File: 97VA-GTNA001

May 26, 1997

Mr. Laszlo Kardos, R.P.F., P.Eng.
Resource Forester
International Forest Products Ltd.
Forestry and Land Use
3500 - 1055 Dunsmuir Street
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**RE: TERRAIN NET DOWN ASSESSMENT
T.F.L. 38, SQUAMISH RIVER
SQUAMISH FOREST DISTRICT**

Dear Laszlo:

As you requested, I have reviewed the terrain net down factors for T.F.L. 38 near Squamish. These net down factors were reviewed since it was suspected the factors are too conservative, based on a low occurrence of landslide activity following previous harvesting on Class IV and V terrain. As a result of this assessment, it is recommended that the net down factor for Class IV terrain be reduced to 10% from 40%. It is also recommended that the net down factor for Class V terrain remain unchanged at this time, until further studies are completed.

1.0 BACKGROUND

Tree Farm Licence (T.F.L.) 38, previously owned by Weldwood of Canada, is located about 25km north of Squamish. In addition to the Squamish River, the main drainages in the area are the Elaho River, Clendenning River, Sims Creek, and Ashlu River. Most of these creeks are 4th order drainges (or higher), as numerous creeks are present in the area. The inset of Figure 1 shows the location of T.F.L 38.

The topography and surficial geology in the area is dominated by rugged mountain topography and glacial landforms. The topographic of the U-shaped valleys relief ranges from 30m a.s.l. near the confluence of the Squamish and Ashlu Rivers to as much as 2650m at the summit of Mt. Boardman. The treeline in most areas of the T.F.L. is at about 1400m to 1500m.

The geology of the T.F.L. area has been summarized by Ryder (1995) and is dominated by formations of the Coast Plutonic Complex, except for a small part of the southeastern part of the T.F.L. which is underlain by the Garabaldi Volcanics (Figure 1). For the Coast Plutonic Complex formations, the plutons are separated by bands of older, metamorphosed rocks. The plutonic formations have been mapped as quartz diorite and granodiorite, with lesser amounts of diorite and gabbro. These rock types are generally high strength, massive; weathering through glacial and post-glacial processes has resulted in blocky talus slopes, bouldery till (moraine), and bouldery stream gravels. These rock types generally weather to a coarse to medium sand, which is prevalent throughout the glacial till and glaciofluvial deposits in the area. In some locations, the plutons host intrusive basalt/andesite dykes. These dykes can act to weaken the rock mass, although this is generally not a concern for stability related to clearcut timber harvesting activities. The Garibaldi Volcanic formations are generally flat-lying lavas and underlie the low-relief terrain along the eastern and southeastern boundary of the T.F.L. On many of these slopes, there are pyroclasitic deposits which may exhibit instability following harvesting activities. The natural instability of some of these areas een documented in the academic literature, such as Jordan (1994). In the T.F.L., the Garibaldi Volcanics occupy less than 5% of the land area, based on overview information.

Terrain Mapping and Terrain Stability Mapping have been completed for the T.F.L. (J.M. Ryder and Associates, 1995). Surficial landforms in the area are dominated by colluvial and morainal materials on the hillslopes, with fluvial (and in some locations glaciofluvial and/or bedrock) in the valley floors. Both basal and ablation moraines were observed during the terrain mapping of the watershed. In most locations in the T.F.L. the lower creeks and rivers in the area have downcut into the moraine and glaciofluvial materials or weaker bedrock, leaving steep escarpments immediately above the watercourses. The types of active geomorphic processes identified from aerial photos of the T.F.L. include debris slides, debris flows, rockfalls, snow avalanches, and flooding. Landslides in previously logged areas of the watersheds are discussed in detail in Section 2.0, below.

The climate in the area is generally one of cold, wet winters with dry summers, although temperatures are more moderate than interior areas. The precipitation in Squamish totals 2247mm annually. The monthly precipitation varies from about 300mm in the winter months to as little as 50mm in July and August. The maximum recorded daily precipitation is 112mm. The rainfall in the T.F.L. may be somewhat greater due to topographic influences. Rain-on-snow events occur frequently. Winter snowfall on the steep slopes typically leads to wet snow avalanches, and has resulted in numerous snow avalanches chutes throughout the T.F.L. These chutes host poor quality timber, and consequently are not included in the operable land base for the timber supply review.

There has been logging activities carried out in the Squamish River watershed since the mid 1960's. Many areas of the lower Squamish and Ashlu Rivers; Tatlow and High Falls Creeks. Development is starting to take place in the lower Elaho River and Sims Creek areas. Most of this development would have been carried out prior to the Forest Practices Code (FPC). The landslides which have occurred on this previously logged terrain are discussed in detail in section 2.0.

Several types of resources are present in the downslope areas of the watershed, which could potentially be affected by landslides in logged areas. These resources include: the aquatic environments of the creeks and rivers, the productive forest site on the lower slope areas, and industrial forest roads. The T.F.L. area is not a community watershed.

2.0 LANDSLIDE ASSESSMENT

An assessment of landslides in the logged areas for T.F.L. 38 was carried out to determine the number and characteristics of landslide events. The assessment was carried out for all logged areas observed in aerial photographs of the area, regardless of the age of the logged areas.

A total of 47 landslides from logged terrain were identified. All the landslides which initiated outside the road corridor are termed as "clearcut related" for the purposes of this study, and the landslides which initiated at the road were termed as "road related". Most of the landslides were clearcut related, with 12 road related and 35 clearcut related. Although some of these 35 clearcut landslides may be attributed to road drainage, it was not possible to conclude this relationship without a detailed ground investigation. Note that including these potentially road-related failures in the net down assessment is conservative, since these are not likely to occur with the increased standard of road activities required by the Forest Practices Code. Also, stream avulsion/bank erosion on steep creeks was not termed as a landslide for the purposes of this study, since these events usually affect downslope resources significantly less than a landslide or debris flow. Buffers for these areas would be accounted for as net downs for riparian areas, so include these potential events as a terrain net down would be "double counting". Snow avalanche chutes were not included in the operable area, and thus net down factors for these areas are not applicable.

2.1 Landslide Initiation Characteristics

The initiation of a landslide refers to the occurrence of a landslide event at a particular location in the landscape. The characteristics, or attributes, of the terrain in the landscape where events have initiated in T.F.L. 38 were tabulated to determine the patterns of attributes related to landslide activity. These attributes can be extremely useful in determining areas which may be susceptible to future landslide activity. The 35 clearcut related landslides identified in logged areas were used to determine the characteristics of landslide initiation.

For the clearcut landslides studied for initiation characteristics, 20 initiated on open slopes and 15 initiated in gully systems. Graphs are presented in Figure 3. For the 35 landslides in the study, 16 were observed to occur in the lower slope areas. Another 8 events were observed to occur in escarpment areas, with an equal number occurring in mid-slope areas. In terms of the slope morphology at the initiation locations, over half of the events initiated on open slopes, while 9 events initiated from gully sidewalls and 6 from gully headwalls. Virtually all of the initiation sites are either concave or straight in slope curvature (along the slope contour). For the terrain polygons where landslide initiation occurred, most were mapped as moraine (till) or colluvium, with lesser amounts of bedrock, and fine-grained glacial sediments (glaciofluvial and/or glaciolacustrine). For the 35 polygons where landslides initiated, 21 were mapped as having no active geomorphic process, while only 9 were mapped as having gullying and 5 as having rockfalls present.

2.2 Landslide Runout Characteristics

All 47 landslides identified as having initiated in logged areas, including the landslides from roads, were included in the assessment of runout to characterize the travel distance and downslope impacts of the landslide events. The runout characteristics of a landslide event include the travel distance from the initiation point to the terminus, as well as the slope morphology of the terminus site.

The characteristics of landslide runout from these events is presented in Figure 4. The approximate travel distance, as measured from 1:20,000 maps is typically 100m (± 50m) for 26 of the events. Of the remaining events, 13 have a travel distance of less than 450m. One event had a travel distance of about 1200m. The terminus (area where the landslide event stopped) for 18 of the 47 events was an open slope. For gully events, most of the 17 landslides did not develop into a debris flow: 13 events terminated on the gully sidewall of in the gully channel, while 4 of the 17 became a debris flow and travelled down to the debris fan. Ten of the events deposited material directly into a stream channel; most of these events are debris slides which initiated on stream escarpments directly above the stream channel. Two of the events stopped on a downslope forestry road.

3.0 UNSTABLE POLYGON AREA

The area of terrain polygons where landslides were identified following harvesting (unstable polygons) were calculated as a guide to determining net down factors. Net down factors for terrain stability are included for areas mapped as Class IV or Class V. For Class III terrain, no terrain net down factor is applied and all of this area is in included in the timber supply review. For Class IV terrain, the net down previously applied is equal to 40% and the net down factor for Class V terrain is set as 90%. These net down factors are the Ministry of Forests default values for net downs in the absence of detailed information for the study area. Subsequently, a landslide prediction study was started by the Vancouver Forest Region, Forest Sciences Section which includes T.F.L. 38. Based on the low landslide frequency observed in logged areas, it was determined that the stability ratings for the area may be too conservative with respect to clearcut harvesting. A methodology was developed to study T.F.L. 38, and determine net down factors which were more representative of the observed terrain stability of logged areas (letter to T.Rollerson, February 4, 1997).

Table 1 summarizes the area of Class IV and Class V terrain which has been harvested in the T.F.L. For polygons mapped as Class IV, the total area of those which have exhibited clearcut landslide behaviour following harvesting is calculated as 148ha. Since the total logged area of Class IV terrain is 2,639ha (mapped as forest cover age class ≤ 31 years). Thus, about 5% of the Class IV area has exhibited landslide activity following harvesting. In terms of landslide frequency, the 35 landslides in 2,639ha is equal to 0.013 events/ha.

Class V terrain and snow avalanche chutes were not included as part of this assessment. Snow avalanche chutes are not mapped as operable, since in most cases these areas do not contain merchantable timber.

Table 1: Comparison of landslides and landslide frequencies

Terrain Class[1]	Landslide Freq. after timber harvesting[2] (#/ha)	Net Area Harvested[3] (ha)	T.F.L. 38 landslides[4] after timber harvesting	T.F.L. 38 landslide frequency (#/ha)
III	0.02 to 0.10	6,355	19	not applicable
IV	0.10 to 0.50	2639	9	0.0034
V	greater than 0.50	338	7	0.02 [5]

Notes:
1. Terrain Stability Class as mapped by J.M.Ryder and Associates for T.F.L. 38 area.
2. From FPC Guidebook *Mapping and Assessing Terrain Stability*, April 1995.
3. Based on Forest Cover Inventory for net operable area with age less than 31 years.
4. Clearcut related landslides identified in this study.
5. Detailed assessment not carried out for Class V terrain.

4.0 DISCUSSION AND RESULTS

4.1 Discussion

As discussed in Section 1.0, the net down factor for Class IV terrain in T.F.L. 38 has been set previously at 40%. Based on the assessment of landslides in logged terrain, polygons totalling about 5% of the area mapped as Class IV have landslides following harvesting activities. This low landslide frequency with respect to the moderate likelihood of landslides for Class IV terrain can be explained by the "dual" definition of Class IV, which indicates a moderate likelihood of landslides following clearcut harvesting *or* road construction in these polygons. Most of these polygons are likely sufficiently steep to require a geotechnical assessment prior to conventional road construction, and consequently the mapping reflects this requirement under the Forest Practices Code. However, the amount of area likely to be removed from a cutblock for terrain concerns is often small, based on recent terrain assessments of proposed blocks. (Baumann, 1997).

An assessment of existing landslides in logged terrain, described in Section 2 above, indicates that there is a relatively low landslide frequency is present in Class IV terrain in

T.F.L. 38. The frequency of landslides is in the "low" category for the relationship between terrain stability class and likelihood of landslides following harvesting activities, given in Table 1. Further, the landslide frequency observed in T.F.L. 38 following harvesting activities is less than the mean post-logging landslide frequency of 0.08 events/ha, documented for areas on western Vancouver Island and 0.17 events/ha in the Queen Charlotte Islands (Rollerson et al, 1997). In addition, this work documents that a generally low landslide frequency is expected in the T.F.L. given the geology, surficial material materials, and relative stability of unlogged areas. Consequently, the 40% net down factor is judged to be too conservative for Class IV terrain for T.F.L. 38.

An assessment of the unlogged terrain in T.F.L. 38 was carried out to determine whether any differences exist between the unlogged and logged terrain. Surficial materials, textures, surface expresssions, and active geomorphic processes were compared to those mapped in unlogged areas to determine the extent of differences.

4.2 Results

On the basis of the characteristics of low number of landslides in logged terrain, the small unstable polygon area, and the similarity of the logged terrain to the unlogged terrain in T.F.L. 38, it is recommended that the net down for Class IV terrain be reduced from 40% to 10%. The level of 10% accounts for a similar landslide frequency in the unlogged areas as for the logged areas, as well as site specific changes which cannot be mapped at the 1:20,000 scale. This 10% net down will also cover mitigation actions adjacent to snow avalanche areas, such as leaving high stumps in initiation areas, and high stumps/protective buffers in runout areas.

At this time, there is not a basis for decreasing the 90% net down for Class V terrain in T.F.L. 38. Since Class V polygons are typically mapped as terrain which is naturally unstable, or will have a high likelihood of landslide activities following harvesting activities, often these areas are mapped with less ambiguity than for Class IV polygons (Rollerson, 1997).

Further studies on landslides in T.F.L. 38 and nearby areas may provide information which can be used to establish more accurate net down factors for Class IV and Class V terrain. These studies include terrain attribute (landslide prediction) studies carried out by Ministry of Forests, for T.F.L. 38 and the surrounding areas. Detailed geotechnical investigations will also provide additional information to better identify areas prone to landslides or harvesting activities following harvesting and road construction. An audit of post-F.P.C. terrain reports could also provide guidance for setting net down factors for Class IV and Class V terrain. It should also be noted that reclassifying the terrain stability of the mapped polygons in T.F.L. 38 is not practical at this point in time, and would best be undertaken following completion of the terrain attribute studies in the area.

5.0 SUMMARY

Non-road related landslides on logged terrain within T.F.L. 38 have been reviewed to determine whether the 40% net down factor applied in the timber supply review is appropriate. Of the 47 landslides identified, 12 initiated from roads and 35 initiated from clearcut areas. Most of these landslides were found to initiate in Class III terrain. A lesser number initiated in Class IV terrain. Most landslides had a minimal impact on downslope resources, including aquatic habitat and site productivity. Of the logged Class IV terrain, about 5% of the area has exhibited landslide activity following harvesting. The landslide frequency was calculated to be 0.013 events/ha, which is low compared to other areas on western Vancouver Island and the Queen Charlotte Islands.

Geology and terrain attributes in the unlogged portion of T.F.L. 38 is similar to those in the logged portion of the T.F.L. This assessment was made on the basis of the materials, textures, and surface expressions denoted in the terrain mapping. The active geomorphic processes, such as gullying and rockfalls, denoted in the mapping did not have a correlation with observed landslides in logged terrain.

On the basis of the assessment of existing landslides and the surficial geology in the unlogged areas, the expected landslide frequency is expected to be comparable to that in the logged area. Based on the landslide frequency observed in logged areas, a geotechnical assessment of future cutblocks is likely to result in between 5% to 10% of block removed to address stability concerns. As a result of this assessment, it is recommended that the net down factor for Class IV terrain be set at 10%. Is also recommended that the net down factor for Class V terrain remain at 90%, until the completion of more detailed studies and a more detailed assessment can be carried out.

6.0 CLOSURE

The interpretations, assessments, and recommendations made in this report are based on an office review of terrain mapping and terrain stability mapping, as well as recent airphotos, of Tree Farm Licence 38. The assessment of terrain net down factors is an empirical estimate of the operable area which will not be harvested due to terrain stability concerns. The actual amount may vary from the estimate given in this report, since it is dependent on many site specific factors such as the existing stability of the proposed cutblock, as well as the proposed harvesting techniques and road location. It must be noted that some degree of landslide risk is associated with any forest harvesting activities in steep, mountainous terrain.

I trust this letter outlines the development of detailed terrain net down factors for Tree Farm Licence 38. If you have any questions, please contact me at the Vancouver Office.

Yours truly,

INTERNATIONAL FOREST PRODUCTS LIMITED
Forest Resource Advisory Team

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cc: Jim Rodney, R.P.F.
Planning Forester, Empire Logging, Squamish

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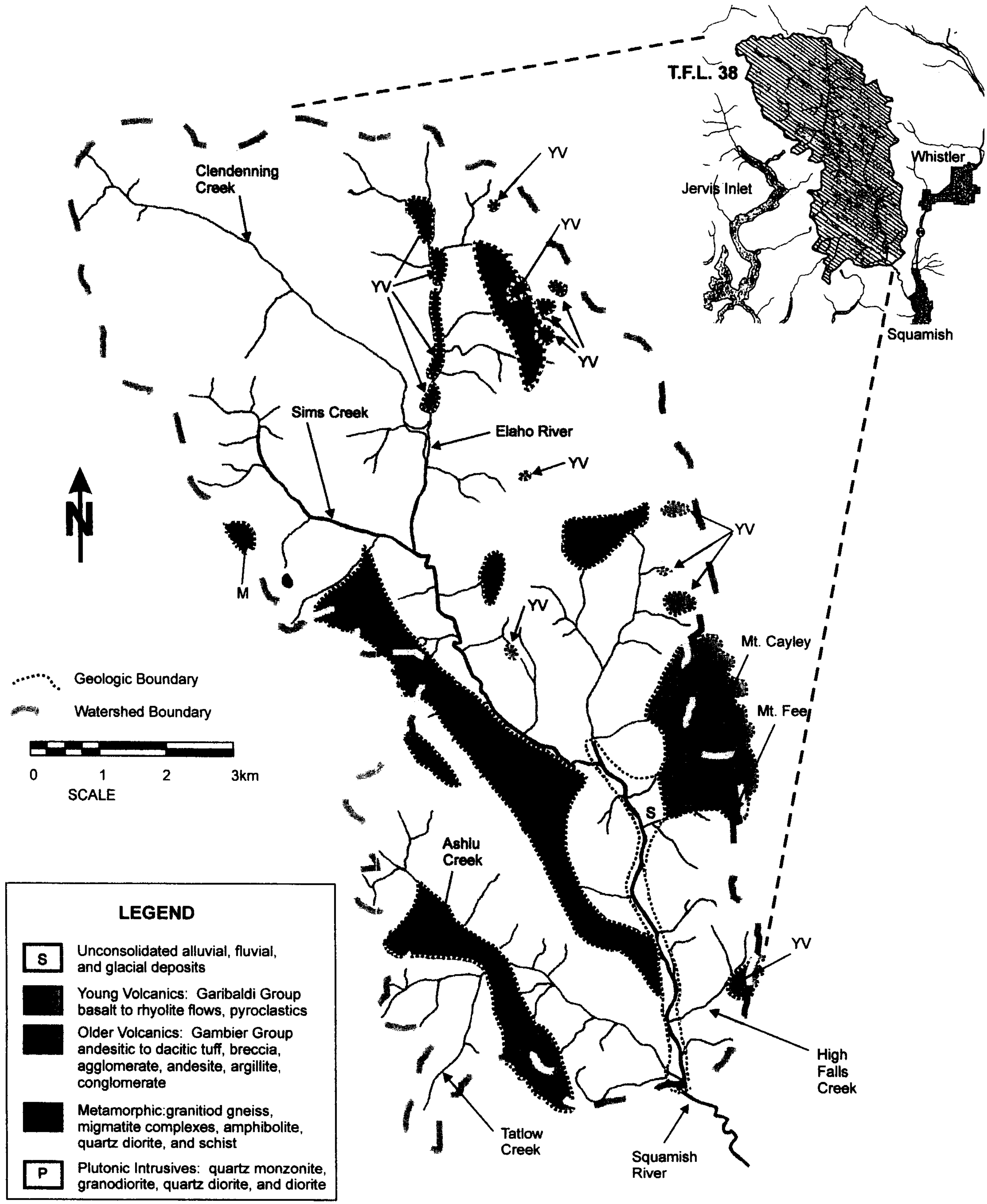

Figure 1: Location and bedrock geology of T.F.L. 38, Squamish

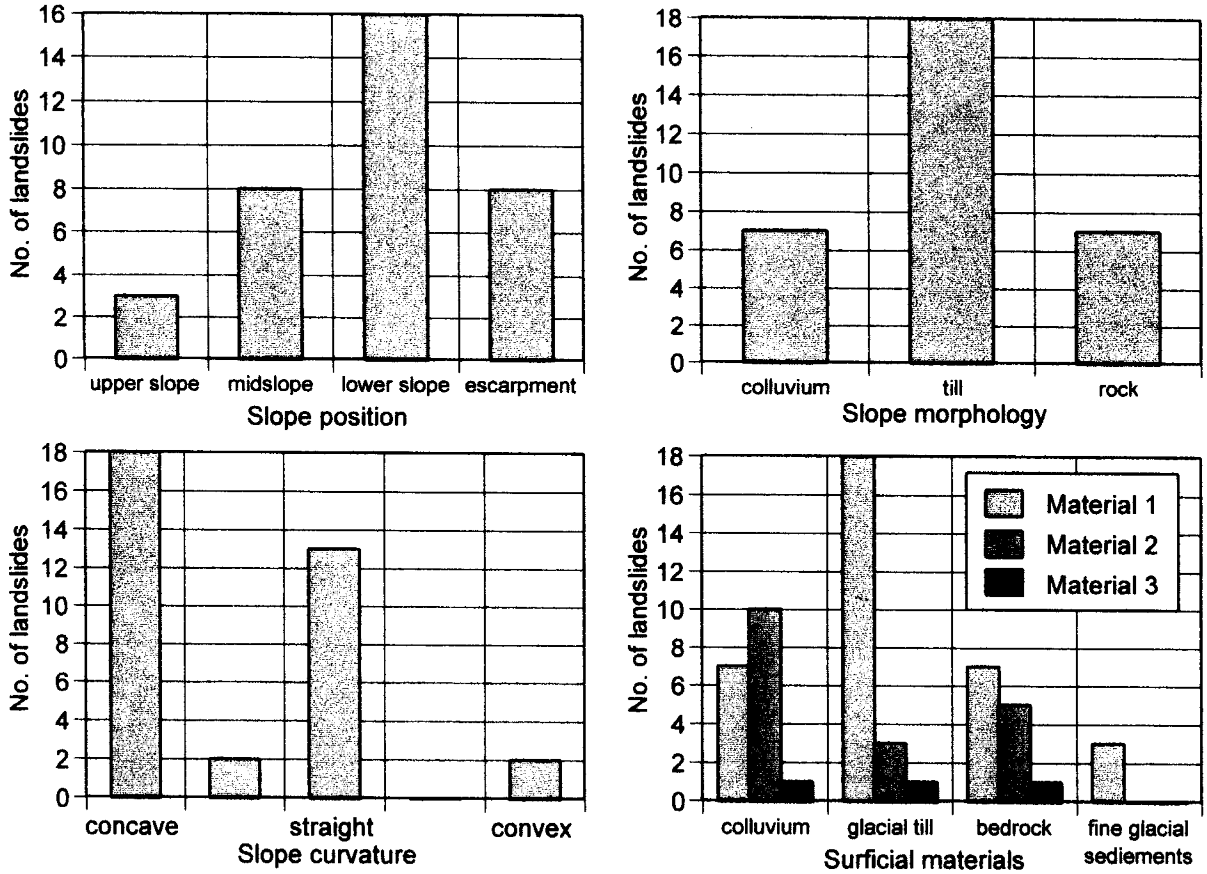

Figure 2: Landslide initiation characteristics for clearcut related landslides, T.F.L. 38.

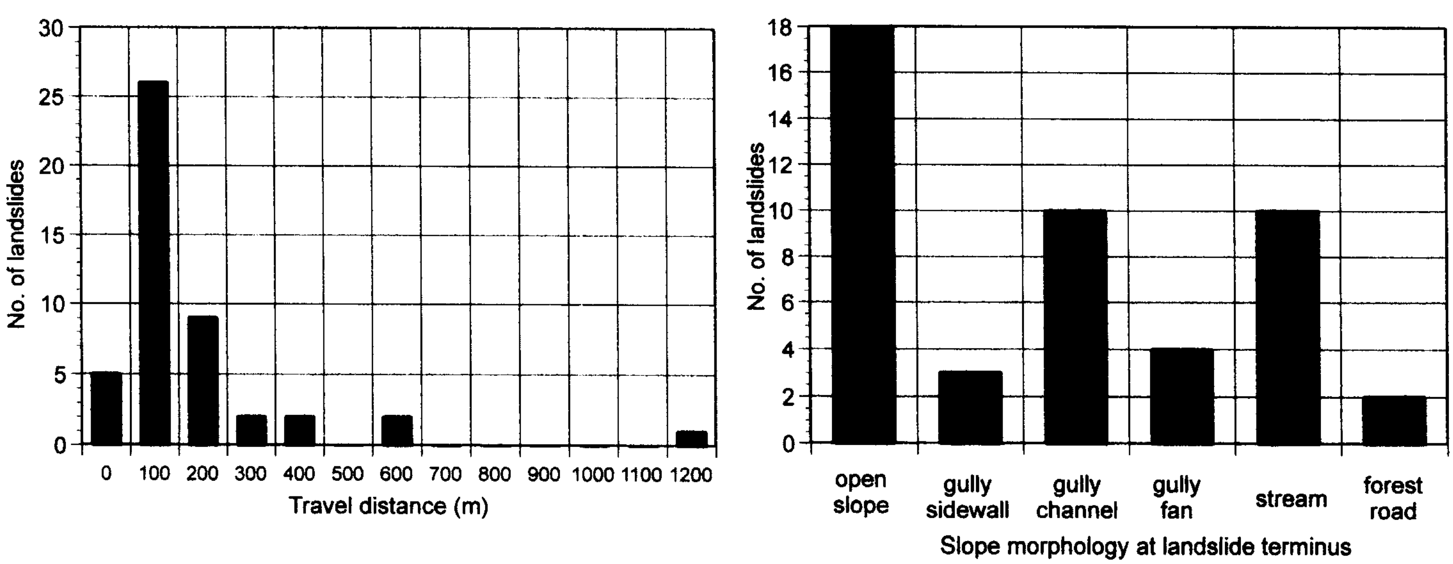

Figure 3: Landslide runout characteristics for clearcut- and road related landslides, T.F.L. 38.

REFERENCES

Baumann, F.W. 1997. Personal Communication.

Jordan, R.P. 1994. Debris flows in the Southern Coast Mountains, British Columbia: Dynamic Behaviour and Physical Properties.

J.M. Ryder and Associates, 1995. **Squamish River Drainage Basin: (TFL 38) Terrain and Slope Stability Mapping for Forest Management.** Report and maps submitted to International Forest Products, June 1995.

Rollerson, T.P. 1997. Personal Communication.

Rollerson, T.P., Thomson, B., and Millard, T.H. 1997. Identification of coastal British Columbia Terrain Susceptible to Debris Flows. Preprint manuscript, Proceedings for the First International Conference Debris-Flow Hazards Mitigation: Mechanics, Prediction, and Assessment. American Society of Civil Engineers, August 7-9, 1997 San Francisco, California.

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May 1, 1997

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RE: TERRAIN NET DOWN FACTORS T.F.L. 38 TIMBER SUPPLY REVIEW

Dear Sir:

Further to your February 4, 1997 letter regarding the proposed methodology for terrain net down assessment in TFL 38, and our meetings on regarding this issue on December 4, 1996 and April 1, 1997 I would like to extend my approval of the method you have chosen to modify the net down factors for the timber supply review.

Based on recent data for the area, the net down factors which are currently used are likely too conservative due to the low landslide frequency observed in logged Class IV/V terrain in TFL 38. I would recommend that you review the criteria used for terrain stability classes in this area, it would appear that they may be too conservative. If this is the case a reinterpretation of the stablity class designations may be in order. The mapping of the operability in the watershed will also likely result in the reduction of the net down factors, since many unstable areas (e.g. snow avalanche tracks) have not been included in the net timber base.

Please contact me if you make changes to your current methodology, so that we can discuss the ramifications of such changes.

Sincerely,

Terry Rollerson, P. Geo.

Research Manager

MAY 6 1997

INTERFOR

Forestry and Logging Group

B.C. SOFTWOOD NATURAL • RENEWABLE

File: 96VA-GTNA001

February 24, 1997

Mr. Terry Rollerson, P.Geo.
Research Manager/Research Geomorphologist
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RE: PROPOSED TIMBER NET DOWN FACTOR VERIFICATION
TIMBER SUPPLY REVIEW, T.F.L. 38, SQUAMISH RIVER WATERSHED
SQUAMISH FOREST DISTRICT

Dear Terry:

This letter outlines the methodology which is proposed to verify terrain net down factors for Class IV and Class V terrain in Tree Farm Licence 38 near Squamish. Revised net down factors are proposed since there is some uncertainty as to whether the established net down factors are applicable to the terrain in T.F.L. 38. Provided that you approve of the proposed methodology described in this letter, revised net down factors will be developed and used in timber supply modelling for the T.F.L. 38 Management Plan.

BACKGROUND

Tree Farm Licence 38 is located in the Squamish River Watershed, north of the town of Squamish. The T.F.L. is bounded to the north by the Clendenning Creek and Elaho River basins, to the west by the Sims Creek and Tatlow Creek basin, and to the east by the Squamish River and High Falls Creek basins, as well as Mt. Cayley and Mt. Fee. The southern boundary of the T.F.L. is located near the confluence of Ashlu Creek and the Squamish River. The approximate boundary of the 218,500 ha T.F.L. is shown in Figure 1.

Topography in the area is typical of the Coast Mountain Range, with steep mountains and active (geologically young) creeks and rivers. Bedrock geology in the area consists of plutonic formations of quartz monzonite, granodiorite, quartz diorite, and diorite which are typical of the Coast Plutonic Complex. Other types of bedrock are also present: these range from formations of young volcanics (Garibaldi Group) near Mt. Cayley to older volcanics (Gambier Group) near Ashlu and Tatlow Creeks. Metamorphic formations, including gneisses and schists, are also present west of the Elaho and Squamish Rivers.

There has been a documented difference in the importance of these different types of bedrock on the runout distance of debris flows in the area (Jordan, 1987). Currently, there is a Terrain Attribute Study being carried out to obtain information regarding landslide occurrence and terrain attributes for several operating areas in the Coast Mountains (Rollerson, 1996).

Terrain mapping and terrain stability mapping has been also been carried out in the watershed as required for forest planning and operations in the area (Ryder, 1995). In conjunction with this terrain stability mapping, terrain default net down factors were chosen for timber supply modelling of the area. These net down factors are 40% for Class IV terrain and 90% for Class V terrain. Based on a preliminary assessment of the Terrain Attribute Data from the area in our December 4, 1996 meeting, these factors are likely too conservative for the terrain in T.F.L. 38 particularly for Class IV terrain.

AVAILABLE INFORMATION

The following information is available for use in determining revised terrain net down factors for T.F.L. 38.

- **Forest Development Plans:** 1:20,000 Maps of Silviculture, Terrain Stability, Engineering
- Ryder, J.M. and Associates, 1995. **Terrain Mapping and Terrain Stability Mapping** at 1:20,000 scale for TFL 38 (1992 airphotos)
- Rollerson, T.P. 1996. (Ministry of Forests with J.M.Ryder and Associates, 1996). **Terrain Attribute Data** (includes terrain mapping at 1:20,000 scale) for the TFL 38 area (1994 airphotos). Data obtained for about 100 polygons mapped and field checked

during 1996 field season.

- Jordan, P. 1987. **Impacts of mass movement events on rivers in the southern Coast Mountains, British Columbia: Summary Report.** Water Resources Branch, Environment Canada.
- Jordan, P. 1994. **Debris flows in the southern Coast Mountians, British Columbia: Dynamic behaviour and physical properties.** Ph.D. thesis, University of British Columbia.
- Roddick, J.A. and Woodsworth, G.J. 1979. **Geology of the West Half of Vancouver Island and mainland part of Alberni** (1:125,000 map).

3.0 PROPOSED METHODOLOGY

Objectives: The landslide occurrence associated with areas within TFL 38 which were logged greater than 5 years ago will be used as a basis for terrain net down factors. However, in many older areas there is only a limited number of landslides associated with logging activities. In these areas, the terrain attributes associated with with landslide non-occurrence will be characterized. These attributes and the post-logging stability will then be extrapolated to Class IV and Class V polygons in a qualitative manner to verify the existing default net down factors or determine more appropriate factors.

Methodology Summary:

1. Overlay forest cover information with Terrain Stability maps, and highlight Class IV and Class V polygons. Areas which were logged greater than 5 years ago will also be highlighted.
2. From most recent set of airphotos, map landslides in all areas which are associated with harvesting activities. Omit any failures which are associated with forestry roads, since the higher standard of design, construction, maintenance, and deactivation under the FPC is likely to minimize/eliminate landslides from roads.
3. Use Terrain Attribute Study data to characterize terrain types where landslides have not occurred greater than 5 years following clearcutting.
4. Catalogue terrain types present in Class IV and Class V polygons based on airphoto

and map information such as natural landslide occurrence, slope morphology, slope, curvature, and bedrock formation. For terrain which is similar to terrain which has been clearcut in the past without causing landslides, a much smaller net down factor is more appropriate. For terrain which is dissimilar to terrain which has been clearcut previously, a qualitative assessment will be made regarding the net down factor for the area. If no justification can be shown for decreasing the net down factor, then the net down will be left at the default value for the polygon.

5. Gully systems will have estimated net down factors in general agreement with the management strategies in of the Gully Assessment Procedure.
6. In avalanche areas, the net down factors applied will consist of 80% to 100% net down in initiation areas (depending on whether high stumps can be used to mitigate snow creep hazards) and partial net down to reflect the required buffers in runout areas. It is noted that there is no FPC guidebook available to document management strategies in avalanche areas.
7. The modified net down factors will be multiplied by the area of each polygon, and the normalized factors will be averaged separately for Class IV and Class V terrain. These averages will then be used in the Timber Supply Review for T.F.L. 38.
8. If modifications to the above procedure are required, the necessary changes will be made in consultation with terrain specialists at the Ministry of Forests, Vancouver Forest Region.

SUMMARY

Based on a preliminary assessment of terrain attribute information in the T.F.L. 38 area, a low rate of landslide occurrence has been observed. It is proposed to verify the default timber net down factors, or determine other values which more accurately reflect observed landslide occurrence in the area, by qualitative assessment of existing landslide occurrence using terrain attribute data and recent air photograph information. This information will be extrapolated to undeveloped areas to determine single net down factors for Class IV and Class V terrain, respectively.

CLOSURE

I trust this letter outlines the methodology for verification of the timber net down factors for TFL 38, and it is consistent with the 1:20,000 overview approach for timber supply modelling. Please forward a letter with any comments you have regarding the proposed methodology, which will be included with the background documentation for the timber supply modelling. In the meantime, if you have any comments or questions, don't hesitate to give me a call at the Vancouver Office.

Yours very truly,

INTERNATIONAL FOREST PRODUCTS LIMITED
Forest Resource Advisory Team

Michael P. Wise, P.Eng.
Geotechnical Engineer

M. P. WISE
MPW
Feb. 24/97

cc: Laszlo Kardos, P.Eng./R.P.F.
Resource Forester, Interfor Vancouver

FOREST RESOURCE ADVISORY TEAM
International Forest Products

Project Name: Terrain Net Down Review / T.F.L. 38
Project Code: 96VA-GTNA001
Date: February 18, 1997

Operation Office: Vancouver
Drawn by: MP Wise
Reviewed by:

Figure 1: T.F.L. 38 BOUNDARY AND BEDROCK GEOLOGY