

# Outline for Avalanche Program Annual Reports

## Season Summary

- A short overview of the contents of the report
- Points to key events of the season

Example:

### Summary

After a cold and relatively quiet start to the winter a large storm at the end of January initiated an avalanche season near the Bear Pass norm. Atypically for the area, a layer of faceted snow formed in November remained reactive on high north and east aspects until late in the spring. No large avalanches ran onto the highway while it was open. There was one incident, a school bus ran into a small deposit on the road at Cracker, no injuries resulted.

Total closure hours at the Bear Pass were eighty-three hours and forty minutes - ninety per cent of average. A preventative closure on January twenty-ninth lasted more than two days. The Stewart-Hyder road was closed for four hours and five minutes, the Stewart Bypass for thirty-eight hours and forty minutes and the Stewart Harbour was closed for forty-three hours and twenty-five minutes. All of these closures were for preventative reasons.

The most notable program developments were the signing of a formal agreement between the District of Stewart and the Ministry for avalanche services, the addition of new RAWs weather stations at Kettle Hole and Summit Sluffs and the construction of a set of six - ten meter high splitter mounds in the runout of the Little Entrance #1 avalanche path.

## Climate

- Text description of significant storms or situations that were critical factors in the avalanche activity this season
- Summary of monthly and annual climate data from main indicator sites with comparison to long term averages
- Numerical data is most clearly represented using graphs

Climate summary examples:

### WEATHER AND SNOWPACK

The general weather pattern for the winter was an active storm track supported by the upper jet stream, which produced substantial precipitation and average to above average snowpacks in the higher elevations. Paradoxically, the low elevation snowpack stayed below threshold for most of the season. This was mainly due to rising freezing levels in valley bottom locations, which allowed frequent melt back and settlement during storm periods. Otherwise, temperatures were generally cool, with few extremes. Both arctic outbreaks and mid-winter thaws to ridge top were infrequent. The coldest temperatures of the season were on or near the first day of spring. Several wind events were noteworthy this season and contributed to periods of snow instability.

## Duffey Lake

Winter arrived on schedule after a normally wet autumn. A classic November rainstorm mid month created a crust / facet combination that is in the alpine start zones at this writing. Threshold snowpack values were reached early in December.

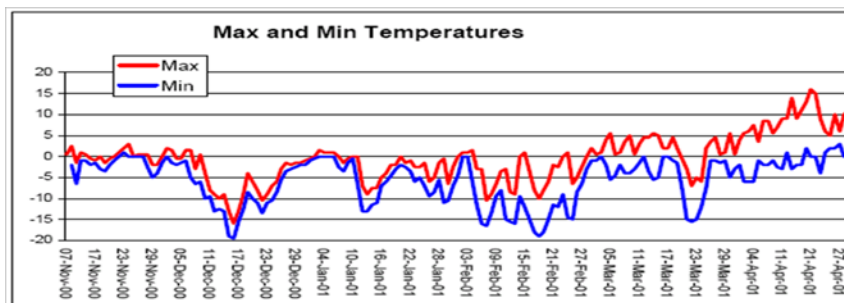
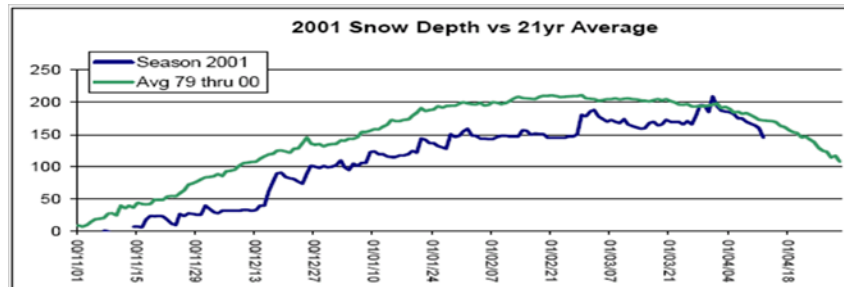
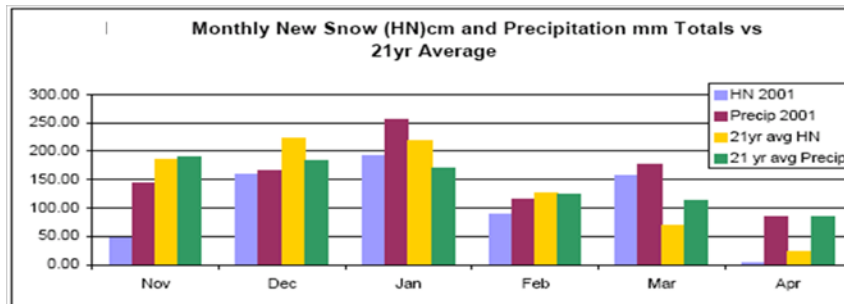
A significant storm December 15-16 triggered a cycle of large avalanches on the November crust necessitating the first high hazard and highway closure of the season. Storms held off and a temperature inversion parked for the holiday week while record sized surface hoar grew in the valleys and cutblocks (one specimen was 200mm). The storm track returned with a warm deluge Jan 6-7 and another Duffey Lake Road closure.

Continued fair to good stability characterized January as the snowpack warmed and settled. Stronger layering mid month bridged the November weaknesses. A persistent surface hoar and facet layer kept up the avalanche activity pace late in January and contributed to one heli skier fatality locally January 25.

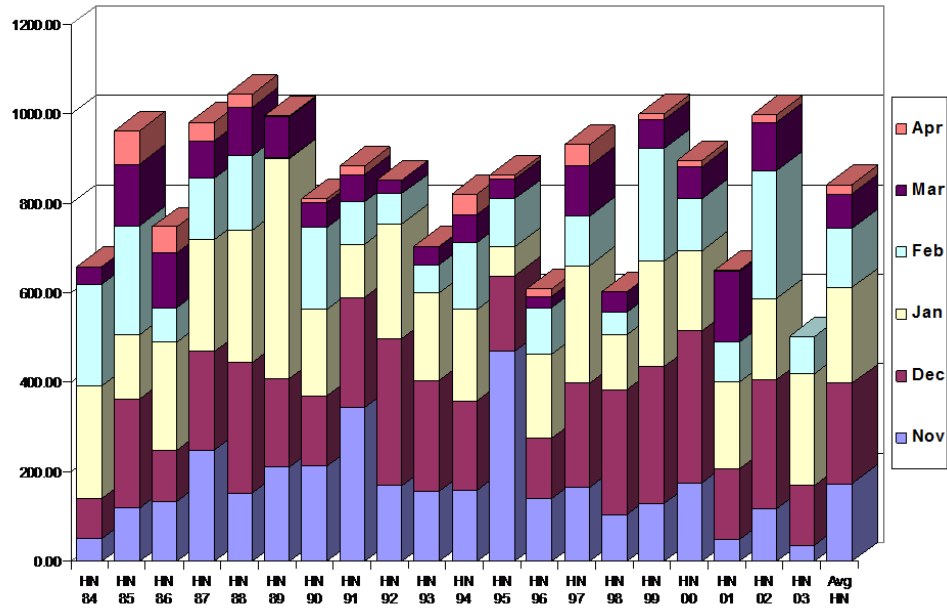
February produced an intense storm on the 21st that closed Hwy #99 overnight due to snowfall turning to rain, increasing temperatures and high winds. Numerous avalanches to size 2.5 ran early in the storm on a layer of old faceted grains over a wind pressed harder layer. Limited heli bombing was performed on the 22nd in poor weather. The remainder of February was cool and convective showers were the norm.

March continued the pattern of cold unstable arctic air and low-density new snow layers. At least one record low maximum temperature was set. The sun had minimal effect on south aspect sites.

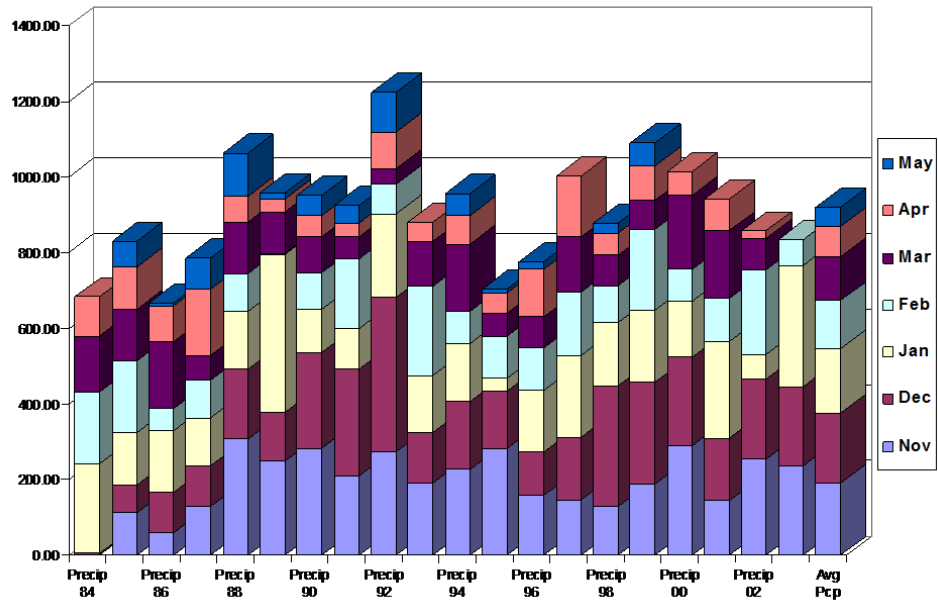
Some examples of charted climate data:



HN (cm) by Year and Month



Precip (mm) by Year and Month



## Snowpack

- Description of the snowpack characteristics that drove the seasons major avalanche forecast decisions
- Mention of snowpack characteristics that are unusual or infrequent in the area
- Summary of monthly and annual HS and HN data from main indicator sites with comparison to long term averages
- Numerical data is most clearly represented using graphs

Examples of snowpack summary:

### **Snowpack**

#### **Skeena District**

The late fall storms caused threshold levels to be reached at both 35 Mile and Rainbow Summit by the end of November. Several surface hoar layers and crust/facet combinations which developed over the winter were carefully monitored. The only large path that reached the threshold level was the Shames path 4.1.

#### **Bulkley-Stikine District**

##### **Ningunsaw Pass**

The early season snowpack was slow to develop this winter resulting in a weaker faceted base due to early season cold weather. Threshold levels were reached by early January. Mid-pack layers comprised of mostly stable layers however the faceted based remained a concern, particularly in shallower snowpack areas. Several surface layers developed mid-season which required monitoring and prompted one control mission which produced good results in the Snowbank area. A late season storm in early March resulted in a natural avalanche cycle in all Ningunsaw Pass areas with all avalanches stopping well back from the highway.

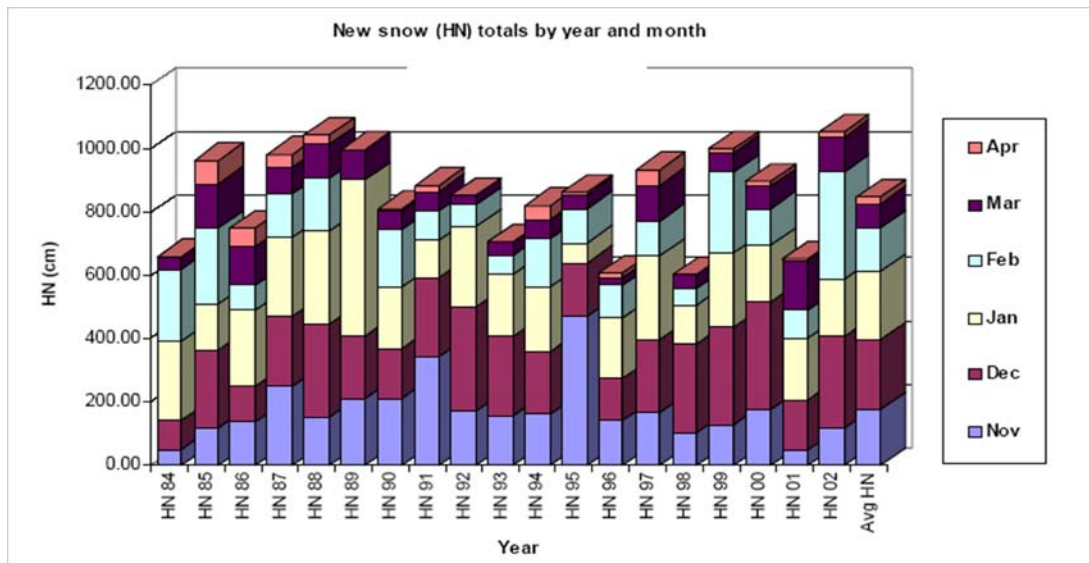
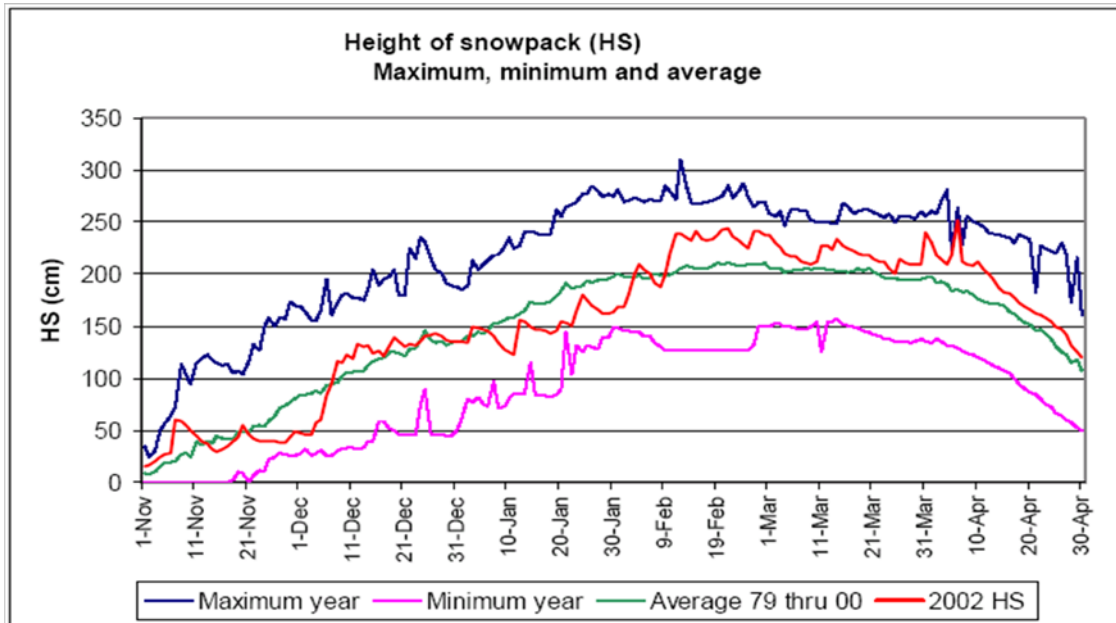
### **Snowpack summary**

A combination of numerous but minor snowfall events, intermittent rain, and wildly fluctuating freezing levels slowly built a rather strong alpine snowpack. Instead of being composed of the more common "rounded" grain layers this pack was composed mostly of frozen wet grains. This type of snowpack is incredibly strong when frozen but weakens rapidly once warmed to 0.0° Centigrade.

The snowpack below the tree-line was reduced significantly by warm temperatures and rainfall in late November and early December and did not recover to normal levels with subsequent snowfalls.

Strong temperature gradients in the upper pack produced by periods of very cold weather contributed to the growth of weak buried layers three separate times this season. These layers would have been responsible for major avalanche cycles if buried by significant snowfalls but were usually strengthened by periods of warmer weather before a critical load could accumulate.

Examples of snowpack data summary charts:



## Avalanche Activity

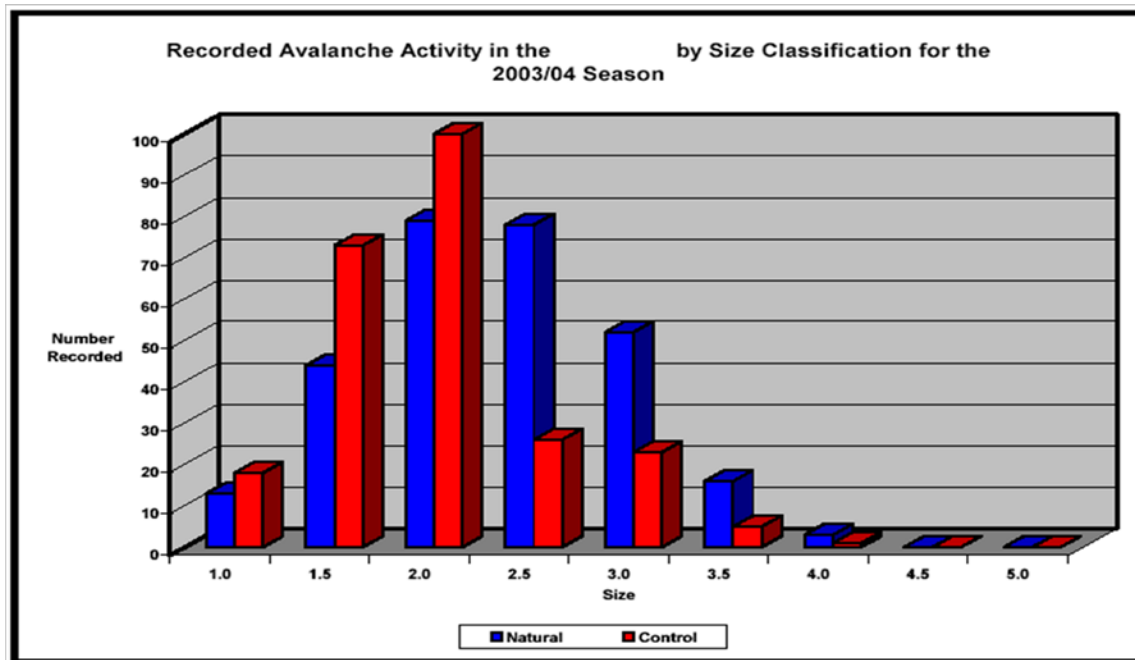
- Number of occurrences observed
- Number that reached Highway
- Break down by size and trigger
- Text description of unusual or informative activity

Example of an avalanche activity summary:

### AVALANCHE ACTIVITY AND CONTROL

Minor avalanche activity occurred in mid January, with scattered activity in 7 Mile Dam and New Denver-Kaslo, but we had to wait until February to record a more significant round of avalanche events. The areas affected at that time were Lardeau, Coffee Creek, Whitewater, Blueberry-Paulson and New Denver-Kaslo. In March, some good sized avalanches were recorded at New Denver-Kaslo and Toby Creek, all associated with large, alpine paths. Details of the various cycles are captured in the monthly reports and in the tables below. To briefly summarize, a total of 81 avalanches were recorded, spread over 8 areas, with 34, or 42% affecting the highways. Explosive control accounted for 30 or 37% of the total. Of the 6 size 3.0 avalanches recorded, 4 were released by explosives and 4 affected the road, all within closure except one.

Examples of summarized avalanche activity records:



AVALANCHE ACTIVITY	
Size	Number of Events
1	4
1.5	4
2	23
2.5	13
3	8
3.5	0
4	0
4.5	0
Total	52
Affecting Highway	3

Table 3. Summary of Avalanche Occurrences.								
Recorded Avalanches*	November	December	January	February	March	April	Season	Average
Controlled avalanches		43	53	0	40	11		
Controlled avalanches affecting Hwy		11	20	0	6	1		
Natural avalanches	1	8	7	1	5	3		
Natural avalanches affecting Hwy.	1	3	4	0	0	0		
Natural avalanches affecting open Hwy.	1	3	4	0	0	0		
Total avalanches affecting Hwy	1	14	24	0	6	1	46	
Total avalanches	1	51	60	1	45	14	172	

\* Generally avalanches less than size 1.5 are not recorded unless they are indicators of a rising hazard.

## Traffic

- Describe the traffic volumes experienced through the winter season
- Note any traffic flow problems or changes
- Discuss any new traffic management procedures or facilities
- Describe the effect of changes on the hazard index or on program operations.

## Closures

- Summary of Closure times for each avalanche area
- Comparison to long term
- Describe any operational issues that are causing closure to be extended or any procedures that have been implemented to reduce closure times.

Examples of closure summaries:

Table 2. Summary of Delays and Road Closures.								
Delay Type	November	December	January	February	March	April	Season	Average
30 min delays	4	4	5	0	0	1	14	
1 hr delays	1	5	2	0	5	2	15	
2 hr delays	0	5	0	0	1	0	6	
Full closures	1	0	2	0	0	0	3	
Hrs closed	6 hr 55 min	10 hr 55 min	33 hr 30 min	0	6hr 55 min	2 hr 5 min	59 hr 5 min	
Avg Hrs closed	6 hr 45 min	32 hr 35 min	53 hr 45 min	33 hr 10 min	17 hr 10 min	7 hr 25 min	149 hr 00 min	

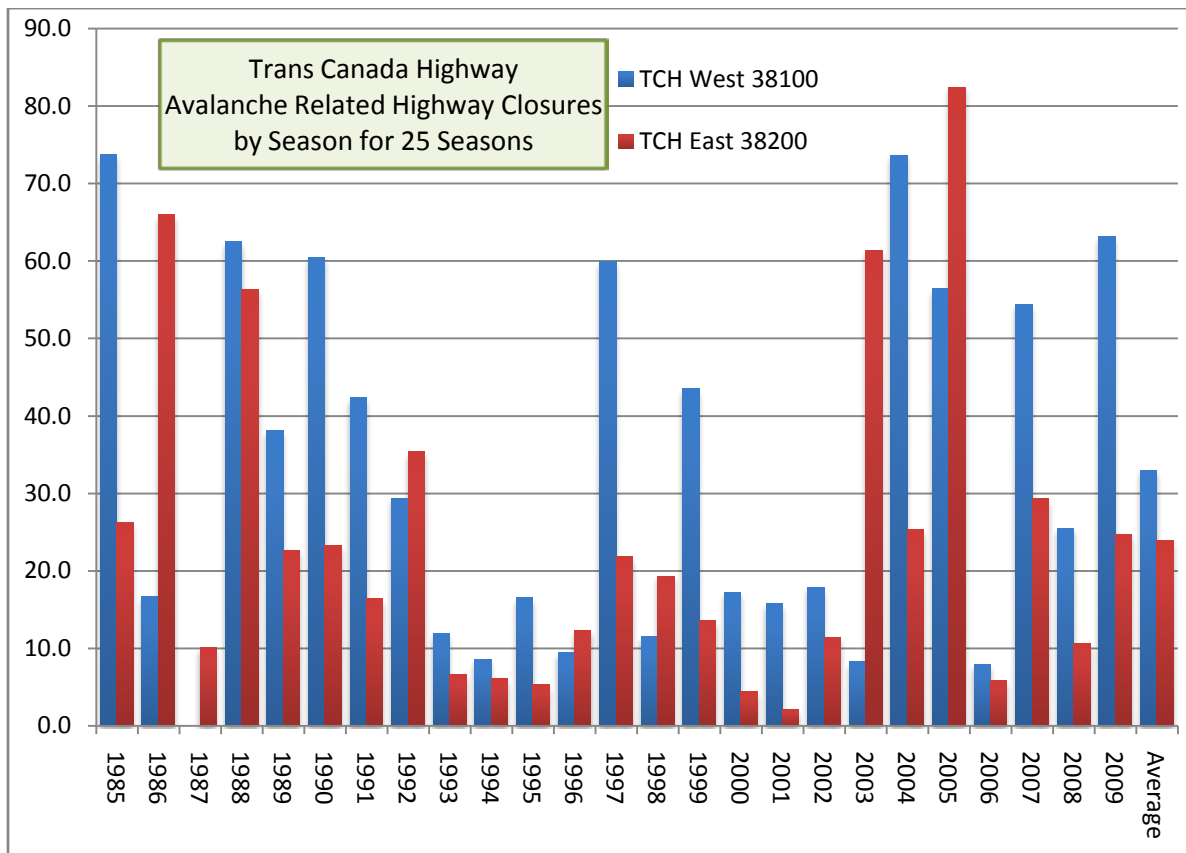
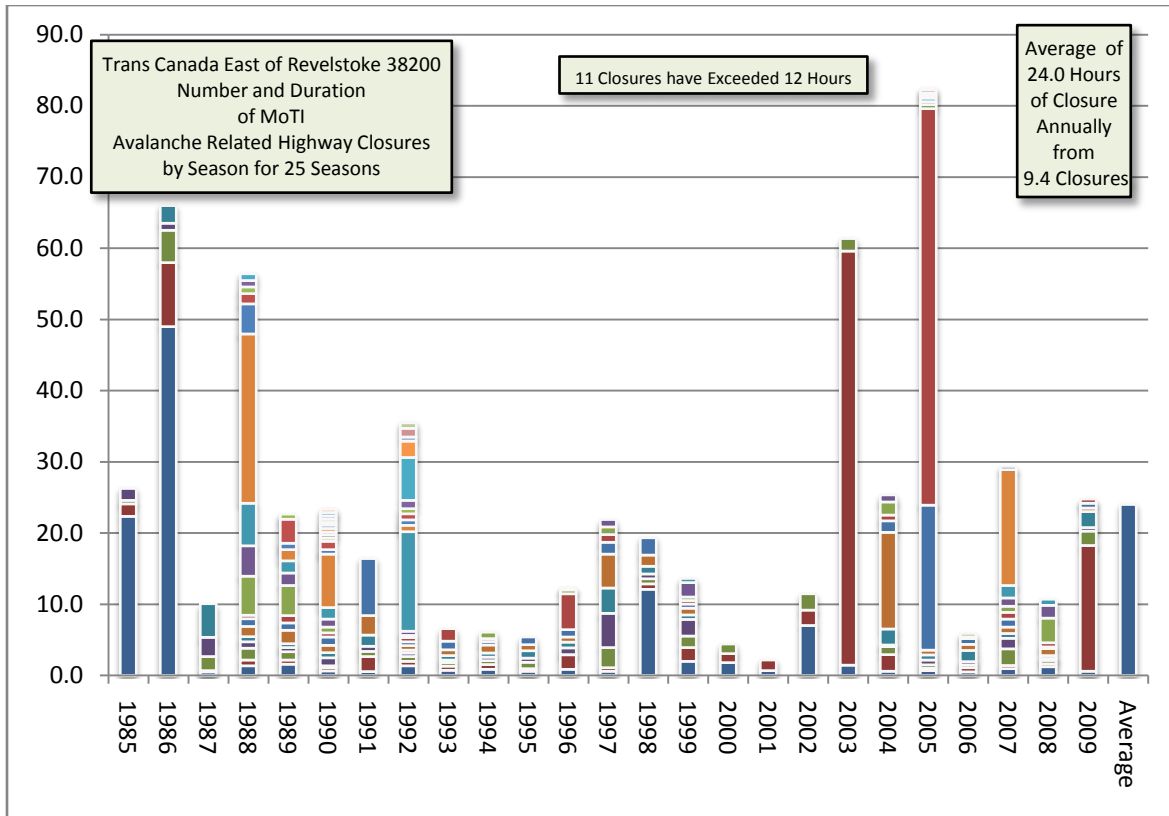
**Terrace-Prince Rupert**

Date	Time of Closure	Duration	Reason	Location
031123	1040-1125	45min	Heli-control	35 Mile
031123	1130-1220	50min	Heli-control	35 Mile
031123	1225-1310	45min	Heli-control	35 Mile
031123	1400-1420	20min	Heli-control	35 Mile
031124	2305-2350	45 min	Case Charge	Rainbow Summit
031125	1125-1245	20 min	Case Charge	35 Mile
031126	1010-1100	50 min	Heli-control	35 Mile
031126	1250-1330	40 min	Heli-control	35 Mile
031126	1405-1440	35 min	Heli-control	McLean
031127	1920-2045	1 hr 25 min	Case Charge	35 Mile
031127	2205-2250	45 min	Case Charge	Rainbow Summit
031128	0720-0755	35 min	105mm control	Kasiks
031128	1105-1130	25 min	Heli-control	35 Mile
031128	1210-1250	40 min	Heli-control	McLean
040130	1450-1515	25 min	Heli-control	East Gate
040302	1150-1220	30 min	105mm RR training	Kasiks
040302	1240-1255	15 min	105mm RR training	Kasiks
040302	1320-1350	30 min	105mm RR training	Kasiks
040306	1155-1210	15 min	Heli-control	East Gate
040324	1350-1410	20 min	Heli-control	50 Mile
040324	1445-1505	20 min	Heli-control	50 Mile
040324	1510-1525	15 min	Heli-control	50 Mile

**Closure Times**

<b>TCH West:</b>	<b>Total Hrs of Closure</b>	<b>44:19</b>	
	<b>Longest Single Closure</b>	<b>12:30</b>	<b>99-01-11</b>
<b>TCH East:</b>	<b>Total Hrs of Closure</b>	<b>13:36</b>	
	<b>Longest Single Closure</b>	<b>1:56</b>	<b>98-12-29</b>
<b>No. 23N:</b>	<b>Total Hrs of Closure</b>	<b>30:27</b>	
	<b>Longest Single Closure</b>	<b>6:24</b>	<b>99-01-11</b>
<b>No 31:</b>	<b>Total Hrs of Closure</b>	<b>59:22</b>	
	<b>Longest Single Closure</b>	<b>12:15</b>	<b>99-01-11</b>
<b>Kicking Horse Canyon</b>			
	<b>Total Hrs of Closure</b>	<b>4:45</b>	
	<b>Longest Single Closure</b>	<b>2:45</b>	<b>99-02-25</b>





## Active Control

- Summarize active control missions
- Describe any changes made or required
- Control related closure info
- Include details of misfired charges (dud records) for the most recent season
- Describe efforts made in the last year to find and destroy any misfired explosive charges
- Describe the plan for conducting dud searches/destruction during the coming spring/summer/fall period

Example of an explosive control summary table:

Table 4. Summary of Avalanche Control Measures.															
System	Nov.	duds	Dec.	duds	Jan.	duds	Feb.	duds	Mar.	duds	April	duds	Season	duds	Average
Gaz-Ex A	5	0	31	0	29	0	0	0	20	0	0	0	85	0	
Gaz-Ex B	5	0	37	0	30	0	0	0	20	1	0	0	92	1	
Gaz-Ex C	3	0	27	5	12	1	0	0	9	0	3	0	54	6	
Gaz-Ex D	8	3	27	0	16	0	0	0	12	0	3	0	66	3	
Gaz-Ex E	5	0	21	0	15	2	0	0	10	4	3	0	54	6	
Total Gaz-Ex	26	3	143	5	102	3	0	0	71	5	9	0	351	16	
Avalauncher	5	0	11	1	12	0	0	0	0	0	0	0	28	1	
Case Charge	0	0	1	0	2	0	0	0	0	0	0	0	3	0	
Heli Bombs	0	0	0	0	12	0	0	0	10	1	18	0	40	1	

## Incidents

- Give a brief summary of all incidents
- Describe the steps taken to implement the recommendations from any incident reviews
- Incident reports from the season are attached as an appendix to the annual report

## Notable Change in the Program Area

Describe changes that have an effect on how the program conducts its business. This might include items such as:

- a new control device or defense structure
- change in procedure
- addition or removal of a weather station
- new signage
- change resulting from action of others or natural events – road re-alignment, speed limits, rock cuts, fire, forestry, landslide etc.
- describe how changes or new situations relate to the avalanche hazard or create/eliminate a forecasting challenge

## Weather Network

- Info on weather station effectiveness and reliability
- Discussion of weather forecasts
- Propose changes or improvements

## **Program Data**

- Describe program data collected during the season
- List the quality control completed, note the type of record (occurrence, weather, closure) and the date range of the records reviewed and corrected
- State the work completed on the program avalanche atlases
- State the work plan for additional data quality controlled and atlas updates

## **Training**

- Give details of all new and recurrent training taken by ministry workers
- State the training requirements for the coming 12 months for each ministry worker. Project the costs associated with the training requirements.
- List the avalanche training delivered to maintenance contractor personnel – Details of courses and records of all attendees at the annual avalanche training day, beacon practices and rescue practices should be an appendix to the annual report.
- Include records of all training and table top exercises of the ERAP 2-0804 plan delivered to ministry and contractor personnel in the appendix.

## **Equipment**

- Describe condition, reliability, usefulness, need for replacement or upgrading
- Project the need and cost of new or replacement purchases for the next season
- Use sub-headers such as:
  - Vehicles
  - Field Equipment
  - Rescue Equipment
  - Signs and Gates
  - Communication Equipment
  - Office and Computer Equipment
  - Facilities

## **Quality Assurance\Audits**

- List the recommendations that were made during the Pre-Season and Mid-Season Audits
- State the work plans or projects that have been completed or that are being undertaken to address the recommendations

## **Summer Availability and Schedules**

- State the summer schedules and availability of each full time regular worker
- Where auxiliary workers will be used during summer projects give details of that scheduling.
- State the work plans or projects for the non-avalanche seasons

## **Personnel**

- State the names and positions of all personnel involved in delivering the program
- Include information on any changes to staffing levels or positions.

## **Additional Information**

Additional headers to include will vary by season and program. When pertinent include information such as:

- Explosive storage
- GazEx
- Artillery
- Avalanche Guard
- Application of New Technology or Research
- Computer Systems
- Logging above the highway
- Winter construction projects
- Avalanche Atlas changes
- New mitigation measures
- Etc.