

Forest Industry Snow Avalanche Hazards in Southeastern B.C.

Lawrence S. Redfern¹

Abstract: Snow avalanche hazards are an issue for the forest industry in southeastern British Columbia; this issue may be of increasing importance in the future as harvesting is located increasingly in potential avalanche terrain. There are no specific requirements to consider avalanche issues in British Columbia's new Forest Practices Code but a number of recent initiatives by both government and industry are aimed at addressing the concerns. The voluntary approach to managing snow avalanche hazards taken by one forest company is discussed.

1.0 Introduction

The objective of this paper is to provide basic information on the state of avalanche issues in the forest industry in the southeastern corner of British Columbia, to describe the avalanche issues faced by forest companies and their possibly unique characteristics, and to describe how one forest company is managing the avalanche hazards in its operating area.

2.0 Background

British Columbia is known for its diversity of terrain and weather. The particular area of the province to be discussed here encompasses the mountain ranges of the Rockies, Selkirks, Purcells, and Monashees. The alpine winter snowpack in this area ranges from just over 1 m in some of the drier areas in the southern Rockies, to 3 m or more in the north Columbia Mountains. While this area is famed for its superb helicopter skiing and backcountry recreational opportunities, it is also the locale of numerous industrial forestry operations. In a provincial forest management context this area is predominantly the Nelson Forest Region.

The forest industry is the leading economic sector in British Columbia providing for nearly 25% of all government revenues in 1996 (Forest Alliance 1998). Provincially, forest industry stumpage revenues to the Crown in 1994 in British Columbia totaled \$1.8 billion on \$14.1 billion worth of wood product exports. Direct employment in the province was estimated at 107,000 in 1993 with direct wages of \$3.5 billion, indirect employment was a further 91,000 jobs meaning provincially

approximately 11% of all jobs are created by industrial forest activity (National Forestry Database 1995).

3.0 Legal environment

In 1995 the provincial government enacted new legislation governing forest practices in an effort to improve the environmental aspects of forest management on public lands. The Forest Practices Code of British Columbia includes an Act, eighteen Regulations, and numerous Guidebooks which provide management direction and specify planning information requirements on nearly all aspects of forest management in the province. One aspect of forest management that is not specifically addressed in the FPC (Forest Practices Code) is the issue of snow avalanches and forest management. The FPC contains non-specific requirements in that development plans must provide for the adequate management and conservation of forest resources prior to approval by the District Manager. There is also requirement for persons carrying out forest practices not to allow damage to the environment to occur as a result of the forest practice either directly or indirectly.

In British Columbia the Association of British Columbia Professional Foresters has the mandate to protect society's interest in the management of forest lands. To this end a Registered Professional Forester's approval is required for the approval of some management plans. Professional Foresters in the province are governed by a code of ethics that requires its members to manage the forest

¹ Crestbrook Forest Industries Ltd., Box 4600, Cranbrook, British Columbia, Canada, V1C 4J7

to sustain its ability to provide those values assigned by society, to advocate good stewardship of forest land, and to speak out against practices that are detrimental to the good stewardship of forest land. The education of foresters regarding snow avalanche risks and issues should, over time, promote the comprehensive management of snow avalanche hazards in industrial forestry activities.

There is in the forest industry safety regulations with respect to snow avalanche hazards. The new Occupational Health and Safety Regulation (1998) enacted by the provincial government this spring states in section 26.18:

In a forestry operation where there may be a risk of a landslide or avalanche

- a) *the risk must be assessed in accordance with a standard acceptable to the board,*
- b) *if a risk is found to be present, written safe work procedures must be developed meeting the requirements of the standard, and*
- c) *workers must be educated in safe work procedures.*

This new safety regulation will provide impetus to ensure snow avalanche safety issues are considered in industrial forestry operations. However, it does not address the issue of potential environmental damage and resource losses that may result from snow avalanches initiating in new cutblock areas.

4.0 Recent initiatives

In recognition of the knowledge gap pertaining to snow avalanche hazards and forest management, the B.C. Ministry of Forests had a comprehensive literature review on the subject of snow avalanche hazard in forest management completed, convened a one-day technical workshop with interested parties to discuss the problem and state of knowledge, and had the results of the review and workshop compiled and published (Jamieson *et. al.* 1996). One of the stated longer term objectives at the time was preparation of a FPC Guidebook for snow avalanche hazard assessment. While a FPC Guidebook has not been written the Ministry of Forests have promoted and/or required assessments of

avalanche hazards as part of the planning process in one forest district.

The Regional Geomorphologist for the Nelson Forest Region (the southeastern corner of British Columbia) has suggested that assessment of the potential to create a snow avalanche starting zone in cutblocks be completed as part of the regular planning process when cutblocks are steeper than 60% and with expected snowpacks of 1 m or more. While it was recognized that there is limited information upon which such assessments could be made it was suggested that a team of a professional forester and a professional member of the Canadian Avalanche Association, both with local knowledge of the area, be employed to estimate risk and suggest possible mitigative measures (Jordan 1996, P. Jordan, pers. com.²).

In the Columbia Forest District (which includes the area around the communities of Revelstoke and Golden) the District Manger requires all cutblocks be reviewed for avalanche hazards prior to the Forest Development Plan public review stage by a professional member of the Canadian Avalanche Association. Following the overview (office) assessment those blocks which are felt to have a moderate to very high hazard rating have a detailed field assessment of the cutblock and hazard are completed. If the hazards are still felt to be high mitigative measures such as boundary relocation or high stump fields may be employed. The Columbia Forest District is the only forest district in the Nelson Region with such a requirement. The impetus to create the requirement came from destructive avalanches which initiated in cutblocks up Nagle Creek (Bay 1996) and Akolkolex River (Lavelle 1996) in the Columbia Forest District and in Airy Creek in the Arrow Forest District immediately to the south (Jordan 1994). At least one licensee outside of the Columbia Forest District has begun doing assessments of avalanche hazards on suspect cutblocks of their own accord (Statham 1998), and are investigating use of developed GIS pre-screening tools as an

² Peter Jordan, personal communication, January 1998. Suggested revisions to the Mapping and Assessing Terrain Stability Guidebook.

efficient means of completing initial overview assessments for cutblocks where avalanche hazards might exist.

5.0 A Forest industry perspective

Winter is an optimum time for the harvest of timber in this region. Operation closures due to spring break up, fire hazards, or wet weather that might cause environmental concerns, are not an issue. Historically the winter has been viewed by licensees and logging contractors as a time when harvesting could occur as scheduled and without interruption. Logging work windows have steadily narrowed to the point where only 150 to 160 days of work might be available, and while work windows have decreased, fixed costs in this capital-intensive industry continue to increase. In the past, timber harvesting in the mountainous areas has tended to be on the lower angle valley bottom slopes at lower elevations. As technology permitted, and timber supply constraints demanded, the harvesting has crept up the valley sides to the point today where all merchantable and accessible wood between the valley bottom and the sub-alpine is scheduled into development plans.

In the course of preparing this paper a survey of major licensees operating in potential avalanche terrain in the Nelson Forest Region was completed. The goal was to obtain a rough, but up-to-date picture of snow avalanche hazard awareness, and specific operational policies and procedures that may have been implemented to deal with the issue. The summaries below are based on ten major licensees that operate in potential avalanche terrain. Two major licensees were not contacted during the survey.

Out of the ten licensees surveyed four had established snow safety programs. These programs included: the maintenance of weather stations, the use of qualified individuals to complete snow stability assessments in their operating area throughout the winter, training of staff - and sometimes contractors - on basic safety procedures, development of specific safe work procedures when crews faced known hazards, provision of avalanche rescue safety equipment, and employment of active control

to reduce hazard and ensure the safety of crews. Two other licensees had utilized avalanche professionals on an as needed basis for assessment and control work, but had engaged in no formal training of staff or logging contractors. The remaining four licensees had not utilized any professional avalanche expertise and generally viewed their exposure to avalanche hazards to be very low.

With the exception of the three events previously mentioned none of the licensees were aware of any damage to forest resource values having occurred as a result of avalanches initiating in cut blocks, although five of the ten were aware of avalanche events that had occurred in their cutblocks. With the exception of two of the three previously mentioned incidents, only one minor incident was reported where there was damage to commercially valuable trees outside of the avalanching cutblock; in this case a small area of a plantation received some damage to regenerating trees. There were no reported concerns of damage to trees growing in cutblocks where avalanches were known to have occurred.

There were also some other issues for the industry revealed in the survey. Two licensees were unaware of there being any avalanche hazard from cutblocks indicating a real need for some improved awareness of the hazards in at least some areas of the industry. This was in stark contrast with one licensee who felt their biggest avalanche problems were with cutblocks (blocking roads and stopping work in other safe to operate areas).

None of the licensees (of those who had experience with them) had much faith that the mitigative measures prescribed by CAA professionals would result in elimination of the type of large and environmentally-damaging avalanche events that initially triggered the assessment requirement by the government in the first place. There was considerable frustration at the cost of the assessments, their impracticality, the lack of forestry knowledge by the people completing the assessments, and the lack of any real problem to address. All licensees felt the decision to require an assessment should be left to the discretion of the professional forester approving the plans;

a number agreed however, that their own professional foresters may not have the necessary skills and experience to accurately make such determinations. One licensee pointed out that their most serious involvement - which saw a person buried inside of their excavator (and safely recovered) - was below a low angle cutblock that, in their view, would not have been viewed a high risk cutblock by a CAA professional.

6.0 A case study: Crestbrook Forest Industries Ltd.

Crestbrook Forest Industries Ltd. is a medium-sized forest products company based in Cranbrook, British Columbia. Crestbrook's operating area extends from the United States border at the south and the Alberta border on the east, north to the southern edge of Glacier National Park and west to the height of the Purcell Mountains. Crestbrook operates two sawmills and one pulp mill and harvests approximately 1.3 million cubic metres of wood annually from 1.5 million hectares of crown land and 107,000 hectares of privately-owned managed forest. Of the approximately 5,000 ha total harvest area in 1997 about 25% was harvested using helicopter and cable systems due to ground steepness and equipment access restrictions. An in-house GIS estimate of operable ground with slopes over 60% found that 22% of Crestbrook's operating area would likely fall into this category.

6.1 The snow safety program

This winter will be Crestbrook's third winter with a formal Snow Safety Program in place; prior to this Crestbrook utilized professional members of the Canadian Avalanche Association on an as-needed basis. The Snow Safety Program was implemented in recognition of the increasing safety hazard to logging contractors and staff that logging at higher elevations on steeper ground in the winter presented. The program has three main thrusts: training of contractors and staff, monitoring of snow pack and assessment of stability, and active control when necessary. Crestbrook has also established formal rescue protocols for avalanche incidents, and completed an extensive signing program on all its roads; development of an avalanche atlas for all areas where avalanches may effect

roads is ongoing. Crestbrook recently became involved in a jointly funded NSERC/ FRBC/ CMH research project which will provide much needed information and direction on improving snow avalanche hazard management in industrial forestry operations.

6.1.1 Training

Training has been provided to over 100 individuals the past two winters. Attendance at training sessions has varied from excellent to very poor depending on the local logging contractors perception of their exposure. To date, luckily, the "wake up calls" have not resulted in any injuries, and only a few minor involvements. As all logging contractors operate independently from Crestbrook, there has been no clear Workers Compensation Board requirement for training, and as the recently-enacted British Columbia FPC has created a surge in required training, Crestbrook has only so far *offered* logging contractors avalanche safety training and has not required it. This winter Crestbrook may *require* a certain number of individuals on each logging crew to have completed a snow safety training day. (All logging crews clearly exposed to an avalanche hazard have received specific safety training.) Logging crew personnel typically changes over the course of the winter and Crestbrook has observed situations where crews have started working a block with three trained people on board, but may have as few as one on a given day. It is hoped that a requirement for a minimum number of trained people will lead to nearly all crew members that start the winter receiving training. Crestbrook intends to continue offering training to its staff and contractors annually, and at no charge.

The past two winters Crestbrook's training sessions have been conducted by an experienced and professional member of the CAA (Canadian Avalanche Association). The one day courses have introduced attendees to the various avalanche types and their characteristics, basic avalanche terrain, basics of avalanche formation, and basic safety measures. All courses have finished with "parking lot" practice sessions with transceivers and probes. The hope that attendees would then have the necessary

skills to practice on their own, and would do so, has clearly not been fulfilled.

Self-rescue is critical as most winter operations are over an hour from any outside rescue opportunity. In fact logging crews are often more than 15 minutes from each other and some members of the crew - hooking chokers, for example - may be 10 minutes from their own work base. The need for as many people as possible to be familiar with and practiced in self-rescue techniques is obvious. Crestbrook's 1998-99 training sessions will emphasize the safe work procedures and self-rescue techniques necessary, and will strive to provide a more realistic rescue practice scenario.

In order to ensure contractors have easy access to all necessary safety equipment Crestbrook has added the snow avalanche equipment to its safety store inventory. To date 44 collapsible probes and 36 transceivers have been purchased. In addition Crestbrook provides fixed-length probe caches at all winter operations with hazards, and has established roadside probe caches at regular intervals along all its winter-maintained roads. Crestbrook also has a number of transceivers available for short-term loan to its logging contractor and road maintenance staff, and for the use of its own staff.

6.1.2 Hazard monitoring

Crestbrook monitors snow avalanche hazards throughout its operating area 5 to 7 days a week through the winter, depending on exposure and hazard trend. Remote manual weather stations, daily field snow pack evaluations, and CAA InfoEx information form the basis of the hazard forecasts which are communicated at least twice weekly to all of Crestbrook's Woodlands offices. Local staff and contractor observations, and British Columbia Ministry of Highways and Ministry of Environment information on weather and snow pack (available over the Internet) is also utilized.

Out of the approximately 22,000 km of access roads within Crestbrook's operating area roughly 1% will be maintained over winter in any given year where avalanche hazards may exist. Each year the physical location of the

maintained roads and the cut blocks they access changes making establishment of permanent "indicator" weather stations and snow pack study plots difficult. Last year one weather station was established that will have permanent and dependable winter access; the intention is to allow the other stations to float as the movement of operations dictates. Field observations are made by an individual trained and experienced in avalanche safety who is a member of Crestbrook's staff. This individual is responsible for the entire snow safety program at Crestbrook. This person has attended and successfully completed the Canadian Avalanche Association's Ski Operations Level 1, and Transportation and Industry Avalanche Safety Level 1 courses, and has been active in backcountry recreation for over a decade; they are not however a full professional member of the Canadian Avalanche Association. The past two winters the daily observations and hazard forecasts of the staff member have been supplemented and checked by monthly visits from a full professional member of the CAA.

Field observations have been made with two general goals: to obtain a feel for regional snow pack conditions and aid in the development of area hazard forecasts, and to assess the snow stability of specific slopes - typically cutblocks - for determination of worker safety margins below the slope. Although fairly extensive, our operations are limited to forested areas; access to tree line and alpine snow packs requires extensive foot traversing. This restricted access limits the number of observations that can be made. Over the past two winters we have located a few locations where snow machine access is good and where observations are possible for multiple aspects and over a range of elevations.

Site specific assessment of snow stability has presented a considerable challenge to Crestbrook's snow safety program. The vast majority of these assessments are being made on logging cutblocks that have either been recently cut (past 5 years), or are being actively harvested. As these areas quite typically have no similar slope, aspect and elevation openings against which to compare, and sometimes no other openings in the entire valley, assessments are

being made without any Class I data from reasonably representative areas. These areas also often present the greatest threat to people who may be exposed on foot below these slopes for considerable periods each day.

Where specific hazards to workers are identified Crestbrook has developed site-specific safe work procedures which are implemented as the avalanche hazard changes. Crude weather stations have been established as close to the potential avalanche slope as can be safely and easily visited, and daily observations are recorded for Crestbrook's snow safety staff member. To date active control has only been applied to natural paths that ran over roads or into the top of a cut block area (Figure 1); no control measures within a cutblock have been attempted yet.

heli-bombing missions were successful in that they reduced hazard, ensured worker safety, and facilitated a relatively quick and organized clearing of affected roads. On one occasion a decision not to heli-bomb left logging crews waiting for almost two weeks while a single piece of equipment cleared a number of up to size 3.5 avalanches that had blocked the road. With a planned and controlled release by explosives equipment could have been in position to quickly clear the road, and logging crew down time reduced to a few days.

Access to personnel trained and qualified to conduct explosive control has hampered Crestbrook's ability to use this tool. During windows of opportunity the few local qualified individuals are typically already busy bombing elsewhere. Training opportunities are limited



Figure 1. Explosive control was twice employed to reduce hazards to logging contractors active in this cutblock. Triggered avalanches ran approximately 100 m into block and crossed three skid trails.

6.1.3 Control measures

In the past two winters Crestbrook has engaged in active control measures. These

for heli-bombing, though Crestbrook is encouraged by recent suggestions that the CAA may offer training in this area

(Boissonneault 1998). Access to qualified heli-bombers and hand-bombers will enable Crestbrook to better manage the avalanche hazards its staff and contractors face, and to gain efficiencies in winter road maintenance operations.

The possibility of employing static controls on specific cutblocks that may pose a danger to public safety, or where chronic avalanching was frustrating regeneration efforts, is being considered. At this time it appears that public safety concerns are better addressed by signing areas, active continuous monitoring, and explosive control, as necessary. No silviculture concerns have yet been documented in Crestbrook's operating area that would suggest the use of static controls are needed to allow regeneration to get established. The possibility of using high stumps, with or without logs positioned across slope during harvesting, may be one feasible static control method in smaller specific start zone areas if the consequences of an avalanche are deemed high. Cutblock orientation and design modifications may also be operationally feasible if specific requirements for hazard mitigation could be developed.

7.0 Summary

Snow avalanche safety is currently a consideration for many forest licensees operating in the southeast corner of British Columbia. The extent of the avalanche hazard in the forest industry may be increasing as technological advances and the need for balanced harvest of the total timber profile leads to an increase in harvest levels on steeper, high elevation slopes. The forest industry is a critical economic engine for the province of British Columbia and the need for quantification of the avalanche hazard in the industry and for the development of tools to deal with it is clear.

There is sufficient environmental regulation in place to require forest industry licensees to consider and manage for avalanche hazards. In the long term the most efficient way to ensure avalanche hazards are adequately considered will be through education of the professional forester community working in avalanche terrain. The professional foresters, whose mandate is to practice good

stewardship of forest lands, would then be most able to efficiently utilize the expertise of the professional avalanche community in developing and modifying management plans. Government requirements, currently applied unevenly across jurisdictions, for blanket assessments of cutblocks based on vague screening criteria and at significant cost and perceived limited benefit, is unsatisfactory to the industry.

The forest industry is perhaps unique in the avalanche hazards it faces and in its ability to effectively deal with them. As operations are typically located in a valley for only a year or two every twenty or so years there is limited opportunity to get to know your avalanche paths and how they will react given baseline weather and snow stability information. Many of the potential avalanche slopes are cutblocks with no history of avalanches at all. This creates difficulties with determining the likelihood of a natural avalanche from the block, and more importantly in instilling an awareness and respect among workers of the potential dangers. Finally, the forest industry workforce is somewhat transient which creates an annual need for training of otherwise disinterested individuals on the hazards of, and in the necessary skills needed for, working in avalanche terrain.

Snow avalanche safety issues are also dealt with in regulation, however many aspects of the safety question can only be dealt with by the logging crews themselves. As with other segments of society that have had to come to grips with operating in avalanche country, the logging community will necessarily go through a period of growth of knowledge and skills until they are adequately prepared to operate with an appropriate margin of safety in avalanche terrain. Both the forest industry and snow avalanche professionals have an important role to play in achieving this critical goal. The forest industry licensees must work to ensure provision of effective training, and must ensure safe work procedures are developed and followed. The professional avalanche community must design and deliver these training sessions in an effective and meaningful manner, and develop - in conjunction with licensees - the necessary safe work procedures. Only through a strong

cooperative effort will be the ultimate goal of widespread avalanche hazard safety be achieved in the forest industry.

Bibliography

Bay, J. 1996. Nagle Creek Avalanche Report. Stellar Consulting Services Ltd., Revelstoke, B.C. 11pp.

Boissonneault, M. 1998. Fuse News *in* Avalanche News, Summer 1998, Volume 55. Canadian Avalanche Association, Revelstoke, Canada. pp. 28-30.

Jamieson, B., P. Schaerer, and C. Stethem. 1996. Snow Avalanche Hazard in Forest Management. A report prepared for the BC Ministry of Forests by Chris Stethem and Associates Ltd., Canmore, Canada. 49 pp.

Jordan, P. 1996. Nelson Forest Region, Interim Guidebook Supplement, 1996: A User's Guide to Terrain Stability Mapping and Terrain Assessments. Nelson Forest Region, Nelson, B.C. 48 pp.

Lavelle, K. Avalanche Event - Opening 82K091-11, Incident Report. Revelstoke Forest District, Revelstoke, B.C. 3 pp.

Statham, G. 1998. Avalanche considerations relating to past, present and future harvesting: CP 119 - Blocks 42 & 43, Fenwick Creek. A report for Crestbrook Forest Industries Ltd., Cranbrook, B.C. 8 pp.

Workers Compensation Board of British Columbia. 1998. Occupational Health and Safety Regulation, BC Regulation 296/97. Workers Compensation Board, Vancouver, B.C.