. The darker the block, the more cliffs and ridges mapped.

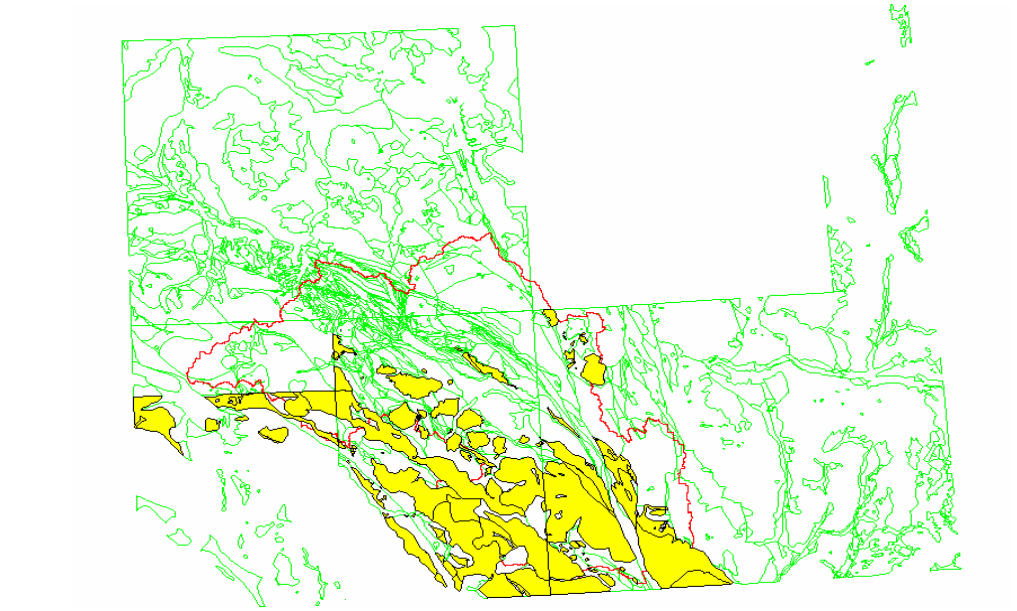


A more detailed view of a section of the TRIM 2 maps (red marks are ridges or cliffs).

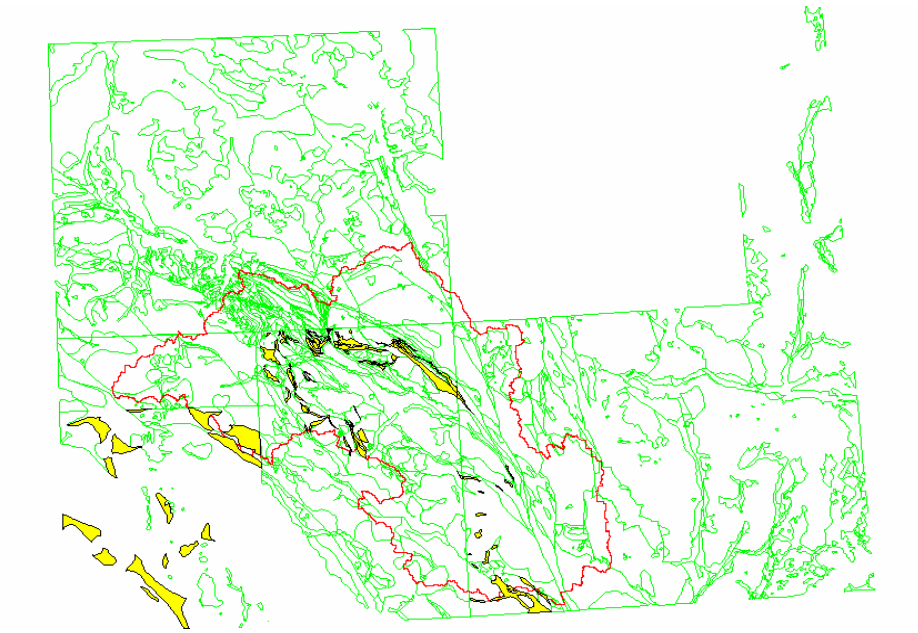




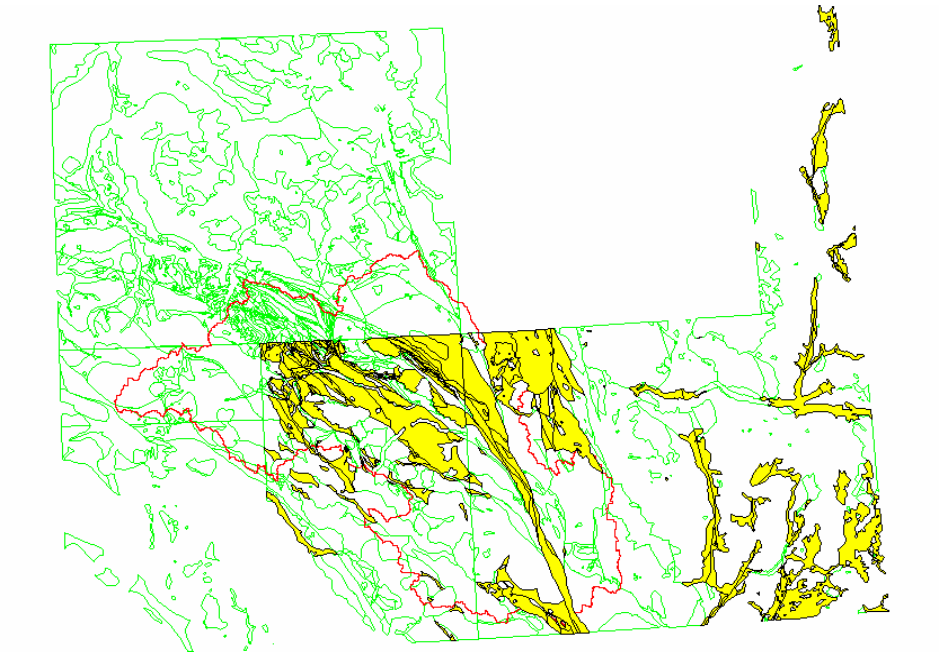
Above: highlighted “Undifferentiated” Rock Type on Bedrock Geology Mapping. Note the abrupt changes at the edges of the mapsheets. The Lillooet Forest District is shown outlined in red.



Above: highlighted “Intrusive” Rock Type on Bedrock Geology Mapping. Note the upper left corner has abrupt polygon lines. This interpreter didn’t record the word Intrusive on the polygon data label, however, did record the intrusive rock type code in the numeric label.



Above: highlighted “Metamorphic” Rock Type on Bedrock Geology Mapping.



Above: highlighted “Sedimentary” Rock Type on Bedrock Geology Mapping.

Appendix 2: Map Entities Legend

The following is the legend of the Site Series that were mapped in this PEM project. The legend also shows the colors that were used on the PEM maps to represent these site series.

Of note, we did not encounter the 07 Larch – Horsetail ecosystem unit so we lumped it with the 06 Black Spruce – Feathermoss – Bluebells unit. As well, we did not encounter the new 12 White Spruce – Devil's club ecosystem unit, so we lumped it with the 05 White Spruce – Current – Horsetail unit.

For the wetland units, we had to lump the shrubby wetlands together and the graminoid wetlands together since we are unable to distinguish between these types with satellite imagery or VRI information.

This file is also found on the accompanying CD as pem_4021_ursMapEntities.rtf

Appendix 3: PEM Entities Legend

The following is a description of the site series mapped in this PEM project.

This file is also found on the accompanying CD as pem_4021_ursPEMEntities.rtf

For more information on these ecosystem units, please refer to the Draft Classification Guide by Craig DeLong, Will Mackenzie and Del Meidinger (July, 2003) on the attached CD.

Lillooet PEM Project Site Series Names, Codes and Descriptions
of the Revised Biogeoclimatic Classification System (D. Lloyd et. al, 2001-03)

The Lillooet PEM project used the revised BEC classification system being completed by D. Lloyd, Regional Ecologist of the Kamloops Forest Region. The Bunchgrass subzones (BGxh3 and xw2) were revised by R. Coupé, Regional Ecologist of the Cariboo Forest Region. The following table outlines each site series in the new BEC classification that was mapped in this PEM project. Those site series that do not occur in the Lillooet District are not described. All site series numbers and letter codes are tentative and subject to change until they are approved by the RIC committee. The published descriptions of these revised classifications are not available for distribution at this time. The draft descriptions must be requested by Ray Coupé or Dennis Lloyd directly.

Letter codes are no longer recommended in these tables, other than the lumped non-forested ecosystem unit codes, unlike in the first two years of the project. The codes we suggested were not incorporated into the classification scheme provided by D. Lloyd, and the classification schemes have changed repeatedly over the three years of this project. This table reflects the latest classification scheme provided by D. Lloyd and leaves all naming responsibilities to D. Lloyd. We used the abbreviation "not reg'd" to indicate that the unit is not yet registered and approved by the Provincial Ecologist.

The following table also identifies which SIBEC values from the old BEC classification that should be applied for the new site series as an interim measure. After the new BEC classification is finalized and approved by RIC, new SIBEC values will be assigned to the site series for data analyses. SIBEC values are used to calculate growth and yield estimates for the operable forest land base, which leads to the calculation of annual allowable cuts.

In this PEM project, we did not endeavor to map out the seral stages of the ecosystem units. This is more easily and accurately dealt with as a post-mapping module using the forest species correlated with the predicted site series.

Elevational gradients were also not dealt with. In the first two years of the project, we identified the ESSF high elevation break at which the patterns of ecosystem distribution changed. However, due to the changes in the BEC linework provided by D. Lloyd, in particular the parkland boundary lines, we stopped doing this. Dennis attempted to capture this same pattern shift, so we left it to his authority and responsibility.

Bgc_Zone	Bgc_Subzone	Bgc_Vrt	Bgc_Phase	Site_S	SiteMC_S	Site Series Name	TypeSMR	Region	SIBEC Correla-tion	Description of Site Series Distinguishing Characteristics
BG	xh	2		01 01YS 01MS	Not reg'd	Big sage - Bluebunch wheatgrass; Big sage – Needle & thread grass; Big sage – Bluebunch wheatgrass & Needle & thread grass	mesic	Kam	n/a	Zonal positions in the grasslands. Slopes <25% on all aspects. This unit is also on toes of slopes and adjacent to the stream edge unit. This is also the unit on north-facing slopes in the grasslands in which *Poa secunda* is a dominant grass species.
BG	xh	2		92 93	Not reg'd	Bluebunch wheatgrass – Selaginella; Big sage – Bluebunch wheatgrass	subxeric - submesic	Kam	n/a	Very dry, sparsely-vegetated grasslands. Typically on or adjacent to rocky outcrops. Selaginella densa is an indicator species. Ridge tops and very steep slopes within Open Range polygons are used to pull out this unit.
BG	xh	2		94	Not reg'd	Py – Red three awn	mesic - submesic	Kam	Use BGxh2 03	East, south and west -facing slopes in the grasslands on moderate to steep slopes. May occasionally have a few Py trees that are able to establish despite the heat and winds. These are also the gentle ridge top ecosystem units, such as eskers or shoulder ridges.
BG	xh	2		95	Not reg'd	Rough fescue – Bluebunch wheatgrass	subxeric - submesic	Kam	n/a	Not in the Lillooet TSA.
BG	xh	2		02	Not reg'd	Py – Bluebunch wheatgrass	mesic - submesic	Kam	Use BGxh2 04	Forested unit on zonal positions or south-facing slopes. This unit is common on toes of slopes due to the sandy soils in the District. Islands of forest stands do occur in the BG subzone.
BG	xh	2		03	Not reg'd	Fd Py – Snowberry	submesic - subhygric	Kam	Use BGxh2 07	Forested unit on north-facing slopes and gullies. Forest stands are common on north slopes of gullies.
BG	xh	2		04	Not reg'd	Act – Snowberry – Dogwood	subhygric - hygric	Kam	Use BGxh2 07	Forested unit along stream edges or on fluvial benches
We were instructed by D. Lloyd (2001 and 2002) to use the new classification created by Ray Coupé, Regional Ecologist of the former Cariboo Region. D. Lloyd has since changed the classification for this BEC subzone significantly. Due to the large discrepancies between the two classifications, we are sticking with the original instructions in order to avoid having to completely re-do this knowledge table.										
BG	xh	3		01	Not	Bluebunch wheatgrass – Big sagebrush	mesic	Kam	n/a	Mesic grassland on flat to gentle slopes of all aspects; also occurs on the E and NW

					reg'd					slopes that transition between south and north aspects.
BG	xh	3		80 81	Not reg'd	Big Sagebrush – Prickly pear cactus; Saskatoon – Douglas fir	subxeric	Kam	n/a	Xeric grasslands over very shallow soils such as cliffs, rock outcrops or talus.
BG	xh	3		82 83a/b	Not reg'd	Big sagebrush – Sand dropsee; Bluebunch wheatgrass – Prairie sagewort	subxeric - submesic	Kam	n/a	Dry grasslands on steep south-facing slopes; soils may be eroding; generally these are sparsely-vegetated slopes.
BG	xh	3		84 85 83a	Not reg'd	Sand dropseed – Indian ricegrass; Needle-and-thread grass– Cladonia cariosa; Bluebunch wheatgrass – Prairie sagewort	submesic	Kam	n/a	Dry grasslands on gentle to moderate south-facing slopes; may include some 83a ecosystem units (stable slope phase); may also include some 85 units that occur over fine textured soils which are not common in the Lillooet TSA.
BG	xh	3		87	Not reg'd	Bluebunch wheatgrass – Round-leaved alumroot;	mesic - subhygric	Kam	n/a	Moderate to steep north slopes.
BG	xh	3		53 86 50	Not reg'd	Water birch – Prairie rose Snowberry – Juniper Wolf-willow – Giant wildrye	mesic - subhygric	Kam	n/a	Shrub or grassland units that are slightly moist toes of slopes, stream edges or gully bottoms. The 50 unit is sporadic and unpredictable – cannot be mapped as its own unit. Satellite imagery is not sufficiently refined to separate these units.
BG	xh	3		52 88	Not reg'd	Snowberry – Kentucky bluegrass Short-awned porcupinegrass – Small-flowered penstemon	subhygric	Kam	n/a	Shrub or grassland units on fluvial terraces; these often intermix and are not separated in the satellite imagery.
BG	xh	3		51	Not reg'd	Prairie Rose – Snowberry	subhygric - hygric	Kam	n/a	This unit is lumped with the WS wetland shrub community since it exists in these same locations.
BG	xh	3		03	Not reg'd	Fd - Snowberry - Bluebunch wheatgrass	mesic	Kam	Use BGxh2 04	Forested mesic – level to gently sloping, slightly elevated benches above major streams; Also the south and west-facing slopes that are forested
BG	xh	3		02	Not reg'd	Fd - Rocky Mountain juniper	subxeric	Kam	Use BGxh2 03	Forested dry, shallow soils – steep north- and northeast-facing slopes and on shaded toe slopes.
BG	xh	3		04	Not reg'd	Douglas-fir - Prairie rose - Saskatoon	subhygric	Kam	Use BGxh2 07	Forested mid to toe slope positions in moist, steep sided gullies with permanent or ephemeral streams. Due to intermittent seepage and their shade topographic position these sites have a subhygric moisture regime.
BG	xh	3		05	Not reg'd	Black Cottonwood - Prairie rose – Snowberry; Black Cottonwood – Sandbar willow -	subhygric - hygric	Kam	Use BGxh2 07	Forested active floodplains – the 05 is a mid bench while the 06 is a low bench ecosystem unit.

				06		dogbane				
BG	xw	2		01	Not reg'd	Bluebunch wheatgrass – Needle-and-thread grass;	mesic	Kam	n/a	Mesic grassland on flat to gentle slopes of all aspects; also occurs on the E and NW slopes that transition between south and north aspects.
BG	xw	2		80		Saskatoon – Prairie sagewort	xeric	Kam	n/a	Cliff-face ecosystems growing on pockets of soil where possible. This unit has been lumped with the RT unit since it is not possible to map them separately from the rock.
BG	xw	2		81 82	Not reg'd	Big Sage – Prairie sagewort; Small-flowered ricegrass - Lichen	subxeric	Kam	n/a	Xeric grasslands over very shallow soils such as cliffs, rock outcrops or talus.
BG	xw	2		83	Not reg'd	Prairie sagewort – Bluebunch wheatgrass	subxeric - submesic	Kam	n/a	Dry grasslands on steep south-facing slopes; vegetation varies from moderate cover to sparse; on steeper slopes, soils may be eroding.
BG	xw	2		84		Needle-and-thread grass– Sand dropseed	submesic	Kam	n/a	Dry grasslands on moderate south-facing slopes; vegetation is denser than the 83 unit but still sparser than the 01 unit.
BG	xw	2		86 85	Not reg'd	Bluebunch wheatgrass – Nodding onion; Spreading needlegrass – Old man's whiskers	mesic - subhygric	Kam	n/a	Moderate to steep north slopes. The 85 unit is slightly drier due to being higher in elevation and receiving some sunlight wrapping around the hill sides.
BG	xw	2		87	Not reg'd	Short-awned porcupinegrass - Lemonweed	mesic - subhygric	Kam	n/a	Shrub or grassland units that are slightly moist toes of slopes, stream edges or gully bottoms.
BG	xw	2		88	Not reg'd	Spreading needlegrass – Northern bedstraw	subhygric	Kam	n/a	Grassland unit that occurs in depression pockets that are not true wetlands.
BG	xw	2		50	Not reg'd	Willow – Kentucky bluegrass	subhygric - hygric	Kam	n/a	This unit is lumped with the WS wetland shrub community since it exists in these same locations.
BG	xw	2		04	Not reg'd	Fd - Pinegrass – Red-stemmed feathermoss	mesic	Kam	Use BGxw2 05	Forested mesic – level to gently sloping north-facing slopes.
BG	xw	2		02	Not reg'd	Fd – Spike-like goldenrod – Pelt lichen	subxeric	Kam	Use BGxw2 03	Forested dry, shallow soils – very steep north- facing slopes; also on the vertical bands of the NE and NW slopes transitioning to the south aspect. If there is any forest on a south-facing slope, it will be this unit.

BG	xw	2		03	Not reg'd	Fd – Rocky Mountain juniper – Bluebunch wheatgrass	mesic - submesic	Kam	Use BGxh2 05	Forested moderate to steep north-facing slopes
BG	xw	2		05	Not reg'd	Fd – Douglas maple	subhygric	Kam	Use BGxh2 05	Forested – moist units typically in steep sided gullies with permanent or ephemeral streams. Due to intermittent seepage and their shade topographic position these sites have a subhygric moisture regime.
BG	xw	2		06	Not reg'd	Trembling aspen- Snowberry	subhygric	Kam	Use BGxh2 07	Forested moist depressions dominated by At.
BG	xw	2		07	Not reg'd	Black Cottonwood – Wild rose – Snowberry	subhygric - hygric	Kam	Use BGxh2 07	Forested active floodplains.
PP	xh	2		01 01YS	Not reg'd	Py - Bluebunch wheatgrass – Fescue; Py Fd – Kentucky bluegrass	mesic	Kam	Use PPxh2 01	Not in Lillooet TSA. The Fescue is a species common to the Merritt area.
PP	xh	2		05 05YS 05MS 06	Not reg'd	Py - Bluebunch wheatgrass; Py Fd - Bluebunch wheatgrass – kinnickinick; Py Fd - Bluebunch wheatgrass – Needlegrass; Py Fd - Big sage - Bluebunch wheatgrass	submesic - mesic	Kam	Use PPxh2 04	Zonal positions in this subzone – slopes <25% on all aspects. The 06 is the forested unit that typically surrounds grasslands on flat slopes – wheatgrass and big sage encroach into these stands for a distance of about 50 metres.
PP	xh	2		02	Not reg'd	FdPy - Bluebunch wheatgrass - Selaginella	subxeric	Kam	Use PPxh2 02	Rocky outcrops with forests (10% or denser cover). These occur on large ridge tops, hyper-steep slopes, or adjacent to cliffs or talus slopes.
PP	xh	2		03	Not reg'd	Py - Red three-awn	subxeric - submesic	Kam	Use PPxh2 03	Steep, south-facing slopes with open canopies; Py is the dominant tree species. These can be open crown closures or NP stands. Grasses and herbs have a very sparse cover. There is considerable bare ground in this unit. These are also the gentle ridge top ecosystem units, such as eskers or shoulder ridges.
PP	xh	2		04	Not reg'd	PyFd – Saskatoon – Rose	submesic	Kam	Use PPxh2 04	Moderate to steep, south-facing (E, S, SW) slopes with closed canopies. There is a low to moderate cover of Bluebunch wheatgrass and with other grass species, no mosses. Saskatoon, snowberry and Oregon grape are the dominant shrubs.
PP	xh	2		07a	Not reg'd	Fd - Feathermoss	mesic - submesic	Kam	Use PPxh2 01	Steep to hyper-steep, north-facing slopes with closed or open canopies. The tree boles are far apart but their canopies often intersect. The ground cover is a dense carpet of moss and rock with few herbs or shrubs.
PP	xh	2		07	Not reg'd	Fd - Pinegrass - Feathermoss	mesic - subhygric	Kam	Use PPxh2 01	Moderate to steep, north-facing slopes with closed canopies. Feathermoss intermixed with the pinegrass is an indicator of this unit. Dense pinegrass, mod-

										dense mosses (feathermoss, heron's bill moss, electrified cat's tail), aster and soopalalie.
PP	xh	2		08	Not reg'd	FdPy - Snowberry - Saskatoon	subhygric	Kam	Use PPxh2 06	This unit includes the slightly moist toes of slopes and transitions to stream edges as well as the stream edge units.
PP	xh	2		09	Not reg'd	Act - Water birch	subhygric - hygric	Kam	Use PPxh2 07	This unit includes a wide range, from the fluvial benches along rivers or large streams to the horsetail flats along slow-moving streams or around wetlands. These can be productive forests or unproductive forests depending on the quantity of water and whether it is flowing or stagnant.
PP	xh	2		92	GX	Selaginella grassland	xeric - subxeric	Kam		Very dry, sparsely-vegetated grasslands. Typically on or adjacent to rocky outcrops. Selaginella densa is an indicator species. Ridge tops and very steep slopes within Open Range polygons are used to pull out this unit.
PP	xh	2		93 & 91	GD	Big sage – Bluebunch wheatgrass	subxeric - submesic	Kam		Flat to moderate slopes dominated by grasses and sagebrush. Generally south - facing, but occasionally wrapping around to northerly aspects. These are the OR (open range) polygons from Forest Cover.
IDF	xw			01	DJ	Fd – Juniper – Bluebunch wheatgrass	mesic	Kam	Use Cariboo SIBEC values	Zonal positions in this subzone – slopes <25% on all aspects.
IDF	xw			02	PW	FdPy- Bluebunch wheatgrass - Pinegrass	subxeric	Kam	Use Cariboo SIBEC values	Rocky outcrops with forests (10% or denser cover). These occur on large ridge tops, hyper-steep slopes, or adjacent to cliffs or talus slopes. The classification scheme now omits this unit, but it does exist regularly in this subzone.
IDF	xw			03	DS	FdPy – Western Snowberry - Bluebunch wheatgrass	subxeric - submesic	Kam	Use Cariboo SIBEC values	Steep, south-facing slopes with open canopies; Py is the dominant tree species. These can be open crown closures or NP stands. Grasses and herbs have a very sparse cover. There is considerable bare ground in this unit. These are also the gentle ridge top ecosystem units, such as eskers or shoulder ridges.
IDF	xw			04	DW	FdPy - Bluebunch wheatgrass - Balsamroot	submesic	Kam	Use Cariboo SIBEC values	Moderate to steep, south-facing (E, S, SW) slopes with closed canopies. There is a low to moderate cover of Bluebunch wheatgrass and with other grass species, no mosses. Saskatoon, snowberry and Oregon grape are the dominant shrubs.
IDF	xw			05a	DF	Fd - Feathermoss	mesic - submesic	Kam	Use Cariboo SIBEC	Steep to hyper-steep, north-facing slopes with closed or open canopies. The tree boles are far apart but their canopies often intersect. The ground cover is a dense carpet of moss and rock with few herbs or shrubs.

									values	
IDF	xw			05	DF	Fd – Feathermoss	mesic - subhygric	Kam	Use Cariboo SIBEC values	Moderate to steep, north-facing slopes with closed canopies. Feathermoss intermixed with the pinegrass is an indicator of this unit. Dense pinegrass, mod-dense mosses (feathermoss, heron's bill moss, electrified cat's tail), aster and soopalalie.
IDF	xw			06	SB	Sxw – Water birch	subhygric	Kam	Use Cariboo SIBEC values	This unit includes the slightly moist toes of slopes and transitions to stream edges as well as the stream edge units.
IDF	xw			07	SR	Sxw – Prickly rose - Coltsfoot	subhygric - hygric	Kam	Use Cariboo SIBEC values	This unit includes the horsetail flats along slow-moving streams or around wetlands. These can be productive forests or unproductive forests depending on the quantity of water and whether it is flowing or stagnant.
IDF	xw				GX	Selaginella grassland	xeric - subxeric	Kam		Very dry, sparsely-vegetated grasslands. Typically on or adjacent to rocky outcrops. Selaginella densa is an indicator species. Ridge tops and very steep slopes within Open Range polygons are used to pull out this unit.
IDF	xw				GD	Big sage – Bluebunch wheatgrass	subxeric - submesic	Kam		Flat to moderate slopes dominated by grasses and sagebrush. Generally south-facing, but occasionally wrapping around to northerly aspects. These are the OR (open range) polygons from Forest Cover.
This subzone was mapped during the first year of the project, but subsequently removed by D. Lloyd during the final year of the project. As such, we removed it from the KB's.										
IDF	xm			01		Fd – Pinegrass – Feathermoss	mesic	Kam	Use Cariboo SIBEC values	Zonal positions in this subzone – slopes <25% on all aspects.
IDF	xm			02		Bluebunch wheatgrass – Penstemon	subxeric	Kam	Use Cariboo SIBEC values	Rocky outcrops with forests (10% or denser cover). These occur on large ridge tops, hyper-steep slopes, or adjacent to cliffs or talus slopes. The classification scheme now omits this unit, but it does exist regularly in this subzone.
IDF	xm			03		Fd – Junipter Cladonia	subxeric - submesic	Kam	Use Cariboo SIBEC values	Steep, south-facing slopes with open canopies; Py is the dominant tree species. These can be open crown closures or NP stands. Grasses and herbs have a very sparse cover. There is considerable bare ground in this unit. These are also the gentle ridge top ecosystem units, such as eskers or shoulder ridges.

IDF	xm			04		Fd – Bluebunch wheatgrass – Pasture Sage	submesic	Kam	Use Cariboo SIBEC values	Moderate to steep, south-facing (E, S, SW) slopes with closed canopies. There is a low to moderate cover of Bluebunch wheatgrass and with other grass species, no mosses. Saskatoon, snowberry and Oregon grape are the dominant shrubs.
IDF	xm			05a		Fd – Feathermoss – Stepmoss	mesic - submesic	Kam	Use Cariboo SIBEC values	Steep to hyper-steep, north-facing slopes with closed or open canopies. The tree boles are far apart but their canopies often intersect. The ground cover is a dense carpet of moss and rock with few herbs or shrubs.
IDF	xm			05		Fd – Feathermoss – Stepmoss	mesic - subhygric	Kam	Use Cariboo SIBEC values	Moderate to steep, north-facing slopes with closed canopies. Feathermoss intermixed with the pinegrass is an indicator of this unit. Dense pinegrass, mod-dense mosses (feathermoss, heron's bill moss, electrified cat's tail), aster and soopalalie.
IDF	xm			07 06 08		Fd – Prickly rose– Sarsaparilla Fd – Ricegrass – Feathermoss	subhygric	Kam	Use Cariboo SIBEC values	This unit includes the slightly moist toes of slopes and transitions to stream edges as well as the stream edge units.
IDF	xm			09		??	subhygric-hygric	Kam	Use Cariboo SIBEC values	This unit includes a wide range, from the fluvial benches along rivers or large streams to the horsetail flats along slow-moving streams or around wetlands. These can be productive forests or unproductive forests depending on the quantity of water and whether it is flowing or stagnant.
IDF	xm				GX	Selaginella grassland	xeric - subxeric	Kam		Very dry, sparsely-vegetated grasslands. Typically on or adjacent to rocky outcrops. Selaginella densa is an indicator species. Ridge tops and very steep slopes within Open Range polygons are used to pull out this unit.
IDF	xm				GD	Big sage – Bluebunch wheatgrass	subxeric - submesic	Kam		Flat to moderate slopes dominated by grasses and sagebrush. Generally south-facing, but occasionally wrapping around to northerly aspects. These are the OR (open range) polygons from Forest Cover.
The classification scheme for this subzone was changed by D. Lloyd et. al. during the PEM project.										
IDF	xh	2 & 2	a	01 06	Not reg'd	FdPy - Pinegrass– Feathermoss; and Fd – Snowberry - Pinegrass	mesic	Kam	Use IDFxh2 01	Zonal positions in this subzone – slopes <25% on all aspects.
IDF	xh	2 &		02	Not reg'd	Selaginella – Bluebunch wheatgrass	subxeric	Kam	Use IDFxh2	Rocky outcrops with forests (10% or denser cover). These occur on large ridge tops, hyper-steep slopes, or adjacent to cliffs or talus slopes. The classification

		2	a			(formerly FdPy - Bluebunch wheatgrass - Rough fescue)			02	scheme now omits this unit, but it does exist regularly in this subzone.
IDF	xh	2 & 2	a	03	Not reg'd	FdPy - Bluebunch wheatgrass - Balsamroot	subxeric - submesic	Kam	Use IDFxh2 03	Steep, south-facing slopes with open canopies; Py is the dominant tree species. These can be open crown closures or NP stands. Grasses and herbs have a very sparse cover. There is considerable bare ground in this unit. These are also the gentle ridge top ecosystem units, such as eskers or shoulder ridges.
IDF	xh	2 & 2	a	04	Not reg'd	FdPy - Bluebunch wheatgrass - Pinegrass	submesic	Kam	Use IDFxh2 04	Moderate to steep, south-facing (E, S, SW) slopes with closed canopies. There is a low to moderate cover of Bluebunch wheatgrass and with other grass species, no mosses. Saskatoon, snowberry and Oregon grape are the dominant shrubs.
IDF	xh	2 & 2	a	05	Not reg'd	Fd - Fescue	submesic	Kam	Use IDFxh2 05	Does not exist in the Lillooet TSA. Fescue is common in the Merritt area.
IDF	xh	2 & 2	a	07a	Not reg'd	Fd – Feathermoss (hyper-steep north slopes)	mesic - submesic	Kam	Use IDFxh2 06	Steep to hyper-steep, north-facing slopes with closed or open canopies. The tree boles are far apart but their canopies often intersect. The ground cover is a dense carpet of moss and rock with few herbs or shrubs.
IDF	xh	2 & 2	a	07	Not reg'd	Fd – Feathermoss	mesic - subhygric	Kam	Use IDFxh2 06	Moderate to steep, north-facing slopes with closed canopies. Feathermoss intermixed with the pinegrass is an indicator of this unit. Dense pinegrass, mod-dense mosses (feathermoss, heron's bill moss, electrified cat's tail), aster and soopalalie.
IDF	xh	2 & 2	a	08	Not reg'd	CwFd - Dogwood	subhygric	Kam	Use IDFxh2 07	This is a wide range unit. It includes the slightly moist toes of slopes and transitions to stream edges. It includes the stream edge units. It also includes the fluvial benches along rivers or large streams. According to the classification system, there are no horsetail flats in this subzone.
IDF	xh	2 & 2	a		GX	Selaginella grassland	xeric - subxeric	Kam		Very dry, sparsely-vegetated grasslands. Typically on or adjacent to rocky outcrops. Selaginella densa is an indicator species. Ridge tops and very steep slopes within Open Range polygons are used to pull out this unit.
IDF	xh	2 & 2	a		GD	Big sage – Bluebunch wheatgrass	subxeric - submesic	Kam		Flat to moderate slopes dominated by grasses and sagebrush. Generally south-facing, but occasionally wrapping around to northerly aspects. These are the OR (open range) polygons from Forest Cover.
The classification scheme for this subzone was changed by D. Lloyd et. al. during the PEM project.										

IDF	xh	3		01	Not reg'd	FdPy - Pinegrass	mesic	Kam	Use IDFxh2 01	Zonal positions in this subzone – slopes <25% on all aspects.
IDF	xh	3		02	Not reg'd	Fd – Penstemon - Selaginella	subxeric	Kam	Use IDFxh2 02	Rocky outcrops with forests (10% or denser cover). These occur on large ridge tops, hyper-steep slopes, or adjacent to cliffs or talus slopes. The classification scheme now omits this unit, but it does exist regularly in this subzone.
IDF	xh	3		03	Not reg'd	FdPy – Saskatoon - Penstemon	subxeric - submesic	Kam	Use IDFxh2 03	Steep, south-facing slopes with open canopies; Py is the dominant tree species. These can be open crown closures or NP stands. Grasses and herbs have a very sparse cover. There is considerable bare ground in this unit. These are also the gentle ridge top ecosystem units, such as eskers or shoulder ridges.
IDF	xh	3		04	Not reg'd	FdPy - Bluebunch wheatgrass	submesic	Kam	Use IDFxh2 04	Moderate to steep, south-facing (E, S, SW) slopes with closed canopies. There is a low to moderate cover of Bluebunch wheatgrass and with other grass species, no mosses. Saskatoon, snowberry and Oregon grape are the dominant shrubs.
IDF	xh	3		05a	Not reg'd	Fd – Feathermoss – hyper-steep north slopes	mesic - submesic	Kam	Use IDFxh2 05	Steep to hyper-steep, north-facing slopes with closed or open canopies. The tree boles are far apart but their canopies often intersect. The ground cover is a dense carpet of moss and rock with few herbs or shrubs.
IDF	xh	3		05	Not reg'd	Fd – Feathermoss – moderate north slopese	mesic - subhygric	Kam	Use IDFxh2 05	Moderate to steep, north-facing slopes with closed canopies. Feathermoss intermixed with the pinegrass is an indicator of this unit. Dense pinegrass, mod-dense mosses (feathermoss, heron's bill moss, electrified cat's tail), aster and soopalalie.
IDF	xh	3		06	Not reg'd	Act - Fd - Dogwood – Gooseberry; and CwFd – Goodyera	subhygric - hygric	Kam	Use IDFxh2 07	This is a wide range unit. It includes the slightly moist toes of slopes and transitions to stream edges. It includes the stream edge units. It also includes the fluvial benches along rivers or large streams. According to the classification system, there are no horsetail flats in this subzone.
IDF	xh	3		93	GX	Selaginella grassland	xeric - subxeric	Kam		Very dry, sparsely-vegetated grasslands. Typically on or adjacent to rocky outcrops. Selaginella densa is an indicator species. Ridge tops and very steep slopes within Open Range polygons are used to pull out this unit.
IDF	xh	3		921 & 92	GD	Big sage – Bluebunch wheatgrass	subxeric - submesic	Kam		Flat to moderate slopes dominated by grasses and sagebrush. Generally south-facing, but occasionally wrapping around to northerly aspects. These are the OR (open range) polygons from Forest Cover.

The classification scheme for this subzone was changed by D. Lloyd et. al. during the PEM project.

IDF	dk	1 & 1	a	01 05 06	Not reg'd	FdPl - Pinegrass – Feathermoss; Fd – Juniper – Wheatgrass; Fd – Pinegrass – Yarrow	mesic - submesic	Kam	Use IDFdk1 01	Zonal positions of flat to gentle (25%) slopes on all aspects. The 05 unit exists on zonal positions near the IDFxh boundaries (<5% mosses, no twinflower, more kinnickinnick). The 06 (with significant grouseberry) exists on zonal positions near the MS boundaries. The 01 is the most common unit on zonal positions in this subzone. There is a narrow vertical band of 01 on NE and NW slopes – used solar insolation to try to capture this change.
IDF	dk	1 & 1	a	02	Not reg'd	Fd – Juniper - Penstemon	subxeric	Kam	Use IDFdk1 02	Rocky outcrops with forests (10% or denser cover). These occur on large ridge tops, hyper-steep slopes, or adjacent to cliffs or talus slopes.
IDF	dk	1 & 1	a	03	Not reg'd	Fd - Snowberry - Bluebunch wheatgrass	subxeric - submesic	Kam	Use IDFdk1 02	Steep, south-facing slopes with open canopies; often have a Py component to the stand. These can be open crown closures or NP stands. These are also the gentle ridge top ecosystem units, such as eskers or shoulder ridges.
IDF	dk	1 & 1	a	04	Not reg'd	Fd – Bluebunch wheatgrass - Pinegrass	submesic	Kam	Use IDFdk1 03	Moderate to steep, south-facing (E, S, SW) slopes with closed canopies. Dense pinegrass, bluebunch wheatgrass, no mosses, few soopalalie and Saskatoon, near MS boundaries more falsebox and aster.
IDF	dk	1 & 1	a	07a	Not reg'd	Fd (Pl) – Feathermoss – Hyper-steep north slopes	mesic - submesic	Kam	Use IDFdk1 04	Steep to hyper-steep, north-facing slopes with closed or open canopies. The tree boles are far apart but their canopies often intersect. The ground cover is a dense carpet of moss and rock with few herbs or shrubs.
IDF	dk	1 & 1	a	07	Not reg'd	Fd(Pl) – Pinegrass – Feathermoss	mesic - subhygric	Kam	Use IDFdk1 04	Moderate to steep, north-facing slopes with closed canopies. Feathermoss intermixed with the pinegrass is an indicator of this unit. Dense pinegrass, mod-dense mosses (feathermoss, heron's bill moss, electrified cat's tail), aster and soopalalie.
IDF	dk	1 & 1	a	08	Not reg'd	SxFd - Gooseberry - Feathermoss	subhygric	Kam	Use IDFdk1 05	This is a wide range unit. It includes the slightly moist toes of slopes and transitions to stream edges. It includes the stream edge units. It also includes the fluvial benches along rivers or large streams.
IDF	dk	1 & 1	a	09	Not reg'd	Sxw – Horsetail	subhygric - hygric	Kam	Use IDFdk1 06	Horsetail flats along slow-moving streams or around wetlands. Can be productive forests or unproductive forests depending on the quantity of water and whether it is flowing or stagnant. Horsetail >25%, bunchberry, arnica, aster, gooseberry, dogwood, sweet cicely, etc.
IDF	dk	1 & 1	a	10	Not reg'd	Se-Pl-Trappers tea-Bog birch	Hygric - subhydric	Kam		Not found in the Lillooet TSA. Unproductive swamp forests.

IDF	dk	1 & 1	a	92	GX	Selaginella grassland	xeric - subxeric	Kam		Very dry, sparsely-vegetated grasslands. Typically on or adjacent to rocky outcrops. Selaginella densa is an indicator species. Ridge tops and very steep slopes within Open Range polygons are used to pull out this unit.
IDF	dk	1 & 1	a	93& 96	GD	Big sage – Bluebunch wheatgrass	subxeric - submesic	Kam		Flat to moderate slopes dominated by grasses and sagebrush. Generally south - facing, but occasionally wrapping around to northerly aspects. These are the OR (open range) polygons from Forest Cover.
The classification scheme for this subzone was changed by D. Lloyd et. al. during the PEM project.										
IDF	dk	2		Not reg'd		FdPl - Pinegrass – Twinflower; Pl – Grouseberry – Pinegrass	mesic - submesic	Kam	Use IDFdk2 01	Zonal positions of flat to gentle (25%) slopes on all aspects. The 05 (with significant grouseberry) exists on zonal positions near the MS boundaries. The 01 is the most common unit on zonal positions in this subzone.
IDF	dk	2		Not reg'd		Fd Py – Juniper -Penstemon	subxeric	Kam	Use IDFdk2 02	Rocky outcrops with forests (10% or denser cover). These occur on large ridge tops, hyper-steep slopes, or adjacent to cliffs or talus slopes.
IDF	dk	2		Not reg'd		Fd Py - Bluebunch wheatgrass – Pinegrass	subxeric - submesic	Kam	Use IDFdk2 02	Steep, south-facing slopes with open canopies; has a strong Py component to the stand. These can be open crown closures or NP stands. These are also the gentle ridge top ecosystem units, such as eskers or shoulder ridges.
IDF	dk	2		Not reg'd		Fd Py – Pinegrass	submesic	Kam	Use IDFdk2 03	Moderate to steep, south-facing (E, S, SW) slopes with closed canopies. Dense pinegrass, bluebunch wheatgrass, pockets of mosses, few soopalalie and Saskatoon, near MS boundaries more falsebox and aster.
IDF	dk	2		Not reg'd		Fd (Pl) – Feathermoss – Hyper-steep north slopes	mesic - submesic	Kam	Use IDFdk2 04	Steep to hyper-steep, north-facing slopes with closed or open canopies. The tree boles are far apart but their canopies often intersect. The ground cover is a dense carpet of moss and rock with few herbs or shrubs.
IDF	dk	2		Not reg'd		Sxw Fd – Feathermoss; FdPl – Pinegrass – Feathermoss	mesic - subhygric	Kam	Use IDFdk2 04	Moderate to steep, north-facing slopes with closed canopies. Feathermoss intermixed with the pinegrass is an indicator of this unit. Dense pinegrass, mod-dense mosses (feathermoss, heron's bill moss, electrified cat's tail), aster and soopalalie.
IDF	dk	2		Not reg'd		Pl – Alder – Twinflower	subhygric	Kam	Use IDFdk2 05	The slightly moist toes of slopes and transitions to stream edges.
IDF	dk	2		09		Sxw – Dogwood – Gooseberry	subhygric	Kam	Use	Stream edge units dominated by shrubs. Very productive ecosystem units.

				11		Sxw – Devil's Club			IDFdk105	
IDF	dk	2		10		Sxw – Dogwood – Oakfern	subhygric-hygric	Kam	Use IDFdk205	Fluvial benches along rivers or major streams. These ecosystems are subject to flooding throughout growing season. The moss layer is absent due to flood scouring; the herb layer is moderate; the shrub layer is very dense.
IDF	dk	2		12		Sxw – Horsetail	subhygric-hygric	Kam	Use IDFdk206	Horsetail flats along slow-moving streams or around wetlands. Can be productive forests or unproductive forests depending on the quantity of water and whether it is flowing or stagnant. Horsetail >25%, bunchberry, arnica, aster, gooseberry, dogwood, sweet cicely, etc.
IDF	dk	2		13		Sxw – Soft sedge	Hygric - subhydric	Kam	Use IDFdk207	Unproductive swamp forests. Open canopy of stunted Spruce growing on hummocks. These are typically along the fringes of wetlands or they occupy depression areas.
IDF	dk	2		92	GX	Selaginella grassland	xeric - subxeric	Kam		Very dry, sparsely-vegetated grasslands. Typically on or adjacent to rocky outcrops. Selaginella densa is an indicator species. Ridge tops and very steep slopes within Open Range polygons are used to pull out this unit.
IDF	dk	2		93& 96	GD	Big sage – Bluebunch wheatgrass	subxeric - submesic	Kam		Flat to moderate slopes dominated by grasses and sagebrush. Generally south-facing, but occasionally wrapping around to northerly aspects. These are the OR (open range) polygons from Forest Cover.
We used the Cariboo Site Series Field Guide for this subzone. Please refer to the Cariboo SIBEC values.										
IDF	dk	3		01	LP	FdPl – Pinegrass – Feathermoss	mesic	Kam	Use IDFdk301	Zonal positions in this subzone – slopes <25% on all aspects.
IDF	dk	3		03	DJ	Fd – Juniper – Peltigera	subxeric	Kam	Use IDFdk302	Rocky outcrops with forests (10% or denser cover). These occur on large ridge tops, hyper-steep slopes, or adjacent to cliffs or talus slopes. The classification scheme now omits this unit, but it does exist regularly in this subzone.
IDF	dk	3		02	DK	Fd – Juniper – Kinnikinnick	subxeric - submesic	Kam	Use IDFdk303	Steep, south-facing slopes with open canopies These can be open crown closures or NP stands. Grasses and herbs have a very sparse cover. There is considerable bare ground in this unit. These are also the gentle ridge top ecosystem units, such as eskers or shoulder ridges.
IDF	dk	3		04	DW	Fd – Bluebunch wheatgrass – Needlegrass	submesic	Kam	Use IDFdk304	Moderate to steep, south-facing (E, S, SW) slopes with closed canopies. There is a moderate cover of Bluebunch wheatgrass and with other grass species, few to no mosses. Saskatoon, snowberry and Oregon grape are the dominant shrubs.

IDF	dk	3		05a	DM	Fd – Feathermoss – Stepmoss	mesic - subhygric	Kam	Use IDFdk3 05	Steep to hyper-steep, north-facing slopes with closed or open canopies. The tree boles are far apart but their canopies often intersect. The ground cover is a dense carpet of moss and rock with few herbs or shrubs.
IDF	dk	3		05	DM	Fd – Feathermoss – Stepmoss	mesic - subhygric	Kam	Use IDFdk3 05	Moderate to steep, north-facing slopes with closed canopies. Feathermoss intermixed with the pinegrass is an indicator of this unit. Dense pinegrass, mod-dense mosses (feathermoss, heron's bill moss, electrified cat's tail), aster and soopalalie.
IDF	dk	3		06	DP	Fd – Pinegrass – Aster	mesic - subhygric	Kam	Use IDFdk3 06	N/a - does not occur in the Lillooet District
IDF	dk	3		08 07	SS SR	SxwFd – Prickly rose – Sarsaparilla SxwFd – Prickly rose – Sedge	subhygric	Kam	Use IDFdk3 07	This is a wide range unit. It includes the slightly moist toes of slopes and transitions to stream edges. It includes the stream edge units. It also includes the fluvial benches along rivers or large streams.
IDF	dk	3		09	SH	Sxw – Horsetail – Glow moss	subhygric - hygric	Kam	Use IDFdk3 09	Horsetail flats along slow-moving streams or around wetlands. Can be productive forests or unproductive forests depending on the quantity of water and whether it is flowing or stagnant.
IDF	dk	3			GD	Big sage – Bluebunch wheatgrass	subxeric - submesic	Kam		Flat to moderate slopes dominated by grasses and sagebrush. Generally south - facing, but occasionally wrapping around to northerly aspects. These are the OR (open range) polygons from Forest Cover.
The classification scheme for this subzone was changed by D. Lloyd et. al. during the PEM project.										
IDF	dk	5		01	Not reg'd	Fd Pl - Wintergreen - Feathermoss	mesic	Kam	Use IDFdk2 01	Zonal positions in this subzone – slopes <25% on all aspects.
IDF	dk	5		02	Not reg'd	Fd Juniper - Penstemon	subxeric	Kam	Use IDFdk2 02	Rocky outcrops with forests (10% or denser cover). These occur on large ridge tops, hyper-steep slopes, or adjacent to cliffs or talus slopes. The classification scheme now omits this unit, but it does exist regularly in this subzone.
IDF	dk	5		03	Not reg'd	FdPy - Bluebunch wheatgrass	subxeric - submesic	Kam	Use IDFdk2 02	Steep, south-facing slopes with open canopies. These can be open crown closures or NP stands. Grasses and herbs have a very sparse cover. There is considerable bare ground in this unit. These are also the gentle ridge top ecosystem units, such as eskers or shoulder ridges.
IDF	dk	5		04	Not	FdPl - Pinegrass	submesic	Kam	Use	Moderate to steep, south-facing (E, S, SW) slopes with closed canopies. There is a

					reg'd				IDFdk2 03	moderate cover of Bluebunch wheatgrass and with other grass species, few to no mosses. Saskatoon, snowberry and Oregon grape are the dominant shrubs.
IDF	dk	5		05a	Not reg'd	FdCw – Feathermoss – hyper-steep north slopes	mesic - submesic	Kam	Use IDFdk2 04	Steep to hyper-steep, north-facing slopes with closed or open canopies. The tree boles are far apart but their canopies often intersect. The ground cover is a dense carpet of moss and rock with few herbs or shrubs.
IDF	dk	5		05	Not reg'd	FdCw - Feathermoss	mesic - subhygric	Kam	Use IDFdk2 04	Moderate to steep, north-facing slopes with closed canopies. Feathermoss intermixed with the pinegrass is an indicator of this unit. Dense pinegrass, mod-dense mosses (feathermoss, heron's bill moss, electrified cat's tail), aster and soopalalie.
IDF	dk	5		06	Not reg'd	SxFd - Dogwood – Gooseberry	subhygric	Kam	Use IDFdk2 05	This is a wide range unit. It includes the slightly moist toes of slopes and transitions to stream edges. It includes the stream edge units. It also includes the fluvial benches along rivers or large streams.
IDF	dk	5		07	Not reg'd	Sx – Horsetail & Sx - Soft-leaved sedge	subhygric-hygric	Kam	Use IDFdk2 06	Horsetail flats along slow-moving streams or around wetlands. Can be productive forests or unproductive forests depending on the quantity of water and whether it is flowing or stagnant.
IDF	dk	5		92	GX	Selaginella grassland	xeric - subxeric	Kam		Very dry, sparsely-vegetated grasslands. Typically on or adjacent to rocky outcrops. Selaginella densa is an indicator species. Ridge tops and very steep slopes within Open Range polygons are used to pull out this unit .
IDF	dk	5		93& 96	GD	Big sage – Bluebunch wheatgrass	subxeric - submesic	Kam		Flat to moderate slopes dominated by grasses and sagebrush. Generally south - facing, but occasionally wrapping around to northerly aspects. These are the OR (open range) polygons from Forest Cover.
IDF	dk	5			HM	Herbaceous Meadow (at the Parkland Boundary)	mesic - subhygric	Kam	n/a	These are moist meadows primarily of herbs and grasses. They may also be alder swales in cases of low avalanche activity. They occur at the toes of avalanche paths in this subzone. Many of the species are consistent with alpine species. These are very rich grizzly forage areas.
The classification scheme for this subzone was changed by D. Lloyd et. al. during the PEM project.										
IDF	ww	2		01 04	Not reg'd	Fd Ep – Fairy bells Fd – Snowberry – Moss	mesic - submesic	Kam	Use IDFww 01	Zonal positions of flat to gentle (25%) slopes on all aspects. The 04 unit also occupies zonal positions at higher elevations or the transitions onto northern slopes.
IDF	ww	2		02	Not reg'd	Fd Py – Falsebox – Penstemon (The forested rock outcrop unit and	subxeric - submesic	Kam	Use IDFww 02	Rocky outcrops with forests (10% or denser cover). These occur on large ridge tops, hyper-steep slopes, or adjacent to cliffs or talus slopes.

						ridge/hill top unit have been combined here)				These are also the steep, south-facing slopes with open canopies; has a strong Py component to the stand. These can be open crown closures or NP stands. These are also the gentle ridge top ecosystem units, such as eskers or shoulder ridges.
IDF	ww	2		03	Not reg'd	Fd Py – Pinegrass	submesic	Kam	Use IDFww 03	Moderate to steep, south-facing (E, S, SW) slopes with closed canopies. Dense pinegrass, bluebunch wheatgrass, pockets of mosses, few soopalalie and Saskatoon, near MS boundaries more falsebox and aster.
IDF	ww	2		05a	Not reg'd	Fd Cw – Pinegrass (Hyper-steep north slopes)	mesic - submesic	Kam	Use IDFww 05	Steep to hyper-steep, north-facing slopes with closed or open canopies. The tree boles are far apart but their canopies often intersect. The ground cover is a dense carpet of moss and rock with few herbs or shrubs.
IDF	ww	2		05	Not reg'd	Fd Cw – Pinegrass	mesic - subhygric	Kam	Use IDFww 05	Moderate to steep, north-facing slopes with clo sed canopies. Feathermoss intermixed with the pinegrass is an indicator of this unit. Dense pinegrass, mod-dense mosses (feathermoss, heron's bill moss, electrified cat's tail), aster and soopalalie.
IDF	ww	2		06a 06b 06c	Not reg'd	Fd Cw – Red osier dogwood – Thimbleberry	subhygric	Kam	Use IDFww 06	The slightly moist toes of slopes and transitions to stream edges. Toes of slopes are consistent in this subzone unlike other IDF's. Also includes the stream edge units dominated by shrubs. Very productive ecosystem units.
IDF	ww	2		07 08 09	Not reg'd	High-bench floodplain Cw Ep; Mid-bench Act Fd Cw – Red osier dogwood – Sarsasparilla; Mid-bench Sx Act – Red osier dogwood – Devil's club	subhygric - hygric	Kam	Use IDFww 06	Fluvial benches along rivers or majo r streams. These ecosystems are subject to flooding throughout growing season. The moss layer is absent due to flood scouring; the herb layer is moderate; the shrub layer is very dense.
IDF	ww	2		10a 10b	Not reg'd	Cw – Devil's club - Ladyfern	subhygric - hygric	Kam	Use IDFww 06	Horsetail flats along slow-moving streams or high benches back from large streams or rivers. These are productive forests with fresh water movement.
IDF	ww	2		11	Not reg'd	Cw – Skunk cabbage	Hygric - subhydric	Kam	Use IDFww 07	Unproductive swamp forests. May be open or closed canopies of stunted Spruce growing on hummocks. These are typically along the fringes of wetlands or they occupy depression areas.
IDF	ww	2		92	GX	Selaginella grassland	xeric - subxeric	Kam		Very dry, sparsely-vegetated grasslands. Typically on or adjacent to rocky outcrops. Selaginella densa is an indicator species. Ridge tops and very steep slopes within Open Range polygons are used to pull out this unit.
IDF	ww	2		93& 96	GD	Big sage – Bluebunch wheatgrass	subxeric - submesic	Kam		Flat to moderate slopes dominated by grasses and sagebrush. Generally south-facing, but occasionally wrapping around to northerly aspects. These are the OR (open range) polygons from Forest Cover.

IDF	ww	2			HM	Herbaceous Meadow (at the Parkland Boundary)	mesic - subhygric	Kam	n/a	These are moist meadows primarily of herbs and grasses. They may also be alder swales in cases of low avalanche activity. They occur at the toes of avalanche paths in this subzone. Many of the species are consistent with alpine species. These are very rich grizzly forage areas.
This was an unusual BEC subzone. It was classified as CWHms1 in the old Legacy BEC map, and was not re-checked by D. Lloyd during their BEC revision project. We found no correlation between the ecosystem units on the ground to the Vancouver Field Guide for CWHms1. Instead, the ecosystem units followed a very similar pattern of development as the IDFww2. Therefore, we adapted the IDFww2 KB for this subzone and created the following ecosystem units for mapping purposes. D. Lloyd will change these names as he sees fit.										
CWH	ms	1		01	Not reg'd	Fd Ep – Fairy bells	mesic - submesic	Kam	Use IDFww 01	Zonal positions of flat to gentle (25%) slopes on all aspects. The 04 unit also occupies zonal positions at higher elevations or the transitions onto northern slopes.
CWH	ms	1		02	Not reg'd	Fd Py – Falsebox – Penstemon (The forested rock outcrop unit and ridge/hill top unit have been combined here)	subxeric - submesic	Kam	Use IDFww 02	Rocky outcrops with forests (10% or denser cover). These occur on large ridge tops, hyper-steep slopes, or adjacent to cliffs or talus slopes. These are also the steep, south-facing slopes with open canopies; has a strong Py component to the stand. These can be open crown closures or NP stands. These are also the gentle ridge top ecosystem units, such as eskers or shoulder ridges.
CWH	ms	1		03	Not reg'd	Fd Py – Pinegrass	submesic	Kam	Use IDFww 03	Moderate to steep, south-facing (E, S, SW) slopes with closed canopies. Dense pinegrass, bluebunch wheatgrass, pockets of mosses, few soopalalie and Saskatoon, near MS boundaries more falsebox and aster.
CWH	ms	1		05a	Not reg'd	Fd Cw – Pinegrass (Hyper-steep north slopes)	mesic - submesic	Kam	Use IDFww 05	Steep to hyper-steep, north-facing slopes with closed or open canopies. The tree boles are far apart but their canopies often intersect. The ground cover is a dense carpet of moss and rock with few herbs or shrubs.
CWH	ms	1		05	Not reg'd	Fd Cw – Pinegrass	mesic - subhygric	Kam	Use IDFww 05	Moderate to steep, north-facing slopes with closed canopies. Feathermoss intermixed with the pinegrass is an indicator of this unit. Dense pinegrass, mod-dense mosses (feathermoss, heron's bill moss, electrified cat's tail), aster and soopalalie.
CWH	ms	1		06	Not reg'd	Fd Cw – Red osier dogwood – Thimbleberry	subhygric	Kam	Use IDFww 06	The slightly moist toes of slopes and transitions to stream edges. Toes of slopes are consistent in this subzone unlike other IDF's. Also includes the stream edge units dominated by shrubs. Very productive ecosystem units. Also includes the fluvial benches along rivers or major streams that are subject to flooding throughout growing season. The moss layer is absent due to flood scouring; the herb layer is moderate; the shrub layer is very dense.

CWH	ms	1		10	Not reg'd	Cw – Devil's club - Ladyfern	subhygric-hygric	Kam	Use IDFww 06	Horsetail flats along slow-moving streams or high benches back from large streams or rivers. These are productive forests with fresh water movement.
CWH	ms	1		11	Not reg'd	Cw – Skunk cabbage	Hygric - subhydric	Kam	Use IDFww 07	Unproductive swamp forests. May be open or closed canopies of stunted Spruce growing on hummocks. These are typically along the fringes of wetlands or they occupy depression areas.
CWH	ms	1			HM	Herbaceous Meadow (at the Parkland Boundary)	mesic - subhygric	Kam	n/a	These are moist meadows primarily of herbs and grasses. They may also be alder swales in cases of low avalanche act ivity. They occur at the toes of avalanche paths in this subzone. Many of the species are consistent with alpine species. These are very rich grizzly forage areas.
MS	dc	1		01	Not reg'd	Sxw - Wintergreen - Feathermoss	mesic	Kam	Use MSdc 01	Zonal positions of flat to gentle (25%) slopes on all aspects.
MS	dc	1		02	Not reg'd	FdPl - Juniper	subxeric - submesic	Kam	Use MSdc 02	Rocky outcrops with forests (10% or denser cover). These occur on large ridge tops, hyper-steep slopes, or adjacent to cliffs or talus slopes. The typical 03 unit has also been lumped into this category by D. Lloyd. These are the steep, south-facing slopes with open canopies; Pl is a strong component to the stand. These can be open crown closures or NP stands. These are also the gentle ridge top ecosystem units, such as eskers or shoulder ridges.
MS	dc	1		03	Not reg'd	Pl - Spirea - Pinegrass	submesic	Kam	Use MSdc 03	Moderate to steep, south-facing (E, S, SW) slopes with closed canopies. Moderate covers of Pinegrass and Falsebox with a low cover of mosses are indicators of this unit.
MS	dc	1		04	Not reg'd	Pl – Falsebox – Showy Aster	submesic	Kam	Use MSdc 03	This is the classic west-facing slope seen in all of the MS subzones of the Lillooet TSA. Falsebox, kinnickinick and soopalalie combined are more pronounced with generally less pinegrass than the south-facing units. This unit is the transition between the south- and north-facing slopes.
MS	dc	1		05a	Not reg'd	Bl – Feathermoss	mesic - submesic	Kam	Use MSdc 01	Steep to hyper-steep, north-facing slopes with closed or open canopies. The tree boles are far apart but their canopies often intersect. The ground cover is a dense carpet of moss and rock with few herbs or shrubs.
MS	dc	1		05	Not reg'd	Bl – Rhododendron - Feathermoss	mesic - subhygric	Kam	Use MSdc 01	Moderate to steep, north-facing slopes with closed canopies. Dense feathermoss is the indicator of this unit. Pinegrass is moderate to sparse unlike in the IDF's. Alder and Huckleberry are common shrubs. Rhododendron may appear on these slopes near the ESSF boundary.

MS	dc	1		06	Not reg'd	Sxw – Gooseberry	subhygric	Kam	Use MSdc 04	The stream edge units that are dominated by moist shrubs, such as gooseberry, dogwood and twinberry. These two units intermingle with each other and as such are difficult to separate. These are very productive ecosystem units. This unit also includes fluvial benches along rivers or major streams. These ecosystems are subject to flooding throughout growing season. The moss layer is absent due to flood scouring; the herb layer is moderate; the shrub layer is very dense.
MS	dc	1		07	Not reg'd	Sxw - Horsetail	subhygric-hygric	Kam	Use MSdc 04	Horsetail flats along slow-moving streams or around wetlands. Can be productive forests or unproductive forests depending on the quantity of water and whether it is flowing or stagnant.
MS	dc	1		GJ		Juniper – Pinegrass Grassland	subxeric - submesic	Kam	n/a	Although no grasslands have been included in the classification for this subzone, the GJ unit is included in the KB's in the event that an OR polygon shows up somewhere. Pocket grasslands on upper, south-facing slopes usually associated with hill tops or ridge tops. Juniper patches are prominent and easily recognizable from a distance. These occur primarily near the lower boundary of the MS subzone.
MS	dc	1			HM	Herbaceous Meadow (at the Parkland Boundary)	mesic - subhygric	Kam	n/a	These are moist meadows primarily of herbs and grasses. They may also be alder swales in cases of low avalanche activity. They occur at the toes of avalanche paths in this subzone. Many of the species are consistent with alpine species. These are very rich grizzly forage areas.
MS	dc	2		01	Not reg'd	Sxw - Wintergreen - Feathermoss	mesic	Kam	Use MSdc 01	Zonal positions of flat to gentle (25%) slopes on all aspects.
MS	dc	2		02	Not reg'd	FdPl - Juniper	subxeric	Kam	Use MSdc 02	Rocky outcrops with forests (10% or denser cover). These occur on large ridge tops, hyper-steep slopes, or adjacent to cliffs or talus slopes.
MS	dc	2		03 & 05	Not reg'd	Fd Pl – Bluebunch wheatgrass Fd – Arrowleaf balsamroot – Pinegrass	subxeric - submesic	Kam	Use MSdc 02	The 03 is the steep, south-facing slopes with open canopies; Pl is a strong component to the stand. These can be open crown closures or NP stands. The 05's are generally the gentle ridge top ecosystem units, such as eskers or shoulder ridges
MS	dc	2		06	Not reg'd	Pl – Spirea – Pinegrass	submesic	Kam	Use MSdc 03	Moderate to steep, south-facing (E, S, SW) slopes with closed canopies. Moderate covers of Pinegrass and Falsebox with a low cover of mosses are indicators of this unit.
MS	dc	2		04	Not	Fd – Falsebox	submesic	Kam	Use MSdc	This is the classic west-facing slope seen in all of the MS subzones of the Lillooet

					reg'd				03	TSA. Falsebox, kinnickinick and soopalalie combined are more pronounced with generally less pinegrass than the south-facing units. This unit is the transition between the south- and north-facing slopes.
MS	dc	2		07a	Not reg'd	Sxw – Rhododendron – Feathermoss	mesic - subhygric	Kam	Use MSdc 01	Steep to hyper-steep, north-facing slopes with closed or open canopies. The tree boles are far apart but their canopies often intersect. The ground cover is a dense carpet of moss and rock with few herbs or shrubs.
MS	dc	2		07	Not reg'd	Sxw - Rhododendron	mesic - subhygric	Kam	Use MSdc 01	Moderate to steep, north-facing slopes with closed canopies. Dense feathermoss is the indicator of this unit. Pinegrass is moderate to sparse unlike in the IDF's. Alder and Huckleberry are common shrubs. Rhododendron may appear on these slopes near the ESSF boundary.
MS	dc	2		08	Not reg'd	Sxw - Gooseberry	subhygric	Kam	Use MSdc 04	The stream edge units that are dominated by moist shrubs, such as gooseberry, dogwood and twinberry. These two units intermingle with each other and as such are difficult to separate. These are very productive ecosystem units. This unit also includes fluvial benches along rivers or major streams. These ecosystems are subject to flooding throughout growing season. The moss layer is absent due to flood scouring; the herb layer is moderate; the shrub layer is very dense.
MS	dc	2		09	Not reg'd	Sxw - Horsetail	hygric	Kam	Use MSdc 04	Horsetail flats along slow-moving streams or around wetlands. Can be productive forests or unproductive forests depending on the quantity of water and whether it is flowing or stagnant.
MS	dc	2		GJ		Juniper – Pinegrass Grassland	subxeric - submesic	Kam	n/a	The Bluebunch wheatgrass – Arrowleaf balsamroot and the Juniper grassland units are lumped here since they usually intermix and cannot be separated in the PEM. Pocket grasslands on upper, south-facing slopes usually associated with hill tops or ridge tops. Juniper patches are prominent and easily recognizable from a distance. These occur primarily near the lower boundary of the MS subzone.
MS	dc	2			HM	Herbaceous Meadow (at the Parkland Boundary)	mesic - subhygric	Kam	n/a	These are moist meadows primarily of herbs and grasses. They may also be alder swales in cases of low avalanche activity. They occur at the toes of avalanche paths in this subzone. Many of the species are consistent with alpine species. These are very rich grizzly forage areas.
MS	dm	2		01	Not reg'd	Sxw – Falsebox – Feathermoss	mesic	Kam	Use MSdm 01	Zonal positions of flat to gentle (25%) slopes on all aspects.
MS	dm	2		02	Not	Juniper – Bluebunch wheatgrass	subxeric	Kam	Use	Rocky outcrops with forests (10% or denser cover). These occur on large ridge

					reg'd				MSdm 03	tops, hyper-steep slopes, or adjacent to cliffs or talus slopes.
MS	dm	2		03	Not reg'd	Falsebox – Polytrichum	subxeric - submesic	Kam	Use MSdm 03	Steep, south-facing slopes with open canopies; Pl is a strong component to the stand. These can be open crown closures or NP stands. These are also the gentle ridge top ecosystem units, such as eskers or shoulder ridges.
MS	dm	2		04	Not reg'd	Pl – Pinegrass – Grouseberry	submesic	Kam	Use MSdm 03	Moderate to steep, south-facing (E, S, SW) slopes with closed canopies. Moderate covers of P inegrass and Falsebox with a low cover of mosses are indicators of this unit.
MS	dm	2		05	Not reg'd	Pl – Grouseberry – Pinegrass	submesic	Kam	Use MSdm 04	This is the classic west-facing slope seen in all of the MS subzones of the Lillooet TSA. Falsebox, kinnickinick and soopalalie combined are more pronounced with generally less pinegrass than the south-facing units. This unit is the transition between the south- and north-facing slopes.
MS	dm	2		06a	Not reg'd	Pl – Alder – Grouseberry (hyper-steep north slope)	mesic - subhygric	Kam	Use MSdm 04	Steep to hyper-steep, north-facing slopes with closed or open canopies. The tree boles are far apart but their canopies often intersect. The ground cover is a dense carpet of moss and rock with few herbs or shrubs.
MS	dm	2		06	Not reg'd	Pl – Alder – Grouseberry	mesic - subhygric	Kam	Use MSdm 04	Moderate to steep, north-facing slopes with closed canopies. Dense feathermoss is the indicator of this unit. Pinegrass is moderate to sparse unlike in the IDF's. Alder and Huckleberry are common shrubs. Rhododendron may appear on these slopes near the ESSF boundary.
MS	dm	2		07	Not reg'd	Sxw – Trapper's tea – Grouseberry	subhygric	Kam	Use MSdm 04	Not in the Lillooet TSA
MS	dm	2		08	Not reg'd	Sxw – Gooseberry – Trapper's tea	subhygric	Kam	Use MSdm 05	Not in the Lillooet TSA
MS	dm	2		09 10	Not reg'd	Sxw – Gooseberry – Alder Sxw – Gooseberry – Grouseberry	subhygric	Kam	Use MSdm 05	The slightly moist toes of slopes and transitions to stream edges. Toes of slopes are consistent in this subzone unlike in most IDF's.
MS	dm	2		11 12	Not reg'd	Sxw – Gooseberry – Oakfern Sxw – Gooseberry – Devil's club	subhygric	Kam	Use MSdm 06	The stream edge units that are dominated by moist shrubs, such as gooseberry, dogwood and twinberry. These two units intermingle with each other and as such are difficult to separate. These are very productive ecosystem units. This unit also includes fluvial benches along rivers or major streams. These ecosystems are subject to flooding throughout growing season. The moss layer is absent due to flood scouring; the herb layer is moderate; the shrub layer is very dense.
MS	dm	2		13	Not	Sxw – Horsetail – Leafy moss	hygric -	Kam	Use	Horsetail flats along slow-moving streams or around wetlands. Can be productive

					reg'd		subhydric		MSdm 07	forests or unproductive forests depending on the quantity of water and whether it is flowing or stagnant.
MS	dm	2		14 15	Not reg'd	Sxw – Bluejoint – Horsetail Sxw – Alder – Horsetail	hygric - hydric	Kam	Use MSdm 07	Unproductive swamp forests. Open canopy of stunted Spruce growing on hummocks. These are typically along the fringes of wetlands or they occupy depression areas.
MS	dm	2		92	GX	Selaginella – Fragile Fern Grassland	xeric - subxeric	Kam	n/a	Very dry, sparsely-vegetated grasslands. Typically on or adjacent to rocky outcrops. Selaginella densa is an indicator species. Ridge tops and very steep slopes within Open Range polygons are used to pull out this unit.
MS	dm	2		91	GD	Bluebunch wheatgrass – Junegrass Grassland	subxeric - submesic	Kam	n/a	Flat to moderate slopes dominated by grasses and a few herbs. Generally south-facing, but occasionally wrapping around to northerly aspects. These are the OR (open range) polygons from Forest Cover.
MS	dm	2			HM	Herbaceous Meadow (at the Parkland Boundary)	mesic - subhygric	Kam	n/a	These are moist meadows primarily of herbs and grasses. They may also be alder swales in cases of low avalanche activity. They occur at the toes of avalanche paths in this subzone. Many of the species are consistent with alpine species. These are very rich grizzly forage areas.
The classification scheme for this subzone was changed by D. Lloyd et. al. in the final year of the PEM project.										
We used the same KB for MS xk and MS xk3. Field checks showed no difference in the ecosystems in both areas. The MS xk3 produced for 2002 has been changed significantly for 2003 and is now missing several ecosystem units. The MS xk classification is more reflective of the species in the ground plots. The original MS xk3 descriptions are displayed in turquoise below each ecosystem unit.										
MS	xk			01 01	Not reg'd	Pl – Pinegrass – Lupine FdPl - Pinegrass -Twinflower	mesic - submesic	Kam	Use MSxk 01	Zonal positions of flat to gentle (25%) slopes on all aspects. (01 & 04 were lumped previously by D. Lloyd)
MS	xk			02 02	Not reg'd	Fd Pl – Juniper – Penstemon – Stonecrop Fd - Juniper - Kinnickinnik	subxeric	Kam	Use MSxk 02	Rocky outcrops with forests (10% or denser cover). These occur on large ridge tops, hyper-steep slopes, or adjacent to cliffs or talus slopes.
MS	xk			03 03	Not reg'd	Pl – Juniper – Grouseberry FdPl - Juniper - Pinegrass	subxeric - submesic	Kam	Use MSxk 02	Steep, south-facing slopes with open canopies. These can be open crown closures or NP stands. These are also the gentle ridge top ecosystem units, such as eskers or shoulder ridges.
MS	xk			04	Not reg'd	Fd Pl – Pinegrass – Arnica	submesic	Kam	Use MSxk 05	Moderate to steep, south-facing (E, S, SW) slopes with closed canopies. Dense pinegrass, moderate arnica, sparse mosses. Shrubs are denser than in the IDF's, but falsebox and kinnickinick are sparse on these south slopes.

MS	xk			05	Not reg'd	Fd Pl – Pinegrass– Grouseberry	mesic - submesic	Kam	Use MSxk 05	This is the classic west-facing slope seen in all of the MS subzones of the Lillooet TSA. Falsebox, kinnickinick and soopalalie combined are more pronounced with generally less pinegrass than the south-facing units. This unit is the transition between the south- and north-facing slopes.
MS	xk			06a 05a	Not reg'd	Pl – Alder – Feathermoss (hypersteep north unit) FdSxw – Feathermoss (hyper-steep North)	mesic - submesic	Kam	Use MSxk 06	Steep to hyper-steep, north-facing slopes with closed or open canopies. The tree boles are far apart but their canopies often intersect. The ground cover is a dense carpet of moss and rock with few herbs or shrubs.
MS	xk			06 07 05	Not reg'd	Pl – Grouseberry– Feathermoss Pl – Alder – Feathermoss FdSxw - Alnus - Feathermoss	mesic - subhygric	Kam	Use MSxk 06	Moderate to steep, north-facing slopes with closed canopies. Dense feathermoss is the indicator of this unit. Pinegrass is moderate to sparse unlike in the IDF's. Soopalalie, spirea and alder are common shrubs. Rhododendron appears on these slopes near the ESSF boundaries.
MS	xk			08	Not reg'd	Pl – Falsbox – Lupine	subhygric	Kam	Use MSxk 07	The slightly moist toes of slopes and transitions to stream edges. Toes of slopes are consistent in this subzone unlike in most IDF's. Since this unit is typically a very narrow band alongside the stream-edge unit and seldom is large enough to form its own polygon, it has been lumped with the 11 unit below.
MS	xk			09 10	Not reg'd	Sxw – Trapper's tea – Grouseberry; Sxw – Trappers tea - Valeriana	subhygric-hygric	Kam	Use MSxk 07	Not in the Lillooet TSA. Trapper's tea is common in the Merritt area.
MS	xk			11 06	Not reg'd	Sxw – Gooseberry – Grouseberry Sxw - Gooseberry	subhygric-hygric	Kam	Use MSxk 08	The stream edge units that are dominated by moist shrubs, such as gooseberry and twinberry. Very productive ecosystem units. This unit also includes fluvial benches along rivers or major streams. These ecosystems are subject to flooding throughout growing season. The moss layer is absent due to flood scouring; the herb layer is moderate; the shrub layer is very dense.
MS	xk			12 07	Not reg'd	Sxw – Horsetail –Leafy moss Sxw - Horsetail	subhygric-hygric	Kam	Use MSxk 09	Horsetail flats along slow-moving streams or around wetlands. Can be productive forests or unproductive forests depending on the quantity of water and whether it is flowing or stagnant.
MS	xk			13	Not reg'd	Sxw (Pl) – Bluejoint – Sedge	hygric - subhydric	Kam	Use MSxk 09	Unproductive swamp forests. Open canopy of stunted Spruce growing on hummocks. These are typically along the fringes of wetlands or they occupy depression areas.

MS	xk			92 91	GJ	Juniper – Bluebunch wheatgrass Was formely the 91 unit	subxeric - submesic	Kam	n/a	Pocket grasslands on upper, south-facing slopes usually associated with hill tops or ridge tops. Juniper patches are prominent and easily recognizable from a distance. Big sage occurs at lower elevations in this subzone, but only rarely exists higher up.
MS	xk			93	GD	Bluebunch wheatgrass - Junegrass 91 – Fescue (not in Lillooet)	submesic - mesic	Kam	n/a	Flat to moderate slopes dominated by grasses and a few herbs. Generally south-facing, but occasionally wrapping around to northerly aspects. These are the OR (open range) polygons from Forest Cover.
MS	xk				HM	Herbaceous Meadow (at the Parkland Boundary)	mesic - subhygric	Kam	n/a	These are moist meadows primarily of herbs and grasses. They may also be alder swales in cases of low avalanche activity. They occur at the toes of avalanche paths in this subzone. Many of the species are consistent with alpine species. These are very rich grizzly forage areas.
The Kamloops classification for this subzone is very rough and sparse. We separated the north and south slopes for the purposes of this PEM map. The classification key did not have ecosystem unit names, so we created the following ones. These may be changed by D. Lloyd in his final BEC classification.										
MS	xv	2		01	Not reg'd	Pl – Crowberry – Feathermoss	mesic	Kam	Use Cariboo MSxv 01	Zonal positions o f flat to gentle (25%) slopes on all aspects.
MS	xv	2		03	Not reg'd	Pl – Kinnikinnick – Juniper	subxeric	Kam	Use Cariboo MSxv 02	Rocky outcrops with forests (10% or denser cover). These occur on large ridge tops, hyper-steep slopes, or adjacent to cliffs or talus slopes. Steep, south-facing slopes with open canopies. These can be open crown closures or NP stands. These are also the gentle ridge top ecosystem units, such as eskers or shoulder ridges and hill tops. Glaciofluvial terraces dominated by Pl and have a significant component of dry lichens.
MS	xv	2		04	Not reg'd	Pl - Pinegrass – Kinnikinnick	submesic	Kam	Use Cariboo MSxv 03	Note, this unit is on both south and north slopes according to D. Lloyd (2001) Moderate to steep, south and west -facing slopes with closed canopies. The south slopes have denser pinegrass and generally fewer shrubs. Whereas, the west slopes have denser falsebox, kinnickinick and soopalalie with generally less pinegrass.
MS	xv	2		04a	Not reg'd	Pl - Pinegrass – Kinnikinnick	submesic	Kam	Use Cariboo MSxv 03	Moderate to steep, north-facing slopes with closed canopies. Dense feathermoss is the indicator of this unit. Pinegrass is moderate to sparse unlike in the IDF's. Soopalalie, spirea and alder are common shrubs. Rhododendron appears on these slopes near the ESSF boundaries.

MS	xv	2		04b	Not reg'd	Pl - Pinegrass – Kinnikinnick	submesic	Kam	Use Cariboo MSxv 03	Steep to hyper-steep, north-facing slopes with closed or open canopies. The tree boles are far apart but their canopies often intersect. The ground cover is a dense carpet of moss and rock with few herbs or shrubs.
MS	xv	2		06	Not reg'd	Pl – Twinflower – Stepmoss	mesic - subhygric	Kam	Use Cariboo MSxv 05	The slightly moist toes of slopes, transitions to stream edges and moist flats around wetland complexes. This unit is very similar to the zonal in vegetation composition except for the significant presence of Stepmoss that distinguishes this unit. Soil tests will verify that it is indeed moister than zonals.
MS	xv	2		07	Not reg'd	Sxw - Crowberry - Glow moss	subhygric	Kam	Use Cariboo MSxv 06	The stream edge unit dominated by moist shrubs. This is also the ecosystem unit that grows in cold-air drainages. This unit also includes fluvial benches along rivers or major st reams. These ecosystems are subject to flooding throughout growing season. The moss layer is absent due to flood scouring; the herb layer is moderate; the shrub layer is very dense.
MS	xv	2		08 10	Not reg'd	Sxw - Horsetail – Crowberry & Sxw - Willow - Glow moss (not found in this subzone)	hygric	Kam	Use Cariboo MSxv 06	Horsetail flats along slow-moving streams or around wetlands. Can be productive forests or unproductive forests depending on the quantity of water and whether it is flowing or stagnant. Unproductive swamp forests. Open canopy of stunted Spruce growing on hummocks. These are typically along the fringes of wetlands or they occupy depression areas.
MS	xv	2			GJ	Juniper – Kinnikinnick Grassland	subxeric - submesic	Kam	n/a	Pocket grasslands on upper, south-facing slopes usually associated with hill tops or ridge tops. Juniper patches are prominent and easily recognizable from a distance. These occur primarily near the lower boundary of the MS subzone.
MS	xv	2			HM	Herbaceous Meadow (at the Parkland Boundary)	mesic - subhygric	Kam	n/a	These are moist meadows primarily of herbs and grasses. They may also be alder swales in cases of low avalanche activity. They occur at the toes of avalanche paths in this subzone. Many of the species are consistent with alpine species. These are very rich grizzly forage areas.
MS	mw			01	Not reg'd	Bl Ba – False azalea – Bunchberry	mesic	Kam	See Vancouver Field Guide – no SIBEC values provided in	Zonal positions of flat to gentle (25%) slopes on all aspects.
MS	mw			02	Not reg'd	Kinnikinnck – Rock moss	subxeric	Kam		Rocky outcrops with forests (10% or denser cover). These occur on large ridge tops, hyper-steep slopes, or adjacent to cliffs or talus slopes.
MS	mw			03	Not	Fd – Falsebox – Pinegrass	submesic	Kam		Moderate to steep, south-facing (E, S, SW) slopes with closed canopies. Moderate

					reg'd				Provincial list	covers of Pinegrass and Falsebox with a low cover of mosses are indicators of this unit.
MS	mw			04	Not reg'd	Pl – Grouseberry	subxeric - submesic	Kam		Steep, south-facing slopes with open canopies; Pl is a strong component to the stand. These can be open or closed stands, or NP stands. These are also the gentle ridge top ecosystem units, such as eskers or shoulder ridges.
MS	mw			05	Not reg'd	FdBl – Black huckleberry – Falsebox	submesic	Kam		This is the classic west-facing slope seen in all of the MS subzones of the Lillooet TSA. Falsebox, kinnickinick and huckleberry combined are more pronounced. Pinegrass may or may not be present. This unit is the transition between the south- and north-facing slopes. We also found this unit at the toes of active colluvial slopes (even south-facing). However, the disturbance factor likely resulted in this unit being the pioneer community before the normal ecosystem unit can develop.
MS	mw			06a	Not reg'd	Bl – Feathermoss (hyper-steep north slopes)	mesic - subhygric	Kam		Steep to hyper-steep, north-facing slopes with closed or open canopies. The tree boles are far apart but their canopies often intersect. The ground cover is a dense carpet of moss and rock with few herbs or shrubs.
MS	mw			06	Not reg'd	Bl – White-flowered rhododendron	mesic - subhygric	Kam		Moderate to steep, north-facing slopes with closed canopies. Dense feathermoss is the indicator of this unit. Rhododendron, Falsebox and Huckleberry are common shrubs.
MS	mw			07	Not reg'd	BlBa – Black gooseberry – Sitka valerian	subhygric	Kam		The slightly moist toes of slopes and transitions to stream edges. Toes of slopes are consistent in this subzone unlike in most IDF's.
MS	mw			08	Not reg'd	SxwBl – Devil's club – Lady fern	subhygric - hygric	Kam		The stream edge units that are dominated by moist shrubs, such as Gooseberry and Devil's club. Very productive ecosystem units. This unit also includes fluvial benches along rivers or major streams. These ecosystems are subject to flooding throughout growing season. The moss layer is absent due to flood scouring; the herb layer is moderate; the shrub layer is very dense.
MS	mw			09	Not reg'd	Sxw – Horsetail	hygric - subhydric	Kam		Horsetail flats along slow-moving streams or around wetlands. Can be productive forests or unproductive forests depending on the quantity of water and whether it is flowing or stagnant.
MS	mw					No grasslands in this subzone				
MS	mw				HM	Herbaceous Meadow (at the Parkland Boundary)	mesic - subhygric	Kam	n/a	These are moist meadows primarily of herbs and grasses. They may also be alder swales in cases of low avalanche activity. They occur at the toes of avalanche paths in this subzone. Many of the species are consistent with alpine species. These are very rich grizzly forage areas.

ESSF	dc	2		01	Not reg'd	Bl – Rhododendron – Feathermoss	mesic	Kam	Use ESSFdc2 01	Zonal positions of flat to gentle (25%) slopes on all aspects.
ESSF	dc	2		02	Not reg'd	Juniper – Penstemon	subxeric	Kam	Use ESSFdc2 03	Rocky outcrops with forests (10% or denser cover). These occur on large ridge tops, hyper-steep slopes, or adjacent to cliffs or talus slopes.
ESSF	dc	2		03	Not reg'd	Pl Bl – Rhododendron – Heron's bill	subxeric - submesic	Kam	Use ESSFdc2 03	Steep, south-facing slopes with open canopies; Pl is a strong component to the stand. These can be open crown closures or NP stands. These are also the gentle ridge top ecosystem units, such as eskers or shoulder ridges.
ESSF	dc	2		04	Not reg'd	Pl Se – Falsebox – Pinegrass	submesic	Kam	Use ESSFdc2 03	Moderate to steep, south-facing (E, S, SW) slopes with closed canopies. Moderate covers of Pinegrass and Falsebox with a low cover of mosses are indicators of this unit.
ESSF	dc	2		05	Not reg'd	Bl – Grouseberry – Cladonia	mesic - submesic	Kam	Use ESSFdc2 04	This is a west-facing slope similar to those in the MS subzones. Falsebox, Huckleberry and Grouseberry are pronounced. Many of the herbs are similar to the south-facing unit, but many of the mosses are more similar to the north-facing units. This unit is the transition between the south- and north-facing slopes.
ESSF	dc	2		06	Not reg'd	Bl – Huckleberry – Feathermoss (Hypersteep North slopes)	mesic - submesic	Kam	Use ESSFdc2 05	Steep to hyper-steep, north-facing slopes with closed or open canopies. The tree boles are far apart but their canopies often intersect. The ground cover is a dense carpet of moss and rock with few herbs or shrubs.
ESSF	dc	2		07	Not reg'd	Bl – Rhododendron – Valerian	mesic - submesic	Kam	Use ESSFdc2 07	Moderate to steep, north-facing slopes with closed canopies. Dense feathermoss is the indicator of this unit. Rhododendron, Falsebox and Huckleberry are common shrubs.
ESSF	dc	2		08	Not reg'd	Bl – Trapper's tea	subhygric	Kam	Use ESSFdc2 08	Not in the Lillooet TSA
ESSF	dc	2		09	Not reg'd	Alder	subhygric	Kam	n/a	Alder swales, typically along creeks or disturbances
ESSF	dc	2		10	Not reg'd	Bl – Gooseberry – Oakfern	subhygric	Kam	Use ESSFdc2 06	The slightly moist toes of slopes and transitions to stream edges, as well as the stream edge units that are dominated by moist shrubs, such as gooseberry and twinberry. These two units intermingle with each other and as such are difficult to separate.

										As well, this unit also includes fluvial benches along major streams that are subject to flooding throughout growing season.
ESSF	dc	2		11	Not reg'd	Valerian meadow (Herbaceous meadow forests near the Parkland boundary)	subhygric	Kam	Use ESSFdc2 08	These open, moist meadows are intermixed with tree islands and are not separated in the Forest Cover. In the PEM map, these meadows are combined with the tree islands as an ecosystem unit.
ESSF	dc	2		12	Not reg'd	Se – Horsetail	subhygric - hygric	Kam	Use ESSFdc2 08	Horsetail flats along slow-moving streams or around wetlands. Can be productive forests or unproductive forests depending on the quantity of water and whether it is flowing or stagnant.
ESSF	dc	2		13	Not reg'd	Se – Bluejoint	subhygric - hygric	Kam	Use ESSFdc2 08	Unproductive swamp forests. Open canopy of stunted Spruce growing on hummocks. These are typically along the fringes of wetlands or they occupy depression areas.
ESSF	dc	2			GJ	Juniper – Pinegrass Grassland	subxeric - submesic	Kam	n/a	Pocket grasslands on upper, south-facing slopes usually associated with hill tops or ridge tops. Juniper patches are prominent and easily recognizable from a distance. These occur primarily near the boundary of the MS subzone.
ESSF	dc	2			KR / PF	Krummholtz – heather forest Parkland forest	submesic - mesic	Kam		KR's are the shrubby patches of Bl or occasionally Pa trees that do not exceed 2 metres in height. Their growth is stunted by heavy snow-packs or high winds. Krummholtz is commonly thought of as marking the boundary of the Parkland subzone, however the BEC linework sometimes includes these ecosystems due to the scale of this mapping. PF's are intermixed stands of krummholtz and upright, but stunted, alpine trees. The shrub and herb species underneath are typically alpine species.
ESSF	dc	2			HM	Herbaceous Meadow (at the Parkland Boundary)	mesic - subhygric	Kam	n/a	These are moist meadows primarily of herbs and grasses. They may also be alder swales in cases of low avalanche activity. They occur at the toes of avalanche paths in this subzone. Many of the species are consistent with alpine species. These are very rich grizzly forage areas.
ESSF	dv	1		01	Not reg'd	Bl - Rhododendron - Heron's-bill	mesic	Kam	Use ESSFdv 01	Zonal positions of flat to gentle (25%) slopes on all aspects.
ESSF	dv	1		02	Not reg'd	Pa – Soapberry - Lichen	subxeric	Kam	Use ESSFdv 02	Rocky outcrops with forests (10% or denser cover). These occur on large ridge tops, hyper-steep slopes, or adjacent to cliffs or talus slopes.
ESSF	dv	1		03	Not	Pl Fd - Soapberry - Falsebox	subxeric -	Kam	Use	Steep, south-facing slopes with open canopies; Pl is a strong component to the

					reg'd		submesic		ESSFdv 03	stand. These can be open crown closures or NP stands. These are also the gentle ridge top ecosystem units, such as eskers or shoulder ridges.
ESSF	dv	1		04	Not reg'd	Bl - Huckleberry - Brachythecium	submesic	Kam	Use ESSFdv 04	Moderate to steep, south-facing (E, S, SW) slopes with closed canopies. Moderate covers of Pinegrass and Falsebox with a low cover of mosses are indicators of this unit.
ESSF	dv	1		01b	Not reg'd	Bl - Rhododendron - Heron's-bill (Hypersteep North slopes)	mesic - submesic	Kam	Use ESSFdv 04	Steep to hyper-steep, north-facing slopes with closed or open canopies. The tree boles are far apart but their canopies often intersect. The ground cover is a dense carpet of moss and rock with few herbs or shrubs.
ESSF	dv	1		01a	Not reg'd	Bl - Rhododendron - Heron's-bill	mesic	Kam	Use ESSFdv 01	Moderate to steep, north-facing slopes with closed canopies. Dense feathermoss is the indicator of this unit. Rhododendron, Falsebox and Huckleberry are common shrubs.
ESSF	dv	1		05	Not reg'd	Bl - Valerian - Arnica	subhygric	Kam	Use ESSFdv 05	The slightly moist toes of slopes and transitions to stream edges, as well as the stream edge units that are dominated by moist shrubs, such as gooseberry and twinberry. These two units intermingle with each other and as such are difficult to separate. As well, this unit also includes fluvial benches along major streams that are subject to flooding throughout growing season.
ESSF	dv	1		08	Not reg'd	BL - Heather - Herbaceous meadow forests near the Parkland boundary	subhygric	Kam	Use ESSFdv 06	These open, moist meadows are intermixed with tree islands and are not separated in the Forest Cover. In the PEM map, these meadows are combined with the tree islands as an ecosystem unit.
ESSF	dv	1		07	Not reg'd	Bl - Horsetail - Glow moss	subhygric - hygric	Kam	Use ESSFdv 06	Horsetail flats along slow-moving streams or around wetlands. Can be productive forests or unproductive forests depending on the quantity of water and whether it is flowing or stagnant. Also the unproductive swamp forests. Open canopy of stunted Spruce growing on hummocks. These are typically along the fringes of wetlands or they occupy depression areas.
ESSF	dv	1			GJ	Juniper – Grasslands	subxeric - submesic	Kam	n/a	Pocket grasslands on upper, south-facing slopes usually associated with hill tops or ridge tops. Juniper patches are prominent and easily recognizable from a distance. These occur primarily near the boundary of the MS subzone.
ESSF	dv	1			KR / PF	Krummholtz – heather forest Parkland forest	submesic - mesic	Kam		KR's are the shrubby patches of Bl or occasionally Pa trees that do not exceed 2 metres in height. Their growth is stunted by heavy snow-packs or high winds. Krummholtz is commonly thought of as marking the boundary of the Parkland subzone, however the BEC linework sometimes includes these ecosystems due to the scale of this mapping.

										PF's are intermixed stands of krummholtz and upright, but stunted, alpine trees. The shrub and herb species underneath are typically alpine species.
ESSF	dv	1			HM	Herbaceous Meadow (at the Parkland Boundary)	mesic - subhygric	Kam	n/a	These are moist meadows primarily of herbs and grasses. They may also be alder swales in cases of low avalanche activity. They occur at the toes of avalanche paths in this subzone. Many of the species are consistent with alpine species. These are very rich grizzly forage areas.
This BEC subzone changed significantly since the fieldwork completed in 2001										
ESSF	dv	2		01 & 05	Not reg'd	Bl - Rhododendron - Heron's-bill Bl – Huckleberry – Valerian	mesic	Kam	Use ESSFdv 01	Zonal positions of flat to gentle (25%) slopes on all aspects.
ESSF	dv	2		02	Not reg'd	PaPl - Juniper - Lichen	subxeric	Kam	Use ESSFdv 02	Rocky outcrops with forests (10% or denser cover). These occur on large ridge tops, hyper-steep slopes, or adjacent to cliffs or talus slopes.
ESSF	dv	2		03	Not reg'd	PaPl - Pinegrass - Juniper	subxeric - submesic	Kam	Use ESSFdv 03	Steep, south-facing slopes with open canopies; Pl is a strong component to the stand. These can be open crown closures or NP stands. These are also the gentle ridge top ecosystem units, such as eskers or shoulder ridges.
ESSF	dv	2		04	Not reg'd	Bl - Huckleberry - Lupine	submesic	Kam	Use ESSFdv 04	Moderate to steep, south-facing (E, S, SW) slopes with closed canopies. Moderate covers of Pinegrass and Falsebox with a low cover of mosses are indicators of this unit.
ESSF	dv	2		01b	Not reg'd	Bl - Rhododendron - Heron's-bill	submesic - mesic	Kam	Use ESSFdv 04	Steep to hyper-steep, north-facing slopes with closed or open canopies. The tree boles are far apart but their canopies often intersect. The ground cover is a dense carpet of moss and rock with few herbs or shrubs.
ESSF	dv	2		01a	Not reg'd	Bl - Rhododendron - Heron's-bill	mesic - subhygric	Kam	Use ESSFdv 04	Moderate to steep, north-facing slopes with closed canopies. Dense feathermoss is the indicator of this unit. Rhododendron, Falsebox and Huckleberry are common shrubs.
ESSF	dv	2		06	Not reg'd	Bl – Valerian – Arnica	subhygric	Kam	Use ESSFdv 05	The slightly moist toes of slopes and transitions to stream edges, as well as the stream edge units that are dominated by moist shrubs, such as gooseberry and twinberry. These two units intermingle with each other and as such are difficultto separate. As well, this unit also includes fluvial benches along major streams that are subject to flooding throughout growing season.

ESSF	dv	2		09	Not reg'd	BL - Heather - Herbaceous meadow forests	subhygric	Kam	Use ESSFdv 06	These open, moist meadows are intermixed with tree islands and are not separated in the Forest Cover. In the PEM map, these meadows are combined with the tree islands as an ecosystem unit.
ESSF	dv	2		07 & 08	Not reg'd	Sxw – Horsetail – Glowmoss & Wet Forests	hygric	Kam	Use ESSFdv 06	Horsetail flats along slow-moving streams or around wetlands. Can be productive forests or unproductive forests depending on the quantity of water and whether it is flowing or stagnant. Also the unproductive swamp forests. Open canopy of stunted Spruce growing on hummocks. These are typically along the fringes of wetlands or they occupy depression areas.
ESSF	dv	2			GJ	Juniper – Grasslands	subxeric - submesic	Kam	n/a	Pocket grasslands on upper, south-facing slopes usually associated with hill tops or ridge tops. Juniper patches are prominent and easily recognizable from a distance. These occur primarily near the boundary of the MS subzone.
ESSF	dv	2			KR / PF	Krummholtz – heather forest Parkland forest	submesic - mesic	Kam		KR's are the shrubby patches of Bl or occasionally Pa trees that do not exceed 2 metres in height. Their growth is stunted by heavy snow-packs or high winds. Krummholtz is commonly thought of as marking the boundary of the Parkland subzone, however the BEC linework sometimes includes these ecosystems due to the scale of this mapping. PF's are intermixed stands of krummholtz and upright, but stunted, alpine trees. The shrub and herb species underneath are typically alpine species.
ESSF	dv	2			HM	Herbaceous Meadow (at the Parkland Boundary)	mesic - subhygric	Kam	n/a	These are moist meadows primarily of herbs and grasses. They may also be alder swales in cases of low avalanche activity. They occur at the toes of avalanche paths in this subzone. Many of the species are consistent with alpine species. These are very rich grizzly forage areas.
ESSF	mw			08 / 08 MS / 07	Not reg'd	BlBa – White-flowered Rhododendron – Heron's bill moss BlBa – Azalea – Pipe-cleaner moss	mesic	Kam	Use ESSFmw 01	Zonal positions of flat to gentle (25%) slopes on all aspects. Note in early or mid seral stages of this ecosystem unit, the Rhododendron is sparse. The 07 unit is placed here since the species mix is most similar to the zonal other than the azalea replaces the rhododendron. This switch occurs randomly on zonal units. Oddly, we saw this unit on gentle ridge crests of the Duffy Lake area.
ESSF	mw			02	Not reg'd	Common Juniper – Lance-leaved stonecrop	subxeric	Kam	Use ESSFmw 02	Rocky outcrops with forests (10% or denser cover). These occur on large ridge tops, hyper-steep slopes, or adjacent to cliffs or talus slopes.

ESSF	mw			03	Not reg'd	BlPl – Juniper Racomitrium	subxeric - submesic	Kam	Use ESSFmw 02	Ridge crests or hill top positions. These are also the gentle ridge top ecosystem units, such as eskers or shoulder ridges. These can be open crown closures or NP stands. This unit is common in the Hurley Pass area.
ESSF	mw			04 05	Not reg'd	Fd – Falsebox – Pinegrass Bl – Huckleberry – Falsebox	submesic	Kam	Use ESSFmw 03 or 04 respectively	These are the moderate to steep, south-facing (E, S, SW) slopes. The 04 unit occurs mainly near the MS boundary or in unusually hot/dry valleys. Moderate covers of Pinegrass and Falsebox with a low cover of mosses are indicators of this unit. The 05 unit was more common on south-facing slopes of this subzone – pinegrass was nearly absent but huckleberry increased to the normal abundance for many site series in this subzone.
ESSF	mw			06	Not reg'd	Pl – Grouseberry				Not in this District
ESSF	mw			01b	Not reg'd	BlBa – Rhododendron	submesic - mesic	Kam	Use ESSFmw 05	Steep to hyper-steep, north-facing slopes with closed or open canopies. The tree boles are far apart but their canopies often intersect. The ground cover is a dense carpet of moss and rock with few herbs or shrubs.
ESSF	mw			01	Not reg'd	BlBa – Rhododendron	mesic - subhygric	Kam	Use ESSFmw 05	Moderate to steep, north-facing slopes with closed canopies. Dense feathermoss is the indicator of this unit. Rhododendron, Falsebox and Huckleberry are common shrubs.
ESSF	mw			09	Not reg'd	Bl – Gooseberry – Valerian	subhygric	Kam	Use ESSFmw 06	The slightly moist toes of slopes and transitions to stream edges, as well as the stream edge units that are dominated by moist shrubs, such as gooseberry. As well, this unit also includes fluvial benches along major streams that are subject to flooding throughout growing season.
ESSF	mw			10	Not reg'd	Bl – Gooseberry – Horsetail	hygric	Kam	Use ESSFmw 07	Horsetail flats along slow-moving streams or around wetlands. Can be productive forests or unproductive forests depending on the quantity of water and whether it is flowing or stagnant. Note that the open Pl bog woodlands were lumped with the WE ecosystem unit during the calibration process of this KB.
ESSF	mw				KR / PF	Krummholtz – heather forest Parkland forest	submesic - mesic	Kam		KR's are the shrubby patches of Bl or occasionally Pa trees that do not exceed 2 metres in height. Their growth is stunted by heavy snow-packs or high winds. Krummholtz is commonly thought of as marking the boundary of the Parkland subzone, however the BEC linework sometimes includes these ecosystems due to the scale of this mapping. PF's are intermixed stands of krummholtz and upright, but stunted, alpine trees.

										The shrub and herb species underneath are typically alpine species.
ESSF	mw				HM	Herbaceous Meadow (at the Parkland Boundary)	mesic - subhygric	Kam	n/a	These are moist meadows primarily of herbs and grasses. They may also be alder swales in cases of low avalanche activity. They occur at the toes of avalanche paths in this subzone. Many of the species are consistent with alpine species. These are very rich grizzly forage areas.
This was formerly ESSFxc3 in the first 2 years of the PEM project										
ESSF	xc	4		01 & 05	Not reg'd	Bl – Rhododendron – Barbiliphozia Bl – Barbiliphozia	mesic	Kam	Use ESSFxc 01	Zonal positions of flat to gentle (25%) slopes on all aspects. The zonal and north units were lumped by D. Lloyd. We separated these out anyway and used letter codes to denote which unit we are referring to.
ESSF	xc	4		02	Not reg'd	Bl – Juniper – Lichen	subxeric	Kam	Use ESSFxc 02	Rocky outcrops with forests (10% or denser cover). These occur on large ridge tops, hyper-steep slopes, or adjacent to cliffs or talus slopes.
ESSF	xc	4		03	Not reg'd	PaPl – Juniper	subxeric - submesic	Kam	Use ESSFxc 02	Steep, south-facing slopes with open canopies; P a and P l are strong components to the stand. These can be open crown closures or NP stands. These are also the gentle ridge top ecosystem units, such as eskers or shoulder ridges.
ESSF	xc	4		04	Not reg'd	Se Pl – Pinegrass	submesic	Kam	Use ESSFxc 05	Moderate to steep, south-facing (E, S, SW) slopes with closed canopies. Moderate covers of Pinegrass and Falsebox with a low cover of mosses are indicators of this unit.
ESSF	xc	4		01b	Not reg'd	Bl – Barbiliphozia	submesic - mesic	Kam	Use ESSFxc 06	Steep to hyper-steep, north-facing slopes with closed or open canopies. The tree boles are far apart but their canopies often intersect. The ground cover is a dense carpet of moss and rock with few herbs or shrubs.
ESSF	xc	4		01a	Not reg'd	Bl – Rhododendron – Barbiliphozia	mesic - subhygric	Kam	Use ESSFxc 06	Moderate to steep, north-facing slopes with closed canopies. Dense feathermoss is the indicator of this unit. Rhododendron, Falsebox and Huckleberry are common shrubs.
ESSF	xc	4		08	Not reg'd	Meadow forest unit	mesic - subhygric	Kam	Use ESSFxc 08	This unit was not recognized in the revised classification, but we in cluded it anyway. These open, moist meadows are intermixed with tree islands and are not separated in the Forest Cover. In the PEM map, these meadows are combined with the tree islands as an ecosystem unit.
ESSF	xc	4		06	Not reg'd	Se – Valeriana	subhygric - hygric	Kam	Use ESSFxc 07	The slightly moist toes of slopes and transitions to stream edges, as well as the stream edge units that are dominated by moist shrubs, such as gooseberry. As well, this unit also includes fluvial benches along major streams that are subject to flooding throughout growing season.

ESSF	xc	4		07	Not reg'd	Se – Horsetail	hygric - hydric	Kam	Use ESSFxc 08	Horsetail flats along slow-moving streams or around wetlands. Can be productive forests or unproductive forests depending on the quantity of water and whether it is flowing or stagnant.
ESSF	xc	3		91	GJ	Juniper – Pinegrass Grassland	subxeric - submesic	Kam		Pocket grasslands on upper, south-facing slopes usually associated with hill tops or ridge tops. Juniper, soopalalie and Kinnikinnick form patches that easily recognizable from a distance. These occur primarily near the boundary of the MS subzone.
ESSF	xc	3		93	GD	Bluebunch wheatgrass - Junegrass 91 – Fescue (not in Lillooet)	submesic - mesic	Kam	n/a	Flat to moderate slopes dominated by grasses and a few herbs. Generally south-facing, but occasionally wrapping around to northerly aspects. These are the OR (open range) polygons from Forest Cover.
ESSF	xc	4			KR / PF	Krummholtz – heather forest Parkland forest	submesic - mesic	Kam		KR's are the shrubby patches of Bl or occasionally Pa trees that do not exceed 2 metres in height. Their growth is stunted by heavy snow-packs or high winds. Krummholtz is commonly thought of as marking the boundary of the Parkland subzone, however the BEC linework sometimes includes these ecosystems due to the scale of this mapping. PF's are intermixed stands of krummholtz and upright, but stunted, alpine trees. The shrub and herb species underneath are typically alpine species.
ESSF	xc	4			HM	Herbaceous Meadow (at the Parkland Boundary)	mesic - subhygric	Kam	n/a	These are moist meadows primarily of herbs and grasses. They may also be alder swales in cases of low avalanche activity. They occur at the toes of avalanche paths in this subzone. Many of the species are consistent with alpine species. These are very rich grizzly forage areas.
This was formerly ESSFxc4 in the first 2 years of the PEM project										
ESSF	xc	3		01 04	Not reg'd	Pl - Juniper - Lupine – Twinflower Pl – Alnus viridis (Leon Creek)	mesic	Kam	Use ESSFxc 01	Zonal positions of flat to gentle (25%) slopes on all aspects.
ESSF	xc	3		02	Not reg'd	Juniper – Kinnikinnick Pl - Juniper - Lichen	subxeric	Kam	Use ESSFxc 02	Rocky outcrops with forests (10% or denser cover). These occur on large ridge tops, hyper-steep slopes, or adjacent to cliffs or talus slopes.
ESSF	xc	3		03	Not reg'd	Now missing in the classification Pl - Soapberry - Kinnikinnick	subxeric - submesic	Kam	Use ESSFxc 02	This unit was recognized in the classification system used in the first 2 years of this project. It is now combined with the 04 unit below.

										Steep, south-facing slopes with open canopies; Pl is a strong component to the stand. These can be open crown closures or NP stands. These are also the gentle ridge top ecosystem units, such as eskers or shoulder ridges.
ESSF	xc	3		03	Not reg'd	Pl - Pinegrass	submesic	Kam	Use ESSFxc 05	Moderate to steep, south-facing (E, S, SW) slopes with closed canopies. Moderate covers of Pinegrass and Falsebox with a low cover of mosses are indicators of this unit. This unit now includes the former 03 unit described in the above row.
ESSF	xc	3		05a	Not reg'd	Se - Feathermoss - Heron's Bill (hyper-steep North)	mesic - submesic	Kam	Use ESSFxc 06	Steep to hyper-steep, north-facing slopes with closed or open canopies. The tree boles are far apart but their canopies often intersect. The ground cover is a dense carpet of moss and rock with few herbs or shrubs.
ESSF	xc	3		05	Not reg'd	Se - Rhododendron - Heron's Bill	mesic	Kam	Use ESSFxc 06	Moderate to steep, north-facing slopes with closed canopies. Dense feathermoss is the indicator of this unit. Rhododendron, Falsebox and Huckleberry are common shrubs.
ESSF	xc	3		06	Not reg'd	Se - Rhododendron - Valeriana	subhygric	Kam	Use ESSFxc 07	The slightly moist toes of slopes and transitions to stream edges, as well as the stream edge units that are dominated by moist shrubs, such as gooseberry and twinberry. These two units intermingle with each other and as such are difficult to separate. As well, this unit also includes fluvial benches along major streams that are subject to flooding throughout growing season.
ESSF	xc	3		61 07	Not reg'd	Globeflower – Valeriana Meadow BL – Heather - Herbaceous meadow forests	subhygric	Kam	Use ESSFxc 08	Was formerly included as a forested unit. These open, moist meadows are intermixed with tree islands and are not separated in the Forest Cover. In the PEM map, these meadows are combined with the tree islands as an ecosystem unit.
ESSF	xc	3		07	Not reg'd	Se - Horsetail	subhygric - hygric	Kam	Use ESSFxc 08	Horsetail flats along slow-moving streams or around wetlands. Can be productive forests or unproductive forests depending on the quantity of water and whether it is flowing or stagnant.
ESSF	xc	3		91	GJ	Juniper – Pinegrass Grassland	subxeric - submesic	Kam		Pocket grasslands on upper, south-facing slopes usually associated with hill tops or ridge tops. Juniper, soopalalie and Kinnikinnick form patches that easily recognizable from a distance. These occur primarily near the boundary of the MS subzone.
ESSF	xc	3			KR /	Krummholtz – heather forest	submesic -	Kam		KR's are the shrubby patches of Bl or occasionally Pa trees that do not exceed 2

					PF	Parkland forest	mesic			metres in height. Their growth is stunted by heavy snow-packs or high winds. Krummholtz is commonly thought of as marking the boundary of the Parkland subzone, however the BEC linework sometimes includes these ecosystems due to the scale of this mapping. PF's are intermixed stands of krummholtz and upright, but stunted, alpine trees. The shrub and herb species underneath are typically alpine species.
ESSF	xc	3			HM	Herbaceous Meadow (at the Parkland Boundary)	mesic - subhygric	Kam	n/a	These are moist meadows primarily of herbs and grasses. They may also be alder swales in cases of low avalanche activity. They occur at the toes of avalanche paths in this subzone. Many of the species are consistent with alpine species. These are very rich grizzly forage areas.
This BEC subzone changed significantly since the fieldwork completed in 2001. No meadow forest unit is recognized in the current classification scheme.										
ESSF	xv			01 & 05	Not reg'd	Pl – Arnica – Cladonia & Bl – Brachythecium – Peltigera	mesic	Kam	Use Cariboo ESSFxv1 01	Zonal positions of flat to gentle (25%) slopes on all aspects.
ESSF	xv			02	Not reg'd	Pl – Juniper	subxeric - submesic	Kam	No SIBEC available	Rocky outcrops with forests (10% or denser cover). These occur on large ridge tops, hyper-steep slopes, or adjacent to cliffs or talus slopes.
ESSF	xv			03	Not reg'd	Pa – Juniper – Kinnikinnick	subxeric - submesic	Kam	No SIBEC available	Steep, south-facing slopes with open canopies; has a strong Pa component to the stand. These can be open crown closures or NP stands. These are also the gentle ridge top ecosystem units, such as eskers or shoulder ridges.
ESSF	xv			04	Not reg'd	Pl – Pinegrass	submesic	Kam	No SIBEC available	Moderate to steep, south-facing (E, S, SW) slopes with closed canopies. Moderate covers of Pinegrass and Falsebox with a low cover of mosses are indicators of this unit.
ESSF	xv			06a	Not reg'd	Pl – Rhododendron – Feathermoss	mesic - submesic	Kam	No SIBEC available	Steep to hyper-steep, north-facing slopes with closed or open canopies. The tree boles are far apart but their canopies often intersect. The ground cover is a dense carpet of moss and rock with few herbs or shrubs.
ESSF	xv			06	Not reg'd	Pl – Rhododendron – Feathermoss	mesic - subhygric	Kam	No SIBEC available	Moderate to steep, north-facing slopes with closed canopies. Dense feathermoss is the indicator of this unit. Rhododendron, Falsebox and Huckleberry are common shrubs.
ESSF	xv			07	Not reg'd	Pl – Lousewort – Glowmoss	subhygric	Kam	No SIBEC	The slightly moist toes of slopes and transitions to stream edges, as well as the stream edge units that are dominated by moist shrubs, such as gooseberry and

									available	twinberry. These two units intermingle with each other and as such are difficult to separate. As well, this unit also inc ludes fluvial benches along major streams that are subject to flooding throughout growing season.
ESSF	xv			08 & 09	Not reg'd	Pl – Horsetail & Se – Willow	hygric - subhydric	Kam	No SIBEC available	Horsetail flats along slow-moving streams or around wetlands. Can be productive forests or unproductive forests depending on the quantity of water and whether it is flowing or stagnant. Also the unproductive swamp forests. Open canopy of stunted Spruce growing on hummocks. These are typically along the fringes of wetlands or they occupy depression areas.
ESSF	xv				GJ	Juniper – Fescue Grasslands	subxeric - submesic	Kam		Pocket grasslands on upper, south-facing slopes usually associated with hill tops or ridge tops. Juniper, soopalalie and Kinnikinnick fom patches that easily recognizable from a distance. This unit also includes the dry fescue – tristem grasslands that are rare at this elevation. These occur primarily near the boundary of the MS subzone.
ESSF	xv				KR / PF	Krummholtz – heather forest Parkland forest	submesic - mesic	Kam		KR's are the shrubby patches of Bl or occasionally Pa trees that do not exceed 2 metres in height. Their growth is stunted by heavy snow-packs or high winds. Krummholtz is commonly thought of as marking the boundary of the Parkland subzone, however the BEC linework sometimes includes these ecosystems due to the scale of this mapping. PF's are intermixed stands of krummholtz and upright, but stunted, alpine trees. The shrub and herb species underneath are typically alpine species.
ESSF	xv				HM	Herbaceous Meadow (at the Parkland Boundary)	mesic - subhygric	Kam	n/a	These are moist meadows primarily of herbs and grasses. They may also be alder swales in cases of low avalanche activity. They occur at the toes of avalanche paths in this subzone. Many of the species are consistent with alpine species. These are very rich grizzly forage areas.
					WE	Wetland – undistinguished open water, sedge and shrub	hydric	Kam		This unit describes most of the wetland complexes including shrub wetlands. Due to the coarseness of the available inventory attributes, we created this general category. Technically, the WS is a subset of this WE unit and could be scored as correct if the PEM label is WE. However, we separated these units in an attempt to refine the PEM product.
					WS	Wetland – Shrub-dominated	subhygric - hydric	Kam		This unit describes shrub wetlands that are picked out primarily by the non-productive brush codes from the Forest Cover inventory.

					LA	Lake	N/a	Kam		
					RI	River	N/a	Kam		
					LS	Landslide	N/a	Kam		
					HM	Herbaceous Meadows	N/a	Kam		At lower elevations, these are the toes of avalanche pathes and are either lush tall herbaceous communities with scattered alders or willows, or dense alder swales resulting from low avalanche activity (deep avalanche slabs remove the shrub vegetation). In the parkland and alpine subzones, these are the moist meadows dominated by herbs, variable willow and alder shrubs and few grasses. They generally occur in moist bowls, along seepages or near stream edges.
					AV	Avalanche Track– includes Landslides for these subzones	N/a	Kam		
					RT	Rock or Talus	N/a	Kam		We combined these two categories since we were not able to distinguish them successfully
					GL	Glacier or Snow/Ice	N/a	Kam		
					SB	Sand Bar	N/a	Kam		
					ES	Exposed Soil	N/a	Kam		
					RZ	Roads	N/a	Kam		
					UR	Urban	N/a	Kam		
					AG	Alpine Grassland				Grass or dryland sedge dominated slopes
					HG	Heath Grassland				Heather or dryas dominated slopes
					KR	Krummholtz				Krummholtz dominated slopes with heather and huckleberry shrubs; may have islands of upright trees
					PF	Parkland Forest				High elevation forest stands; either open or closed canopies; understory of heather,

										huckleberry and parkland species
					HM	Herbaceous Meadows				Wet seepage slopes dominated by herbs such as Sitka Valerian, Arctic Lupine and Globe Flower
					WM	Wet Meadows				Wet benches next to streams, wetlands or lakes; dominated by sedges, Bog Laurel and Sweet Coltsfoot.

Appendix 4: PEM Attribute Legend

The following is the legend of all the codes used in the PEM database. These codes are also used in the Knowledge Tables.

This file is also found on the accompanying CD as pem_4021_ursAttribute_Legend.rtf

Legend for the EcoGen Knowledge Table
Lillooet PEM Project – March, 2004

Ranking of Values in the KB's	Each of the site series within the BEC subzone are given a weighting of the likelihood that this particular feature or combination of features will occur there. The normal weighting system is 0 to 3, meaning no chance of occurrence to high chance of occurrence. However, variations of –1, –2, –10, or –100 are also used to counter unwanted effects of cumulative scores due to various features occurring within the PEM polygon.

Category	Value	Description	Notes:
FOREST COVER NON-PRODUCTIVE CODES:			
NP	0	Forested	Forested stands
NP	1	icefield	
NP	2	alpine	
NP	3	rock	Program a 50-m buffer around these polygons for future adjacency searches
NP	7	sand	
NP	9	clay bank	
NP	10	alpine forest	
NP	11	NPBr	Program a 50-m buffer around these polygons for future adjacency searches
NP	12	NP	Program a 50-m buffer around these polygons for future adjacency searches
NP	13	burn	
NP	15	lakes	Merge Forest Cover and TRIM lakes - determine new perimeter and snap FC polygons to edge
NP	18	Gravel Bar	
NP	25	River	
NP	35	wetlands	Merge Forest Cover and TRIM wetlands/depressions - new perimeter & area (TRIM marsh polygons are displayed within the wetland complexes.) Program a 50-m buffer around these polygons for future adjacency searches
NP	42	Clearing	
NP	50	Roads	
NP	54	Urban	
NP	60	hayfield	
NP	62	meadows	
NP	63	open range	Program a 50-m buffer around these polygons for future adjacency searches
NP	64	salt water	
PERCENTAGE OF AREA ANALYSIS: (Qualifying Analysis - Applied to some features only)			
_P	1	5-20%	greater than or equal to 5% and less than 20% of the polygon area
_P	2	21- 50%	greater than 21% and less than 50% of the polygon area
_P	3	>50%	greater than 51% of the polygon area
STREAM DENSITY:			
W	0		No streams found in polygon (0 to 10 m/ha)
W	1		10 m/ha to 30 m/ha (low soil moisture influence)
W	2		30 m/ha to 60 m/ha (moderate soil moisture influence)
W	3		60 m/ha or greater (high soil moisture influence)
SLOPE:			
S	1	0 – 8%	
S	2	8 – 25%	(** aspect applies from this slope class on)
S	3	25 – 45%	
S	4	45 – 65%	
S	5	65 - 85%	

S	6	85 – 130%	
S	7	130 + %	
SF	f	Flat	slope class 1
SF	s	Steep	slope classes 2 to 5
SF	hs	Hyper-steep	slope classes 6 to 7
SFc	g	Gentle	slope classes 1 and 2
SFc	vs	Very steep	slope classes 3 to 5
ASPECT: (Changed to match aspect breaks noted during Lilloet field work)			
As	0	No aspect	Aspect does not apply
As	1	Hot	90.1 to 235 degrees
As	2	Warm	235.1 to 290 degrees
As	3	Cool	290.1 to 90 degrees
ADJACENCY FEATURES: 50-metre buffer searches			
Adj1	1		Adjacent to streams - search around NP or NPBr polygons only
Adj2	1		Adjacent to wetlands - search around NP or NPBr polygons only
Adj3	1	All polygons	Adjacent to rock
Adj4	1	All polygons	Adjacent to alpine polygons
Adj5	1	All polygons	Adjacent to OR polgyons
Adj1+Adj2+Adj3+Adj4+Adj5 = 0			Not adjacent to any of these features
RIPARIAN BENCHES:			
Lakes and Wetlands (Begin bench search from perimeter of combined lakes and wetlands)			
LB	1		0-5% slope adjacent to the water body, to a maximum distance of 100 m
LB_P	1		between 5 and 20% of PEM polygon area
LB_P	2		between 21 and 50% of PEM polygon area
LB_P	3		greater than 51% of the PEM polygon area
Stream Low Benches: (Calculated from double-line streams)			
SLB	1		0-5% slope adjacent to a double-line stream to a maximum distance of 100m
SLB_P SLB_P	1 2		between 5 and 20% of PEM polygon area between 21 and 50% of PEM polygon area
SLB_P	3		greater than 51% of the PEM polygon area
Stream High Benches: (Calculated from double-line streams)			
SHB	1		- 0-5% slope from the edge of the SLB to a max distance of 500 m, or - 0-5% slope adjacent to a small rise up from the river's edge (a slope of 6-20% within 50 m from the river edge) to a max distance of 500 m
SHB_P	1		between 5 and 20% of PEM polygon area
SHB_P	2		between 21 and 50% of PEM polygon area
SHB_P	3		greater than 51% of the PEM polygon area
Stream Terraces: (Calculated from double-line streams)			
ST	1		- 0-10% slope adjacent to a large rise up from the river's edge (a greater than 20% slope within a 400 m distance) to a max distance of 1000 m; or - 0-10% slope adjacent to a small rise up from the edge of the SLB or SHB (a greater than 6% slope within a 400 m distance to a max distance of 1000 m
ST_P	1		between 5 and 20% of PEM polygon area
ST_P	2		between 21 and 50% of PEM polygon area
ST_P	3		greater than 51% of the PEM polygon area
GULLY BOTTOMS and GULLY BUFFERS: (on single-line streams)			
G	1		This is a 20-m buffer on either side of the single-line stream, and search for slope of 30% + (allows for flat-bottom gully and eliminates gully mouths)
G_P	1		between 5 and 20% of PEM polygon area

G_P	2		between 21 and 50% of PEM polygon area
G_P	3		greater than 51% of the PEM polygon area
GB	1		This is a 40-m buffer up the 30%+ slopes starting from edge of the gully bottom polygon (G)
GB_P	1		between 5 and 20% of PEM polygon area
GB_P	2		between 21 and 50% of PEM polygon area
GB_P	3		greater than 51% of the PEM polygon area
HILL TOPS and HILL BUFFERS (upper slope positions)**:**			
HT	1		Hill top is the largest outside contour line less than 1200 m in length and not a depression
HT_P	1		between 5 and 20% of PEM polygon area
HT_P	2		between 21 and 50% of PEM polygon area
HT_P	3		greater than 51% of the PEM polygon area
HB	1		40-m buffer where slope is > or = 20%, starts from edge of HT
HB_P	1		between 5 and 20% of PEM polygon area
HB_P	2		between 21 and 50% of PEM polygon area
HB_P	3		greater than 51% of the PEM polygon area
RIDGE TOPS and RIDGE BUFFERS (defines upper slope positions)**:**			
RT	1		20-m buffer around the ridge break line where slopes are > or = 30%
RT_P	1		between 5 and 20% of PEM polygon area
RT_P	2		between 21 and 50% of PEM polygon area
RT_P	3		greater than 51% of the PEM polygon area
RTL	1		Little ridge tops between 10 and 30% slopes
RTL_P	1		between 5 and 20% of PEM polygon area
RTL_P	2		between 21 and 50% of PEM polygon area
RTL_P	3		greater than 51% of the PEM polygon area
RB	1		40-m buffer from edge of RT if slopes are > or = 30%
RB_P	1		between 5 and 20% of PEM polygon area
RB_P	2		between 21 and 50% of PEM polygon area
RB_P	3		greater than 51% of the PEM polygon area
TOES OF SLOPES			
ToS	1		Interface of >40% slopes above and <25% slopes below, that are within 100 m of each other
ToS_P	1		between 5 and 20% of PEM polygon area
ToS_P	2		between 21 and 50% of PEM polygon area
ToS_P	3		greater than 51% of the PEM polygon area
ELEVATION			
E	1		MHmm1&2 subzone lower band of higher productivity below 920 m
E	2		MHmm1&2 subzone upper band of lower productivity above 920 m
E	20		ESSFxv2 below 1900 m
E	21		ESSFxv2 above 1900m
E	22		ESSFdv2 and ESSFxc4 below 1840 m
E	23		ESSFdv2 and ESSFxc4 above 1840 m
E	24		ESSFdv1 below 1600 m
E	25		ESSFdv1 above 1600 m
E	26		ESSFxc3 below 1840 m
E	27		ESSFxc3 above 1840 m
TRIM 2 LANDFORM FEATURES: (These are assumed to be within a FC forested polygon and influence differently than the NP code)			
L1_P		Rock polygon	TRIM 2 HB25400000 (only 43 identified in the District) (same percent of

			area calculations)
L2		Esker	TRIM 2 HB10200000 (only 31 identified in the District) (same linear calculation as water content)
L3		Cliff/scarp	TRIM 2 HB05650000
L4_P		Slide	TRIM 2 HB27900000
L5		Beaver dam	TRIM 2 GA08450110
L6_P		Flooded area	TRIM 2 GB11350110 (only one area in the District)
L7		Spring	TRIM 2 - does not occur in this Forest District
L8_P		Moraine	TRIM 2 HB18700000
L9_P		Skree	TRIM 2 HB26150000
L10		Avalanche	Forest Cover ESA area (not actually the avalanche track)
L11_P		Glacier	TRIM 2 GD12300000
L12_P		Snow/ice	TRIM 2 (does not occur in this Forest District)
L13		Ridge	TRIM 2 HB06650100
L14_P		Islands	TRIM 2 GE14850000
L15_P		Sand Bars	TRIM 2 GE25850000
L16_P		Pit	TRIM 2 AG21550000
L17		Rock Bluffs	TRIM 2 HB25000100
L19		Cliff drop off	TRIM 2 HB05650100 (this is the majority of the cliffs identified)
L20		Cliff drop off indefinite	TRIM 2 HB05650200
BEDROCK TYPE			
BR	1	Rich	Metamorphic – i.e. gneissic diorites, gabbro, hornblende schists, hornblende biotite, limestone
BR	2	Poor	Igneous (Intrusive) – i.e.granodiorites, quarz diorites, diorites
BR	3	Moderate	Sedimentary – i.e. sandstone, siltstone, shale and slates – Fraser River deposits
BR	4 or0	Not useful	Undivided – everything from volcanic, to sedimentary, to metamorphic, to intrusive
FOREST COVER CHARACTERISTICS:			
Disturbance History:			
D	1	Past burn	(not used in Lillooet project)
Species:			
Sp		FC codes	1st, 2nd or 3rd species listed - SP1, SP2, or SP3 – use capital letters
SpL		lead species	SP1 only
SpS		Second	SP2 only
Height:			
H	s		HST grouping of height classes 1-2
H	t		HST grouping of height classes 4-8
HC	1	FC codes	height class 1 = 0.1 to 10.4 m from Forest Cover (HCTL_PR)
HC	2		class 2 = 10.5 to 19.4 m
HC	3		class 3 = 19.5 to 28.4 m
HC	4		class 4 = 28.5 to 37.4 m
HC	5		class 5 = 37.5 to 46.4 m
HC	6		class 6 = 46.5 to 55.4 m
HC	7		class 7 = 55.5 to 64.4 m
HC	8		class 8 = 64.5 +
Crown Closure:			
CC	o	Open	CC grouping classes 0 to 3
CC	c	closed	CC grouping classes 4+

CRN	0		Crown class 0-5%
CRN	1		6-15%
CRN	2		16-25%
CRN	3		26-35%
CRN	4		36-45%
CRN	5		46-55%
CRN	6		56-65%
CRN	7		66-75%
CRN	8		76-85%
CRN	9		86-95%
CRN	10		96-100%
Age:			
A	m	mature	age classes 4 to 9, grouped together
AGE	1		FC age class 1 (1-20)
AGE	2		FC age class 2 (21-40)
AGE	3		FC age class 3 (41-60)
AGE	4		FC age class 4 (61-80)
AGE	5		FC age class 5 (81-100)
AGE	6		FC age class 6 (101-120)
AGE	7		FC age class 7 (121-140)
AGE	8		FC age class 8 (141-250)
AGE	9		FC age class 9 (250+)
TERRAIN MAPPING FEATURES:			
Terrain Decile: (all T are labeled "Tdec_1" in the terrain database)			
		majority	Decile grouping of 7, 8, 9 and 10 This is done automatically since only those terrain polygons of decile 7 or greater are included in the PEM database. Note that in the Matrix database, the TS column can be "0" due to the terrain polygons having less than decile 7 for the first label.
Terrain Surface Materials: (the TS layer is created from the "Surfm_1" column in the terrain database)			
TS	A		Anthropogenic
TS	C		Colluvial
TS	D		Weathered bedrock
TS	E		Eolian
TS	F		Fluvial
TS	FA		Active Fluvial
TS	FG		Glaciofluvial
TS	I		Ice
TS	L		Lacustrine
TS	LG		Glaciolacustrine
TS	M		Morainal
TS	M1		Morainal
TS	O		Organic
TS	R		Rock
TS	U		Undifferentiated
TS	V		Volcanic
Terrain Surface Expression: (the TE layer is created from the "Surf_E1" column in the terrain database)			
(There are 452 code combinations, only the following will be included in the TE layer)			
TE	1	b, br, bv, w, wv,	Blanket, blanket-ridge, blanket-veneer, variable thickness, variable-veneer
TE	2	c, cb, cf, cv,	Cone, cone-blanket, cone-fan, cone-veneer, veneer-cone

		vc	
TE	3	f, fp, ft, vf	Fan, fan-plain, fan-terrace, veneer-fan
TE	4	h, hr, m, u, uh, uj, ur	Hummocky, hummocky-ridged, rolling, undulating, undulating-hummocky, undulating-gentle, undulating-ridged
TE	5	p, pj, pt	Fluvial, lacustrine or organic plains, plain-gentle slope, plain-terrace
TE	6	r, rs, sr, rv, vr, kr	Strongly ridged: ridge-veneer, ridge-steep slope, steep-ridge, veneer-ridge, moderately steep-ridged
TE	7	ra, rj, rm, rh, rt, ru	Lightly ridged (i.e. eskers or drumlins): ridge-moderate slope, ridge-gentle slope, ridge-rolling, ridge-hummocky, ridge-terrace, ridge-undulating,
TE	8	t, tj, tp	Terrace, terrace-gentle, terrace-plain
TE	9	v, vb, vk, kv, vw, vx, x, xv	Veneer, veneer-blanket, veneer-moderate slope, moderate slope-veneer, veneer-variable, veneer-very thin veneer, very thin veneer, very thin veneer-veneer
Terrain Subsurface Materials: (the TU layer is created from the "Ssurfm_1" column in the terrain database)			
TU	R		Rock
TU	V		Volcanic
Terrain Geological Processes: (the TG layer is created from the "Geop_1" column in the terrain database) Other labels are available in the terrain database but won't be used in the KB's			
TG	A		Avalanche
TG	F		Slow Mass Movement
TG	R		Rapid Mass Movement
Terrain Drainage: (the TD layer is created from the "Drain_1" column in the terrain database)			
TD	r		Rapid (the second drainage label is present in only a few cases so therefore won't be used in the KB's)
TD	w		well
TD	m		moderate
TD	i		imperfect
TD	p		poor
TD	v		very poor
Terrain Texture: (the TX layer is created from the "Ttex_1" column in the terrain database)			
TX	a, b, k, p, s, $, c		Blocks, boulders, cobbles, pebbles, sand, silt, clay
TX	d, x, g, r, m, y		Mixed fragments, angular fragments, gravel, rubble, mud, shells
TX	e, u, h		Fibric, mesic, humic
SOIL DESCRIPTION: (not used in this PEM Project)			
SATELLITE IMAGERY: (the PEM polygons only include the SA values that are > 50% of the polygon)			
SA	1		Forest - closed
SA	2		Krumholtz-Parkland Forest
SA	3		Big Sage Grassland (cutblocks)
SA	4		Open Forest – Fescue Grassland mix
SA	5		Alpine Heathland
SA	6		Herbaceous Meadow (Alpine)
SA	7		Open Forest – Pinegrass Grassland / Deciduous Shrub
SA	8		Landslide
SA	9		Talus (high elevation exposed soil and rock)
SA	10		Rock
SA	11		Snow
SA	12		Water
SA	13		Unclassified
SOLAR RADIATION RANGES: (highest value assigned to the PEM polygon – avoids "noise" of several pixel classes)			

SR	1		Full South-facing, no obstructions – Intensive solar radiation
SR	2		Warm aspects – east or west – moderate solar radiation
SR	3		Full North-facing, no variations – Cool solar radiation
Post Processing to avoid Input database complications			
TEM Structural Stage:			
TSS	1		Shrub (1 to 20 years)
TSS	2		Pole/sapling (20 to 40 years)
TSS	3		Young (40 to 80 years)
TSS	4		Mature (80 to 240 years)
TSS	5		Old (240+ years)

Appendix 5: Knowledge Tables

The following is one example of the Knowledge Tables used for the Lillooet PEM project. We are showing only one example here since there are too many to print out. Please refer to the digital file to view the rest of the KB's.

This file is also found on the accompanying CD as pem_4021_knb.xls

Please note that the PEM standards require each of the KB's saved as their own rtf document and each must be named numerically. This is a cumbersome format that is very difficult to read, so please refer to the Excel version for review.

Appendix 6: Metadata Project File

The following is an index or table of contents for all the data files produced in this PEM project. This file was originally required by the PEM Standards, but now appears to have been dropped. However, in our view this is a critical table since it describes what all the files are and the names for them, so we chose to continue to include it in our data deliverables.

This file is also found on the accompanying CD as pem_4021_pro.rtf

PEM PROJECT OUTPUT FILE – LILLOOET TSA PEM

A. PROJECT

Project Name:	**2001-2004 Lillooet TSA PEM – Year 3 of 3 BAPID# 4021**
	2001: BEC's: IDFxm, IDFdk2, IDFdk3, MSdc2, MSxv2, ESSFdv1, ESSFxc4, ESSFxv2, ESSFxv2a,
	2002: BEC's: BGxh2, BGxh3, BGw2, PPxh2, IDFxh2, IDFxh3, IDFxw, IDFdk1/1a, IDFdk5, MSxk3, MSdc1, ESSFxc3, ESSFdv1. Parkland and Alpine for the north half of the TSA
	2003: BEC's: CWHms1, IDFdk2, IDFww2, MSdm2, MSxk, MSmw, ESSFdc2, ESSFmw, Parkland: ESSF dcu, dcp, dvu, dvu1, dvu2, dvp2, mwu, xcu, xcu3, xcu4, xvu, xvu2, xvp2 Alpine: AT dc, dv, mw, xc3, xc4, xv, ICE
Input File:	PEM_4021_INP.RTF Lillooet District Bio-terrain mapping (Silvatech Consulting) District forest cover mapping. (MSRM) Biogeoclimatic data in put into PEM (MOF regional) TRIM 2 data in put into PEM (MSRM)
Non-standard Inventory File:	PEM_4021_NON.RTF Lillooet District classified satellite imagery. (Silvatech) Bedrock Type input into PEM (Silvatech)
Localized Biogeoclimatic File:	PEM_4021_BGC.RTF The Biogeoclimatic linework revision down to the 1:20,000 scale was completed in three phases for this PEM project. The first revision was provided by Dennis Lloyd, Regional Ecologist for the Central Interior Region, in 2001 showing estimates of the new BEC subzones and their locations. The second revision for the north half of the District (excluding the parkland and alpine areas and two large blocks in the west and the north) was provided in December, 2002. The third and final revision was provided in May, 2003 by D. Lloyd. The rule sets for the derivation of BEC linework were not done according to the Methodology for Large Scale Biogeoclimatic Mapping (M. Eng, 1999). Instead, these BEC lines were hand-drawn by D. Lloyd on 1:50,000 TRIM maps with assistance from Forest Cover overlays. These digitized lines were then projected to the 1:20,000 scale for use in the PEM project.
Project File:	PEM_4021_PRO.RTF : Contains information regarding delivered files.
Knowledge Base File:	Pem_4021_knb.xls – Excel XP for easier viewing Pem_4021_kb01.rtf – each KB is separated out as an rtf file and numbered 01 to 30 Lillooet_EcoNGen_Files.access – KB's, SiteSeries, Order and Configuration tables for EcoNGen processing. Note that the Site Series table must be re-done for each LU

	because of the variations in the BEC unit labels.
Structural Stage File:	Pem_4021_sts.rtf – Defines the parameters for determining the structural stage class.
User Defined File:	Pem_4021_usrAttributesLegend.rtf – Legend of all attribute codes in the Matrix database and KB's; Pem_4021_usrMapEntities.rtf – defines which site series in each BEC subzone were mapped; Pem_4021_usrPEMEntities.rtf – defines each site series by name, code, edatophic condition and SIBEC value
Input Database:	The following contain files contain information for each input data source. PEM_4021_INP.csv Lillooet District Bio-terrain mapping (Silvatech) Lillooet District forest cover mapping. (MSRM) TRIM Information (MSRM) Biogeoclimatic data in put into PEM (Silvatech)
Non-standard Inventory Database:	The following contain files contain information for non-standard input data source. PEM_4021_NON.csv Lillooet District classified satellite imagery. (Silvatech) Bedrock Type used in PEM (Silvatech)
Localized Biogeoclimatic Database:	PEM_4021_BGC.csv Lillooet District Biogeoclimatic data. Coverage was received May, 2003 as a final product.
Project Database:	PEM_4021_MTA.csv: Contains information regarding delivered files
Ecosystem Polygon Database:	PEM_4021_ECP.csv TEM table standard is not applicable: PEM polygon coverage has been supplied with mapsheet, PEM Tag and polygon site series classification. Please refer to GIS methodology and knowledge base classification documentation for explanation on ecosystem model development. This coverage is linked to data tables by a unique label of Mapsheet, PEM tag number and landscape unit for each polygon. Landscapeunit needed to be added to the unique tag because Mapsheet, PEM_TAG was not unique because analysis was completed by landscape unit Mtx(aoi).dbf has been supplied. This is the resultant database from GIS analysis – there is one matrix database for each of the 22 Landscape Units in this Lillooet TSA. Matrix(aoi).mdb is the summarized GIS resultant data from matrix summary.
Structural Stage Database:	PEM_4021_STS.csv Structural stage data was generated from forest cover age of PEM polygon. Field TSS 1 Shrub (1 to 20 years) 2 Pole/sapling (20 to 40 years) 3 Young (40 to 80 years) 4 Mature (80 to 240 years) 5 Old (240+ years)

<table>
<tr><td>Sample Points Database:</td><td colspan="2">Ground point databases (dbf files) are attached to each of the following Shapefiles (ArcView 8.2): [Note that digitizing the ground points was optional in the PEM standards, as such only the 2nd and 3rd year ground points were not digitized. The first year ground points are recorded in Excel tables by their PEM tags only.]</td></tr>
<tr><td></td><td>Pem_4021_eciMU.shp
Pem_4021_eciKW.shp
Pem_4021_eciCC.shp
Pem_4021_eciCS.shp
Pem_4021_eciTC.shp</td><td>Pem_4021_eciHE.shp
Pem_4021_eciHW.shp
Pem_4021_eciDS.shp
Pem_4021_eciPV.shp
Pem_4021_eciWB.shp</td></tr>
<tr><td>Sample Points Database (Excel):</td><td colspan="2">Lillooet PEM Final Results.xls – all ground points and corresponding PEM labels along with accuracy scoring.</td></tr>
<tr><td>User Defined Database:</td><td colspan="2">Not applicable</td></tr>
<tr><td>Localized Biogeoclimatic Spatial Coverage:</td><td colspan="2">PEM_4021_bgc.e00

Lillooet Forest district Biogeoclimatic data set, created by Dennis Lloyd.</td></tr>
<tr><td>Polygon Spatial Coverage:</td><td colspan="2">PEM_4021_ECPS.e00 South Portion of District
PEM_4021_ECPN.e00 North portion of District

PEM polygon coverage is provided as a north and south seamless file. This coverage is linked to data tables by a unique label of Mapsheet, PEM tag number and landscape unit for each polygon. Landscapeunit needed to be added to the unique tag because Mapsheet, PEM_TAG was not unique because analysis was completed by landscape unit. District deliverables had to be split into two areas due to size limitation on the software. Linking table Information can be found in .DAT INFO table with coverage and summarised .MDB.

During the creation of the PEM, we had to divide the project area the existing 22 Landscape Units due to computer software limitations and to decrease processing times. The matrix databases (also provided here) remain divided into these Landscape Units, however the polygon coverages were merged in order to comply with the PEM Standards.</td></tr>
</table>

<table>
<tr><td></td><td>AOI = Landscape unit completed for analysis
PV = Pavillion
FB = French Bar
WB= Watson Bar
YK = Yalakom
CN = Carpenter Lake North
CS = Carpenter Lake South
GU = Gun
SL = Spruce Lake
BE = Bridge East
BW = Bridge West</td><td>HE = Hurley East
HW = Hurley West
DN = Duffy North
DS = Duffy South
KW = Kwoiek
SK = Siska
MU = Murray Creek
TC = Texas Creek
CC = Connell Creek
LC = Lost Creek
SE = Stein East
SW = Stein West</td></tr>
<tr><td>Structural Stage Spatial Coverage:</td><td colspan="2">PEM_4021_STSS.e00 South Portion of District
PEM_4021_STSN.e00 North Portion of District
Structural Polygon coverage is provided as two coverages. Each coverage is linked to an output matrixsum(aoi).MDB file that contains a unique label of mapsheet, PEM Tag and landscape unit for each polygon. Structural stage data table Information can be found in the .DAT table ARC/INFO coverage. Structural stage was derived from forest cover projected age of PEM polygon.</td></tr>
<tr><td>Sample Point Spatial Coverage:</td><td colspan="2">Ground points are digitized in the following Shapefiles (ArcView 8.2):
[Note that these are for years 2 and 3 only. Year 1 was not digitized since it was an optional task in the PEM standards.]</td></tr>
<tr><td></td><td>Pem_4021_eciMU.shp
Pem_4021_eciKW.shp
Pem_4021_eciCC.shp
Pem_4021_eciCS.shp
Pem_4021_eciTC.shp</td><td>Pem_4021_eciHE.shp
Pem_4021_eciHW.shp
Pem_4021_eciDS.shp
Pem_4021_eciPV.shp
Pem_4021_eciWB.shp</td></tr>
<tr><td>Geographic Location:</td><td colspan="2">Lillooet TSA lies between Clinton to the north and Lytton to the south, primarily on the west of the Fraser River above Lillooet and on both sides of the River south of Lillooet. The TSA lies at the confluence of three major climatic/geographic zones: the Chilcotin Plateau (cool and dry), the coastal mountains (warm and moist), and the interior dry belt (hot and dry). As a result, there are an exceptionally high number of BEC subzones in this small geographic area (see the list above).</td></tr>
<tr><td>Consultant/ Department:</td><td colspan="2">GIS Analyst: Graham MacGregor (Silvatech Consulting Ltd.)
Silvatech Consulting Ltd.
P.O Box 1030 Salmon Arm B.C. Canada V1E 4P2
Phone: (250)832-7360 Fax: 832-1939

PEM Ecologist: Colleen Jones (Shamaya Consulting)
5577 Silver Star Road, Vernon, BC V1B 3P7
phone/fax: (250)542-3028</td></tr>
<tr><td>TRIM Version:</td><td colspan="2">TRIM2 was used for the complete Lillooet district</td></tr>
</table>

Ecosystem Survey Intensity Level:	Internal Accuracy Assessment Level 4 – 100% of the sample polygons were assessed by ground checks, either traversed the polygon or mapped simple PEM entities at large scale. Refer to: Lillooet PEM Final Results.xls
Date Recorded:	GIS data and PEM knowledge tables generated in March 2004
Recorder Name:	Graham MacGregor: GIS analysis and data creation Colleen Jones: Knowledge Table Creation
Version of Package Used:	Standards for Predictive Ecosystem Mapping (PEM) Digital Data capture. Version 1.0 Standards for Predictive Ecosystem Mapping (Inventory Standard). Version 1.0 Protocol for Quality Assurance and Accuracy Assessment of Ecosystem Maps, 2000
Version of EcoNGen Used:	EcoNGen 1.0c
PEM Supervisor:	Colleen Jones, RPBio, Shamaya Consulting and Grant Sime, RPF Silvatech Consulting Ltd.
GIS Supervisor:	Graham MacGregor, Silvatech, Consulting Ltd.
Accuracy Assessment:	Internal accuracy assessment was completed on each knowledge table using ground sample points collected during the summers of 2001, 02 and 03.
Image Year:	Not Applicable
Image Scale:	Not Applicable
Image Type:	Not Applicable

Appendix 7: QA Scoring Matrix

The following is an example of the scoring matrices for the Lillooet PEM project.
These were used during the scoring process of the Quality Assessment or Accuracy Assessment. If the PEM label correctly matches the ground label, a full point (1) is given. If the PEM label is not the same as the ground label, this matrix helps to identify which site series are acceptable adjacent ecosystem units (half scores).

This file is also found on the accompanying CD as Patry QA Scoring Matrix.doc

Scoring Matrix for IDFxh2 and xh2a

Standard scheme	01	02	03	04	06	07	08-11	SW	SG							
	01/06	**02**	**03**	**04**	**07a**	**07**	**08**	**GD**	**GX**	**LS**	**RT**	**WE**	**WS**	**LA**	**SB**	**ES**
01/06	1		½	½	½	½										
02		1	½		½				½	½	½					
03	½	½	1	½						½						
04	½		½	1	½											
07a	½	½		½	1	½					½					
07	½				½	1	½									
08						½	1									
GD								1	½							
GX		½						½	1	½	½					
LS		½	½						½	1	½					
RT		½			½				½	½	1					
WE												1	½	½		
WS												½	1			
LA												½		1		
SB															1	½
ES															½	1

Appendix 8: Quality Assessment Data Sets

The following is only one example of the internal QA datasets. All of the datasets have not been printed out due to the large size of the file.

This file is also found on the accompanying CD as Lillooet PEM Final Results.xls

Reliability Table: TexasCrk_Rel
Database Name: TexasCrk_Input

FC Tag	PEM_TAG	PEM_Area	PEM BEC Label	Ground BEC Label	Ground Lal	Predicted S	Score Correct	Score Acceptable	Proportion Correct	Proportion Acceptable	Weighted Scores Dominant	Accept	Overlap	Accept
M092I041	42708	2845.427	MS dc1		01	01	1		1		2845.427	0	2845.427	0
M092I041	43059	1890.241	MS dc1		01	01	1		1		1890.241	0	1890.241	0
M092I041	44647	2186.114	MS dc1		01	01	1		1		2186.114	0	2186.114	0
M092I041	46444	1254.821	MS dc1		01	01	1		1		1254.821	0	1254.821	0
M092I041	40909	1800.178	MS dc1		01	04		0.5		0.5	0	900.0889	0	900.0889
M092I041	41102	6213.279	MS dc1		01/09	06	1		0.5		6213.279	0	3106.64	0
M092I041	42342	14709.6	MS dc1		01/09	06	1		0.5		14709.6	0	7354.799	0
M092I041	43381	5725.257	MS dc1		01/09	06	1		0.5		5725.257	0	2862.628	0
M092I041	43989	16164.17	MS dc1		01/09	06	1		0.5		16164.17	0	8082.086	0
M092I041	44537	10373.9	MS dc1		01/09	06	1		0.5		10373.9	0	5186.948	0
M092I041	47351	10108.19	MS dc1		01/09	06	1		0.5		10108.19	0	5054.096	0
M092I041	40661	16592.85	MS dc1		02	02	1		1		16592.85	0	16592.85	0
M092I041	41304	4807.743	MS dc1		02	02	1		1		4807.743	0	4807.743	0
M092I041	41480	5607.656	MS dc1		02	02	1		1		5607.656	0	5607.656	0
M092I041	43537	22891.19	MS dc1		02	02	1		1		22891.19	0	22891.19	0
M092I041	43874	4207.769	MS dc1		02	02	1		1		4207.769	0	4207.769	0
M092I041	44178	6867.016	MS dc1		02	02	1		1		6867.016	0	6867.016	0
M092I041	44274	5326.164	MS dc1		02	02	1		1		5326.164	0	5326.164	0
M092I041	44380	13542.14	MS dc1		02	02	1		1		13542.14	0	13542.14	0
M092I041	44486	2729.907	MS dc1		02	02	1		1		2729.907	0	2729.907	0
M092I041	41030	7104.172	MS dc1		02(RO)	02/RT	1		1		7104.172	0	7104.172	0
M092I041	41668	62607.81	MS dc1		02(RO/06)	02	1		0.8	0.1	62607.81	0	50086.24	6260.781
M092I041	45388	7788.452	MS dc1		02/06	02	1		0.5	0.25	7788.452	0	3894.226	1947.113
M092I041	45097	2471.62	MS dc1		02/RO	02/02a	1		0.5	0.25	2471.62	0	1235.81	617.9051
M092I041	40665	3082.514	MS dc1		03	02/02a	1		0.5	0.25	3082.514	0	1541.257	770.6285
M092I041	40351	73108.23	MS dc1		03	02a	1		1		73108.23	0	73108.23	0
M092I041	43330	48993.21	MS dc1		03	02a	1		1		48993.21	0	48993.21	0
M092I041	44473	6148.816	MS dc1		03	02a	1		1		6148.816	0	6148.816	0
M092I041	44971	23372.02	MS dc1		03	02a	1		1		23372.02	0	23372.02	0
M092I041	45622	6163.276	MS dc1		03	02a	1		1		6163.276	0	6163.276	0
M092I041	46580	17063.76	MS dc1		03	02a	1		1		17063.76	0	17063.76	0
M092I041	44861	8673.039	MS dc1		03(06)	05		0.5		0.5	0	4336.52	0	4336.52
M092I041	41586	18443.37	MS dc1		04	03	1		1		18443.37	0	18443.37	0
M092I041	41793	10486.72	MS dc1		04	03	1		1		10486.72	0	10486.72	0
M092I041	43692	13621.68	MS dc1		04	03	1		1		13621.68	0	13621.68	0
M092I041	44914	16887.78	MS dc1		04	03	1		1		16887.78	0	16887.78	0
M092I041	45293	36449.95	MS dc1		04	03	1		1		36449.95	0	36449.95	0
M092I041	40862	3573.827	MS dc1		04	03/04	1		0.5	0.25	3573.827	0	1786.914	893.4568
M092I041	43988	6099.027	MS dc1		04	03/06	1		0.5		6099.027	0	3049.513	0
M092I041	43160	40081.43	MS dc1		04(01)	03	1		0.8	0.1	40081.43	0	32065.15	4008.143
M092I041	44543	14420.92	MS dc1		05	04	1		1		14420.92	0	14420.92	0
M092I041	44964	2512.088	MS dc1		05	04/05	1		0.5		2512.088	0	1256.044	0
M092I041	45398	1346.668	MS dc1		05(09)	06	0.2		0.2		269.3335	0	269.3335	0
M092I041	43474	27175.83	MS dc1		05/03	02a	1		0.5	0.25	27175.83	0	13587.91	6793.957
M092I041	44564	3352.701	MS dc1		06	02a	1		1		3352.701	0	3352.701	0
M092I041	44898	2511.655	MS dc1		06	05a	1		1		2511.655	0	2511.655	0
M092I041	44343	89112.11	MS dc1		06(02)	02/05a	1		1		89112.11	0	89112.11	0
M092I041	40543	16924.96	MS dc1		06/RO	02		0.5		0.5	0	8462.479	0	8462.479
M092I041	44616	5483.607	MS dc1		06/RO	05a	1		0.5	0.25	5483.607	0	2741.804	1370.902
M092I041	45003	9379.055	MS dc1		07	02/05a		0.5		0.5	0	4689.527	0	4689.527
M092I041	40539	11801.35	MS dc1		07	05	1		1		11801.35	0	11801.35	0
M092I041	40801	2749.798	MS dc1		07	05	1		1		2749.798	0	2749.798	0
M092I041	41347	3551.756	MS dc1		07	05	1		1		3551.756	0	3551.756	0
M092I041	41741	6829.266	MS dc1		07	05	1		1		6829.266	0	6829.266	0
M092I041	43942	20138.16	MS dc1		07	05	1		1		20138.16	0	20138.16	0
M092I041	44239	7930.129	MS dc1		07	05	1		1		7930.129	0	7930.129	0
M092I041	44580	12681.4	MS dc1		07	05	1		1		12681.4	0	12681.4	0
M092I041	45106	13923.45	MS dc1		07	05	1		1		13923.45	0	13923.45	0
M092I041	42937	40444.21	MS dc1		07(09)	05	1		0.8	0.1	40444.21	0	32355.37	4044.421
M092I041	46587	19183.94	MS dc1		07(09)	05	1		0.8	0.1	19183.94	0	15347.15	1918.394
M092I041	40908	3411.996	MS dc1		07/09	05	1		0.5	0.25	3411.996	0	1705.998	852.999
M092I041	40518	3412.657	MS dc1		07/09	05/06	1		1		3412.657	0	3412.657	0
M092I041	42041	2777.846	MS dc1		09	06	1		1		2777.846	0	2777.846	0
M092I041	42734	8537.352	MS dc1		09	06	1		1		8537.352	0	8537.352	0
M092I041	45249	2227.855	MS dc1		09	06	1		1		2227.855	0	2227.855	0
M092I041	46434	1751.145	MS dc1		09	06	1		1		1751.145	0	1751.145	0
M092I041	46118	3142.082	MS dc1		09(01)	06	1		0.8		3142.082	0	2513.666	0
M092I041	41712	10856.98	MS dc1		09(01/07)	06	1		0.8	0.05	10856.98	0	8685.583	542.8489
M092I041	41317	1740.614	MS dc1		09/07	05	1		0.5	0.25	1740.614	0	870.3072	435.1536
M092I041	42921	2119.03	MS dc1		10	07	1		1		2119.03	0	2119.03	0
M092I041	43632	8191.902	MS dc1		10/09	07	1		0.5	0.25	8191.902	0	4095.951	2047.976
M092I041	46478	58191.21	MS dc1		ALD SWAL	AV	1		1		58191.21	0	58191.21	0
M092I041	44968	6890.653	MS dc1		ALD SWAL	GJ		0		0	0	0	0	0
M092I041	43940	4280.303	MS dc1		AV	AV	1		1		4280.303	0	4280.303	0
M092I041	46267	17634.11	MS dc1		AV	AV	1		1		17634.11	0	17634.11	0
M092I041	47561	7452.325	MS dc1		AV	AV	1		1		7452.325	0	7452.325	0
M092I041	47626	6170.512	MS dc1		AV	AV	1		1		6170.512	0	6170.512	0
M092I041	44101	5536.342	MS dc1		AV	AV/HM	1		0.5	0.25	5536.342	0	2768.171	1384.085
M092I041	43797	18655.08	MS dc1		HM/WS	HM	1		0.5	0.25	18655.08	0	9327.541	4663.771
M092I041	44337	7809.396	MS dc1		RO	RT	1		1		7809.396	0	7809.396	0
M092I041	41201	3181.314	MS dc1		RO/02	02	1		0.5	0.25	3181.314	0	1590.657	795.3285
M092I041	43784	24903.16	MS dc1		TA	02/02a/RT	1		0.33	0.33	24903.16	0	8218.043	8218.043
M092I041	41887	13823.22	MS dc1		TA	RT	1		1		13823.22	0	13823.22	0
M092I041	44004	58386.82	MS dc1		TA	RT	1		1		58386.82	0	58386.82	0
M092I041	44797	9507.37	MS dc1		TA	RT	1		1		9507.37	0	9507.37	0
M092I041	45486	8643.264	MS dc1		TA	RT	1		1		8643.264	0	8643.264	0
M092I041	46225	7048.175	MS dc1		TA	RT	1		1		7048.175	0	7048.175	0
M092I041	45114	2261.826	MS dc1		WS	HM/WS	1		0.5	0.25	2261.826	0	1130.913	565.4565
M092I041	46374	2580.49	MS dc1		WS	WS	1		1		2580.49	0	2580.49	0
M092I041	44265	1695.483	MS dc1		WS/HM	HM	1		0.5	0.25	1695.483	0	847.7416	423.8708
		1192338				subtotal:	84.2	2	71.33	6.28	1147593	18388.61	1012566	66943.85
						n =	90	90	90	90	1192338	1192338	1192338	1192338
							94%	96%	79%	86%	96%	98%	85%	91%

Appendix 9: Photocopied Fieldwork Plot Cards

The following are the photocopies of the plot cards (GIF's) from the third year of fieldwork in this project. Copies of the first two fieldwork seasons have been provided with each Year-End Report. Shamaya Consulting has the originals of all of the plot cards. If Ainsworth would like these, we will forward them on.

Appendix 10: Revised BEC Classification for Lillooet PEM

The revised BEC classifications for the Lillooet TSA were created by Dennis Lloyd et. al. between 2001 and 2003. The BGxh3 and BGxw2 were created by Ray Coupé, Regional Ecologist of the former Cariboo Region. Both Dennis and Ray have asked that these revised classifications only be used with their permission since they may have chosen to edit the information since they were given to us.

The digital site series summary tables are provided on the attached CD.

Appendix 11: Email Correspondence

Email from Corey Erwin regarding a Neatline Issue:

Hi Colleen,

As per our telephone conversation this morning....

Dividing these large PEM datasets into smaller, more manageable, units is a common practice. From a standards perspective, this is acceptable as long as the data within each, individual unit is totally seamless and meets the PEM standard (essentially creating 6 smaller complete standard PEM products). All remaining aspects of the entire project must comply with the requirements of the PEM standard.

For clarification the requirement for a seamless coverage has existed since the onset of the PEM standard. Section 5.2.3 - Spatial databases, of the PEM technical standard (April 2000), spatial deliverables #2, 3, & 4 refer to section 3 of the TEM technical standard (TEM TSD). Section 3.3.11 of the TEM TSD outlines the requirement for a seamless coverage. Granted the cross-referencing of standards is confusing but the requirement for "seamless data" is present and is also mentioned in section 5.1 of the PEM TSD Errata.

Also I would like to comment on your point about creating a database too complex to use. This is an important point. It is critical that we identify, and possibly change, areas where the requirements of the PEM/TEM standards are not meeting current project objectives and/or are resulting in extra work for mappers/clients. However, I don't think we can expect every forester and biologist, to have the skill sets necessary to query these types of complex datasets. Nor can we expect to develop a standard that will be all encompassing. The requirement to have a GIS skill set to use these datasets is one that we cannot avoid. We have the same problem in house. If you have any suggestions around changing the standard in this regard, please forward them to the TEM change mgt website.

As I stated earlier the current provincial standard requires a seamless data coverage and what you have outlined here is acceptable.

Please let me know if you have any further questions.

Corey Erwin
Vegetation Ecologist
Ecosystems Information Section
Phone: (250) 387-2031

-----Original Message-----
From: Shamaya [mailto:shamaya@junction.net]
Sent: December 10, 2003 9:55 AM
To: Erwin, Corey W SRM:EX
Cc: Graham MacGregor
Subject: question regarding seamless coverage for a PEM

Hi Corey,

We have a question for you. In our Patry PEM project, we divided the area into 6 blocks (landscape units) in order to make the data files manageable. Our AA contractor alerted our Client that the coverages were not seamless within these blocks. We followed the edge matching protocol as per the PEM standards, but did not dissolve all the mapsheets. The Client insisted that we do this, so we did. As a consequence, there are no mapsheet labels or forest cover polygon numbers in the database.

This is now causing our databases to malfunction. I cannot locate my ground points without the forest cover polygon number and mapsheet number. I, like most other forestry folks, use the forest cover maps to locate areas of interest, then query which PEM polygons exist within the area, the PEM labels and all their attributes from within the PEM database. This is not possible with the current database. I have to do another GIS overlay to bring back the forest cover.

More importantly, we have now created a database that cannot be used by our Clients, other Foresters and Biologists. Now, they too have to go to their GIS analyst to have this overlay process completed and sit with the GIS person to do all the queries and cross-references. Previously, the Forester and Biologist could sit at their own desk and query the database without the visual plot (or use the cheap ArcExplorer program to see the plots). We've now created a database that can't be used for simple tasks in forest planning - everyone will have to line up to get the assistance of the sole GIS person in their company. This is not an effective use of time or manpower, and our Clients will be mad at us.

We searched all the PEM, TEM and Errata standards and cannot find an actual statement that the PEM maps must be a seamless coverage. Could you please let us know where this is written? Is this a mis-interpretation by the AA contractor of some point in the Standards? If it is there in the Standards, is this an unintended consequence? Can this requirement be ammended to allow us to keep the mapsheet and forest cover labels? The problems created by this requirement are no simple matter. PEM's must be user friendly for our Clients and their contractors otherwise they will not be used.

We do see the requirements in the TEM Digital Data Capture standards section 3.3.5 that the polygon label must have a "provincially unique tag" that includes at least the mapsheet and polygon number. This isn't possible if the neatlines have to be dissolved - polygons that cross a neatline have two mapsheet numbers so these must be thrown out. In previous PEM project, we complied with this TEM labelling requirement.

Have a Great Day!

Colleen F. Jones, M.A. RPBio
Shamaya Consulting - Ecological Services
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Phone/fax: (250) 542-3028