

VISITOR RISK MANAGEMENT APPLIED TO AVALANCHES IN NEW ZEALAND

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ABSTRACT: The Department of Conservation (DOC) manages a third of the land in New Zealand. This is also where the majority of avalanches occur. Many huts, tracks and popular recreational areas are in avalanche terrain. In 2009 DOC finalised a visitor risk management policy that included six underlying principles for managing risk to visitors. In summary they are: The Department will; preserve the range of recreation experiences, facilities are safely situated in accordance with the predominant visitor group and the Department will provide appropriate information about hazards. Visitors will; be responsible for the decision they make and be responsible for their own skills and competence. Concessionaires (tour operators) will be responsible for the safety of their clients.

DOC applies a range of avalanche risk mitigations to the six visitor groups it uses to classify visitors to land managed by the Department. This forms a continuum with a high level of care for the accessible front country through to minimal input for the remotest part of backcountry.

This paper will show how avalanche risk management is integrated with DOC's visitor risk management policy and system to manage visitor risk. Avalanche risk mitigations include avalanche path mapping of huts. The introduction of the Canadian Avalanche Terrain Exposure Scale (ATES) for the backcountry and the application of site management using an avalanche hazard index for high use places where there are users with limited avalanche knowledge. In partnership with the Mountain Safety Council DOC assists with a number of avalanche hazard advisories.

1. INTRODUCTION

The Department of Conservation (DOC) is the government department that manages the national parks and land protected for its conservation values in New Zealand. This is over one third of New Zealand and includes the majority of the avalanche terrain in the country. There are many walking tracks, huts and popular recreation areas that have avalanche risks.

Avalanche risk to visitors has been managed for some time through a range of measures such as applying avalanche hazard indices and associated mitigation measures to popular walks such as the Milford Track. Some other sites had signs at obvious avalanche paths. While this provided a high degree of management to a number of the main sites there was uneven application of visitor risk measures around the country. Visitors would have no way of knowing whether avalanche risks had been identified and managed or whether they had not been identified. It depended to a large

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extent on how staff at different places perceived the risk.

In 2009 DOC produced a policy on managing visitor risk and an accompanying set of standard operating procedures (SOP) on how to apply the principles in the policy. The underlying risk assessment model is based on the joint Australia/New Zealand Standard for risk management ISO 31000:2009 based on the original AS/NZS 4360 Standard. The SOP identifies all the main hazards to visitors using DOC managed land and includes a section on managing avalanche risk to visitors. The full range of avalanche risk measures should be in place nationally for the 2011 winter.

2. POLICY

The policy of DOC is to:-

- undertake visitor management in accordance with the principles outlined below and the relevant legislation, policies, plans and standards that govern the Department
- apply the principles below in a consistent manner to the Department's visitor management work.

3. PRINCIPLES

- 1 The Department will aim, as far as possible, to preserve the range of outdoor recreation experiences sought by visitors.
- 2 The Department will ensure all its legal obligations are met for the facilities it manages and all practicable steps are taken to ensure these facilities are safely situated in accordance with the predominant Visitor Group.
- 3 The Department will where possible inform visitors of hazards and the risks they present, and the level of skill and competence required to cope with these risks commensurate with the predominant Visitor Group.
- 4 Visitors are responsible for decisions regarding the risks they take and for any others under their care and responsibility.
- 5 Visitors are responsible for the skills, competence, and equipment they require to manage the hazards present.
- 6 Concessionaires will be responsible for the safety needs of their clients

4. COMMENT ON PRINCIPLES

There are a number comments associated with the principles that are applicable to the management of avalanche risks. They are:-

The management practices at each site will match the needs of the visitors using those sites. Visitor needs will be periodically assessed via visitor monitoring. The positive aspects of on site risks (e.g. challenge) will be actively preserved according to visitor group needs. There is a continuum of likely risk and associated risk management based on the predominant visitor group; Frontcountry (accessible) sites (short stop traveller, day visitor and overnights) have less risk to visitors, as the risks that may be present are actively managed. The risks present increase in the backcountry (remote) sites for backcountry comfort seeker, and backcountry adventurer visitor groups. Remoteness seeker sites have little active risk management and visitors are expected to be highly capable of looking after themselves. The Department will take all practicable steps to

identify and document hazards appropriate to the visitor group setting.

The Department will work with others to provide information for visitors about hazards and how to deal with them. The Department will communicate this information via the website, publications, visitor centres, signs, editorial and other media. The Department will communicate hazard and safety information in a consistent manner. Website information will be consistent with other visitor information.

The Department will periodically test the effectiveness of hazard information with visitors. The Department will take all practicable steps to identify and where appropriate manage hazards. It will inform visitors about these hazards and the associated risk present in the areas it manages in accordance with the predominant visitor group. All concessionaires operating on land managed by the Department have a safety requirement included as part of their concession conditions which describes their responsibility for the safety of their clients.

5. RANGE OF VISITOR GROUPS

DOC splits visitors into the following visitor groups, in order from those with the most outdoor experience to those with the least they are: Remoteness seeker (RS), backcountry adventurer (BCA), backcountry comfort seekers (BCC), overnights (ON), day visitor (DV) and short stop traveller (SST). Overnights is camping at road end campgrounds. Overnights, day visitor and short stop traveller are regarded as front country users who use accessible sites and generally have limited outdoors risk mitigation skills. They do not expect to encounter life threatening risks when doing their activities. Remoteness seeker and backcountry adventurer are regarded as backcountry users who generally have reasonable outdoors risk mitigation skills. They are expected to understand that risks are present and that they have to take actions to mitigate them. Backcountry comfort seeker users while staying overnights in huts with a higher level of service do so on walks where the tracks are of high quality. They generally have more outdoor risk awareness than front country users, but the skill level is still not high. They do not expect to have to make serious risk mitigation decisions.

All campsites, tracks, routes and huts that the Department manages are assigned a visitor group

type based on the main type of use a site gets. They have service standards specific to that visitor group. Standards go from very high for short stop travellers tracks which are smooth under foot, where guardrails exist next to any drops and all waterways are bridged, through to remoteness seeker routes where there may be no track formation and few if any watercourses are bridged.

6. APPLYING THE PRINCIPLES

In applying the principles to avalanche risk the concept of having a continuum from high care, including closures, active controls and a lot of information for the lower skilled users of the accessible frontcountry, through to only minimal information for the remoter parts of the backcountry was adopted. For the majority of sites providing information so the visitor can make their own decision is the main form of mitigation.

User group	Mitigations
SST, DV, ON, BCC tracks 2WD roads	Avalanche path mapping and avalanche hazard index (AHI) Move tracks out of avalanche paths if possible Applying outcomes of AHI scores:- - Signs at paths - Temporary closures - Active control Information at track ends, huts, visitor centres, website and publications Avalanche hazard advisories where practical
BCC huts	Avalanche assessment and path mapping of hut sites Move huts if high risk Seasonal and temporary closures if moderate risk Provide information to users if low risk
BCA, RS tracks 4WD roads	Avalanche Terrain Exposure Scale (ATES) Signs at high use roadends but not on individual paths ATES information in visitor centres, publications and website Avalanche hazard advisories for

	high use areas where practical
BCA huts	Avalanche assessment and path mapping of hut sites Move huts or seasonal closure of high risk huts Provide information to users if moderate or low risk Build any replacement huts as huts need replacing in safer sites

7. USING THE TOOLS

Part of applying the visitor risk management SOP has been a complete analysis of all risks to visitors on all sites managed by the Department. If avalanche risks are identified then the mitigations in the table in section 6 are applied. The initial avalanche assessment as part of the wider risk management process had a very low threshold for being rated as avalanche risk. If there was likely to be seasonal snow or glaciers on or near the site then it went to the next step of doing an AHI or ATES assessment depending on the visitor category.

Prior to the introduction of the visitor risk management policy the majority of the high risk BCC and DV tracks had been mapped for avalanche paths and had AHI assessments applied to them. Some BCA tracks had their most obvious avalanche paths marked and the majority of huts had been assessed for avalanche risk. There was however no nationally consistent guidance on how and when to mark avalanche hazards or on how much information to give where. It had been left up to local managers in DOC's 50 Area offices to make risk management decisions. This meant in places where the hazards were obvious and or people had an interest in avalanche issues there had been a considerable amount of effort put into risk management. In other places not as much had been done. From a visitors perspective they might go to a site in one place where there was a reasonable amount of avalanche risk but no mitigations. Then go to a less risky site elsewhere where there were avalanche risk mitigations.

By applying the mitigations outlined DOC will be consistent in its risk management and visitors will get more consistent information and will be able to make choices based on their skill level and experience.

7.1 Avalanche hazard index

The avalanche hazard index was originally developed in North America in 1974 for the British Columbia Ministry of Highways. The method was first applied in New Zealand to the Milford Road by Fitzharris and Owens in 1980. In 1985 the method was modified for use on a walking track and applied to the Milford Track, Fitzharris and Owens (1985). The AHI as shown here is directly from the work done by Fitzharris and Owens. It has been applied to a number of DOC's BCC and DV sites. (See sites and scores below) This is now going to be used on all DOC's BCC and DV tracks and low use 2wd roads. Higher use roads need to have a full roading formula applied as the majority of the score on a road assessment comes from vehicle waiting time.

For each path, the probability of an encounter between a track walker and an avalanche in motion is:

$$P_x = \frac{t_e}{t_x} \times \frac{1}{f_x} \times W \quad [1]$$

Where:

- P_x = probability of an encounter per person in the period (x)
- t_e = time the walker is exposed to the potential avalanche. This is normally the time it takes to walk across the avalanche path, but may take into account additional time to visit some interesting natural feature or to admire the view.
- t_x = time period (x) for which the hazard index is to be calculated.
- f_x = frequency of avalanches in the period (x)
- W = a weighting factor to represent the relative cost and consequences that would result from an accident involving an avalanche.

The Hazard Index for each period (x) is the sum of P_x for all paths, multiplied by the number of walkers in the period.

Hazard level	Score	Mitigation
Low hazard	Less than 1	Use signs to give advice and to show where the avalanche paths are. No other response is needed.
Moderate hazard	1 to 10	Use of signs. Some monitoring of conditions and occasional closures or advice not to use the track

High hazard	10 to 100	Formal monitoring programme. Some active avalanche control at selected sites could be used, occasional closures.
Very High hazard	Greater than 100	Full avalanche control programme and frequent closures.

Current hazard index scores for a selection of BCC and DV sites:-

Milford Track	43
Routeburn Track	68
Hooker Valley	3.7
Ball Hut Road	0.3
St James Walkway	0.1

The high scores for the Milford and Routeburn tracks are mainly due to the high use the tracks receive in spring when the commercial walking season starts and avalanche activity is still present. The winter period has a low score. Both tracks have monitoring programmes, temporary closures and some active avalanche control work applied to them during the track walking season. During the low use winter period when the AHI scores are low no active measures or closures are applied but there are signs marking all avalanche paths.

The Hooker Valley is subject to occasional closures. The majority of its score is generated by the track ending in an avalanche path with a 10 year return period. Plans are underway to reroute the track and create a new end point out of the avalanche path.

7.2 Avalanche Terrain Exposure Scale

For BCA and RS sites and for popular places away from DOC track facilities DOC and the Mountain Safety Council have decided to adopt the avalanche terrain exposure scale (ATES) as the New Zealand system for classifying avalanche terrain. ATES was developed in Canada by Parks Canada and the Canadian Avalanche Association. Statham (2006). In adopting the system in New Zealand some minor changes were needed to the wording of how much experience is required in order to fit the avalanche courses available in New Zealand. The public model and the underlying technical model were kept the same to ensure consistency of approach.

The ATES system produces three classes of avalanche terrain:-

1. Class one, Simple
2. Class two, Challenging
3. Class three, Complex

Visitors need limited avalanche skills in simple terrain, good avalanche skills in challenging terrain and very well developed skills in complex terrain. A soft launch of the system has occurred for the winter of 2010 with the system having been applied to Aoraki Mount Cook National Park and surrounding terrain. <http://www.doc.govt.nz/parks-and-recreation/plan-and-prepare/safety/be-avalanche-alert/> For the winter of 2011 both the Mountain Safety Council and DOC will be promoting the system to backcountry users. DOC is planning on classifying the majority of its BCA and RS sites by then and it is hoped that a large amount of the terrain surrounding ski areas and other off track popular winter use places will also be classified for the 2011 winter.

7.3 *Hut inspections system*

Over the years at least 8 huts have been destroyed or been damaged by avalanches. Up until 1995 this seemed to have been accepted as just another hazard that occurs in the mountains like flooding, debris flows and rockfall. In 1995 when a viewing platform collapsed and killed 14 people DOC started a programme of engineering inspections and hazard assessments of all huts and structures. With huts an initial desktop analysis for potential avalanche risk was run using some basic parameters to decide on the need for a site inspection. There was no hazard zoning system in New Zealand so one had to be devised to do the assessments. After looking at several in house solutions it was decided to adopt the Canadian avalanche risk zone system for occupied structures, CAA (2002). This uses a combination of impact pressures and return periods to produce three zones.

1. Red – where occupied structures should not be built.
2. Blue – where occupied structures can be built provided risks can be mitigated
3. White – where occupied structures can be built and no mitigations are necessary.

A total of 53 visitor huts had been inspected as of January 2009. Of those 29 were assessed as being in avalanche paths; 8 in white, 12 in blue and 9 in the red zone. Of the huts in red zones 3

have been replaced by new huts outside of the red zones of avalanche paths, 2 have been moved out of paths, 1 is closed seasonally and 3 are closed in seasons with large snow years. Huts in the blue zone have mainly had warning information provided to visitors. Several have seasonal closures applied if snow depths in the start zones and tracks meet predefined thresholds. No attempt is made to forecast risk.

7.4 *Avalanche advisory*

The Mountain Safety Council produces avalanche hazard advisories for the public at nine sites around New Zealand. These are available at www.avalanche.net.nz DOC supports the Mountain Safety Council with four of these. Subject to funding being available it is hoped to extend coverage of this system to more places in the future.

8. CONCLUSION

Using a mixture of existing systems (AHI, hut inspections system and advisories) and adopting ATES, DOC has a range of tools for mitigating avalanche risks. They cover the different circumstances where visitors to land managed by the Department can have their avalanche risk managed. The application of these in a consistent manner to the different visitor sites will manage the risks for the frontcountry visitors and inform the backcountry users so they can make their own risk management decisions. By doing this the Department's principles for visitor risk management can be met.

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