

## Hemlock Valley Snow Avalanche Assessment

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### Summary

This report represents an assessment of snow avalanche hazards from the perspective of occupied structures and facilities for Hemlock Valley recreational area, British Columbia. It does not include a road hazard assessment. This report may be considered as an updated zoning plan to replace the earlier report in 1999.

From the perspective of avalanche hazard assessment for Hemlock Valley , three things have changed since the earlier report:

1. Forest cover growth has continued which generally lessens the avalanche risk, provided that care is taken to preserve protective forest.
2. Important research on penetration of avalanches into forest cover has been accomplished at the University of British Columbia.
3. The Canadian Avalanche Association (CAA, 2002) has proposed guidelines for acceptable risk and zoning for Canada. In this report, the proposed guidelines are used.

The results of this study have been determined by:

1. Numerous visits to Hemlock Valley including a visit on May 30, 2010 for specifically for this study. These visits have included: slope angle measurements, slope distance measurements, GPS readings, inspection of the state of protective forest cover, visiting with residents and photographs.
2. Slope measurements using Google Earth image of the area (August 28, 2003 image) and use of Google Earth for terrain analysis.

The results of this study are listed here in terms of protection and zoning colour: Red, Blue or White as established by the CAA (2002) and contained in the definitions given below. It may be noted that the return period for definition of a White zone is 300 years as proposed by the CAA (2002) whereas the equivalent value used by the Fraser Valley Regional District is 500 years. For Hemlock Valley, the level of precision is such that these are equivalent.

## **Special considerations for Hemlock Valley**

The avalanche hazards at Hemlock Valley are very subtle to the people without experience in evaluation of such hazards. There is clear evidence of at least three avalanche paths above Edelweiss Drive between Larkspur Road and the corner to the connector to Hemlock Valley Road. In addition, on Edelweiss Drive above Larkspur Road there is an area with terrain steep enough for avalanching with sparse forest cover. In this area, some of this forest cover may be submerged beneath the snow pack in a winter with heavy snow fall. Furthermore, Hemlock Valley, even though not at high elevation, is in a regime of heavy snowfall.

The return periods required for free development (White zone: 300 - 500 years) are well beyond the experience of any resident of Hemlock Valley. For example, if a resident lived there for 30 years, the chance of observing a 300 year return period avalanche is less than 10 percent.

Specific results: summary

Blue Zones:

Sewage lagoons: The sewage lagoons are designed as in a Blue Zone. An earthen berm is recommended up-slope of the fence. Detailed coordinates are given below.

Structures near the sewage lagoons: These structures are designated as in a Blue Zone. An earthen berm is recommended up-slope of the structures. Detailed coordinates are given below.

Edelweiss Drive:

Blue zones are designated along Edelweiss Drive from the corner which connects to Hemlock Valley Road to Larkspur Road proceeding in northwest direction. Detailed coordinates are given below.

Blue zones are designated along Edelweiss Drive from Larkspur Drive northwest for approximately 125 m. Detailed coordinates are given below.

White zones:

All terrain sections along Edelweiss Drive or on present Snowmist Drive are designated as White zones unless mentioned above.

As stated previously (McClung, 2000), it is theoretically possible for avalanches to penetrate to Snowmist Drive and this agrees with the latest research on penetration of avalanches into forest cover. However, it probably would take two avalanches to do so: one to remove part of the forest

cover and another to run the remaining distance.

#### Definitions:

1. White zone: An area with an estimated avalanche return period of greater than 300 years or impact pressures less than 1 kPa with return period greater than 30 years.
2. Blue zone: An area with return periods between 30 and 300 years, the product of frequency and impact pressure is less than 0.1 kPa/year and impact pressure is greater than 1 kPa.
3. Red zone: An area where the return period is less than 30 years and/or impact pressures are greater than or equal to 30 kPa or where the product of frequency and impact pressure exceeds 0.1 kPa/year for return periods between 30 and 300 years.

For purposes of this report, these zone definitions replace earlier zone definitions in the report of McClung (2000) in the reference list.

#### Recommended actions for Canada:

1. White zone (low risk)- Construction of new buildings, including permanently occupied structures normally permitted.

#### **Special zoning considerations for Hemlock Valley**

The White zone is meant to be an area of nominal risk for avalanche hazard and available for development. However, the White zones are determined based on the existing protective forest cover above Edelweiss Drive and Snowmist Drive. If the existing forest cover is altered by natural effects (e.g. forest fire, avalanche) or by significant human effects, the area may need re-evaluation. Normally, it is not possible to construct a dwelling without removing some forest cover. Minor forest cover removal above the roads would not change the zoning for a White zone.

2. Blue zone (moderate risk)- Construction of new buildings such as industrial plants and temporarily occupied structures, possibly permitted with specified conditions. Conditions may include: structures reinforced for avalanche forces, construction of avalanche defences and requirement for evacuation plans or a combination of these. At Hemlock Valley, detailed assessment of the protective forest cover is crucial in any plan regarding a Blue zone.
3. Red zone (high risk)- Construction of new buildings not normally permitted.

Special notes (CAA, 2002): Special structures where large numbers of people may gather, multi-residences or structures used for essential services (hospitals, schools, police, fire stations) must be placed only in a White zone where there is high confidence that the avalanche risk is low.

Properties rented during the winter, in which the tenant may not be aware of or have accepted the risk, should be placed only in the White zone.

Detailed descriptions of Blue zones for Hemlock Valley.

### **Sewage lagoons**

One avalanche has invaded the fence above the sewage lagoons in about 1999. It is recommended that an earthen berm about 70 m long be placed at approximate altitudes between about 852 - 861 m.a.s.l. Approximate UTM coordinates are: 10U578227E; 5468343N to 10U578267E; 5468285 N. Engineering berm placement and design is beyond the scope of this report.

### **Structures near sewage lagoons**

These structures sit in a Blue zone and a protective earthen berm is recommended about 25 m long above the structures with altitude about 862 m . Approximate UTM coordinates are between: 10U578225E; 5468415 N to 10U578215E; 5468391 N. Engineering berm placement and design is beyond the scope of this report.

### **Edelweiss Drive:**

Edelweiss Drive is recommended as zoned Blue proceeding in a northwest direction from just northwest of the corner of the connector to Hemlock Valley Road: elevation 920 m a.s.l. (10U578058E; 5469318 N) to Larkspur Road;; elevation: 948 m (10U577637E; 5469598 N).

Notes:

1. For this section, it is possible that a site visit and detailed study by a P.Eng. might result in re-zoning to White for small sections. This has already happened in two cases. The state of the forest cover above Edelweiss Drive and lot exposure in relation to avalanche paths is highly variable above Edelweiss Drive. There are 3 avalanche paths above this section and there is evidence that avalanches have penetrated to Edelweiss Road in the past.
2. It is recommended that any building application for a lot in a Blue zone include: a. a detailed plan for any planned forest cover removal and b. exact UTM coordinates and elevations for the planned structure, the lot boundaries and limits of forest cover removal.

Edelweiss Drive is recommended as zone Blue in a northwest direction from the Larkspur Road intersection (elevation 950 m a.s.l. 10U577637E; 5469589N) for about 125 m (963 m; 10U577487E; 5469654E).

1. For this section, it is possible that a site visit and detailed study by a P.Eng. might result in re-zoning to White. The terrain above this area is sparse forest cover which is steep enough for avalanche formation and it is possible that avalanches could reach Edelweiss Drive. Due to

possible deep snow accumulations in some years, it is possible that some of the sparse forest cover in potential start zones may be submerged by the seasonal snow pack.

### **Blue zones and protective forest cover for Hemlock Valley**

The Blue zones for Hemlock Valley have been determined considering the existing state of the forest cover. All forest cover above Blue zones in Hemlock Valley should be considered as protective forest cover. Removal of protective forest cover may change the zoning. For a White zone, it would normally take a major event such as fire or large avalanche to alter the zone colour.

### **Note on climate change**

Return periods of interest for a White zone are in excess of 300 years. For such a time scale, it is virtually certain the climate, including the snow climate will change. A warmer climate for an area such as Hemlock Valley generally produces fewer dry snow avalanches which are the concern at Hemlock Valley. The reason is that warmer temperatures produce faster bonding and fewer avalanches.

However, in general, major snow avalanches do not respond directly to climate since they are caused by short term winter weather fluctuations to create weak layers and unstable conditions. On a time scale of 100 years or more, such short term fluctuations are bound to occur in spite of the fact that the general climate may be warmer. As an example, the coming winter of 2010 - 2011 is predicted to be a cold snowy winter due to La Niña. Even though the general climate is getting warmer, short term fluctuations dominate in major avalanche winters.

The winter of 1999 was a 50 year return period snow fall winter in B.C. and Hemlock Valley. At Hemlock Valley, avalanches were reported (McClung, 2000) but they were small and did not penetrate forest cover. In addition, there was a lot of damage due to static snow loads at Hemlock Valley. Due to lack of persistent weaknesses in the snow pack, 1999 was not a major avalanche winter in B.C.. Small rises in winter temperature may mean more snow, as in 1999, but if the key weak layer ingredients are not in place, a major avalanche winter may not evolve.

Combining the two ingredients: deep weak layer and high snow fall one might suggest that high snow fall occurs readily at Hemlock Valley and this may be elevated in the future. However, deep weak persistent layers will be present on time scales of hundreds of years. The result of the combination may mean little overall change for the 300 year return period of interest.

### **Mitigation and zone changes at Hemlock Valley**

For properties in the Blue zone, a detailed evaluation would normally be required by a professional engineer proficient in snow avalanche hazard evaluation. Such a detailed evaluation should list the options available.

In order to change the zone colour from Blue to White, normally start zone defences would be required to reduce the risk to that comparable for a White zone. This will be expensive. In addition, it may not be a possible option for Hemlock Valley since if the 100 year return period snow on the ground exceeds about 4 metres, the method cannot be used.

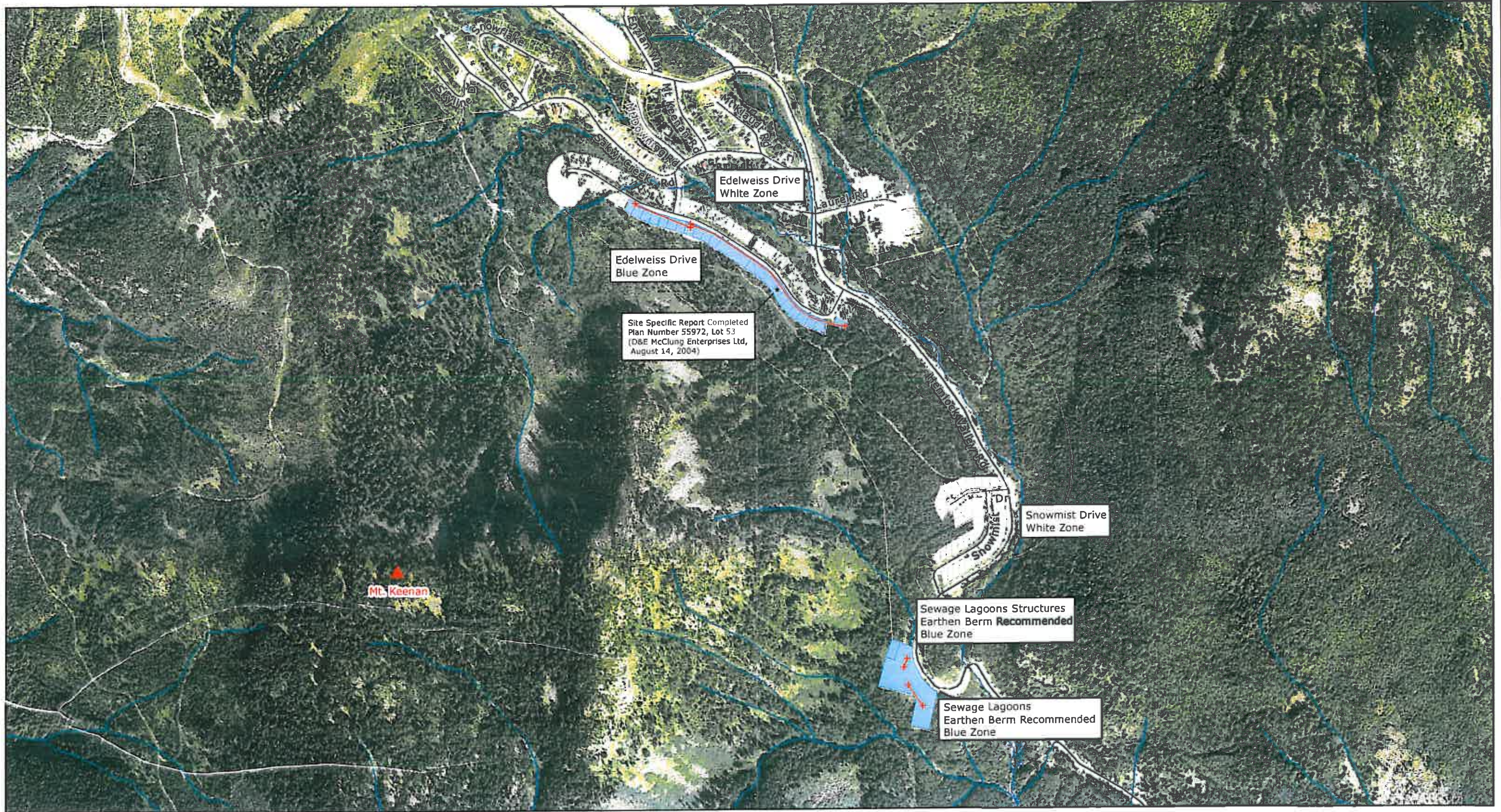
**References:**


Canadian Avalanche Association (2002). Guidelines for Snow Avalanche Risk Determination and Mapping in Canada, CAA, Revelstoke, B.C. V0E 2S0, 23 pp.

McClung, David (2000). Detailed Avalanche Map Study, Edelweiss Drive: Hemlock Valley, B.C., D&E McClung Enterprises Ltd., 7 pp.

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Oct. 15, 2010

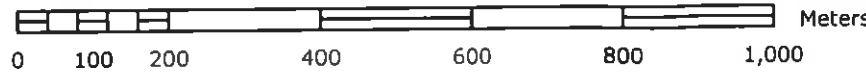





-  Paved Road
-  Unpaved Road
-  Railways
-  Streams
-  Indian Reserves
-  Parcels
-  Parks and Protected Areas
-  Waterbodies
-  Blue Hazard Zones
-  White Hazard Zones

FVRD General Information Map


**Hemlock Valley Avalanche Study**



Meters



Scale  
1:10,000



Date Created:  
August 25, 2010

Disclaimer: This map was compiled by the Fraser Valley Regional District, using data believed to be accurate; however, a margin of error is inherent in all maps. This product is distributed without warranties of any kind, either expressed or implied, including but not limited to warranties of suitability of particular purpose or use. This map identifies the recommended placement of earthen berms and avalanche risk zones which are noted by UTM coordinates in the Hemlock Valley Snow Avalanche Assessment draft report by D&E McClung Enterprises Ltd, 2010. This map also uses an orthophoto that was captured in 2003 for MOE.