

FILE COPY

WASHINGTON STATE HIGHWAY DEPARTMENT RESEARCH PROGRAM REPORT

8.2

**NORTH CASCADES HIGHWAY
SR - 20 AVALANCHE ATLAS**

RESEARCH PROJECT

Y-1301

JUNE 1971

PREPARED FOR
WASHINGTON STATE HIGHWAY COMMISSION
IN COOPERATION WITH
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

E.R. LACHAPELLE
C.B. BROWN R. J. EVANS
GEOPHYSICS PROGRAM AND
DEPARTMENT OF CIVIL ENGINEERING
UNIVERSITY OF WASHINGTON

This Avalanche Atlas catalogs details of snow avalanche activity along the North Cascades Highway, SR-20, between Newhalem on the west side of the Cascade Mountains and Mazama on the east side. Data contained herein have been collected during summer and winter reconnaissances in 1970 and 1971 under a contract between the Washington State Highway Department and the University of Washington. Compilation of this Atlas completes the first phase of a planned three-year study of avalanche problems and control methods on the highways of the State of Washington. Other work under this first phase is detailed in a separate Summary Report.

This Atlas, prepared in loose-leaf form, is designed primarily as an operational guide for Highway Department maintenance personnel who will be involved in snow removal operations on SR-20. There are two reasons for the loose-leaf format. First, additional data acquired during the second and third year of the avalanche study can be furnished in a form suitable for easy insertion in the Atlas. Second, Highway Department maintenance personnel will readily be able to add avalanche occurrence records for each slide path once SR-20 is open to use. A rapid accumulation of occurrence records is essential if an operational forecasting and control program is to be evolved to support winter use of this highway.

Avalanche paths are grouped and named according to major geographical features. The main groups and their abbreviations are, from west to east along the highway: Powerhouse (PH), Newhalem (NH), Ruby Mountain (RM), Crater Mountain (CM), Granite Creek (GC), Rainy Lake (RL), Liberty Bell (LB), Kangaroo (KA), Cutthroat Ridge (CR), Delancy Ridge (DR), and Silver Star (SS). Within these groups, the avalanche paths are numbered in the direction of west-to-east travel along the highway west of Washington Pass, and east-to-west east of this Pass. Individual avalanche paths not logically belonging to the above groups are named separately (e.g., Beebe Mountain, Helicopter Meadows).

Each avalanche path is outlined on the annotated maps and photographs. Normally, this outline indicates the maximum recognizable extent of past avalanche activity on each path. Future overruns of these boundaries are possible in the event of exceptionally large avalanches or ones with

erratic flow behavior. In some cases the release zone is only partly outlined, or is outlined with dashed lines. This signifies either that the exact release zone cannot be clearly identified, or that multiple release zones exist within a given area, all of which normally would not avalanche at any given time. In a few instances arrows are drawn along flow lines within an avalanche path. These arrows indicate that separate small avalanches occur commonly within the general path area.

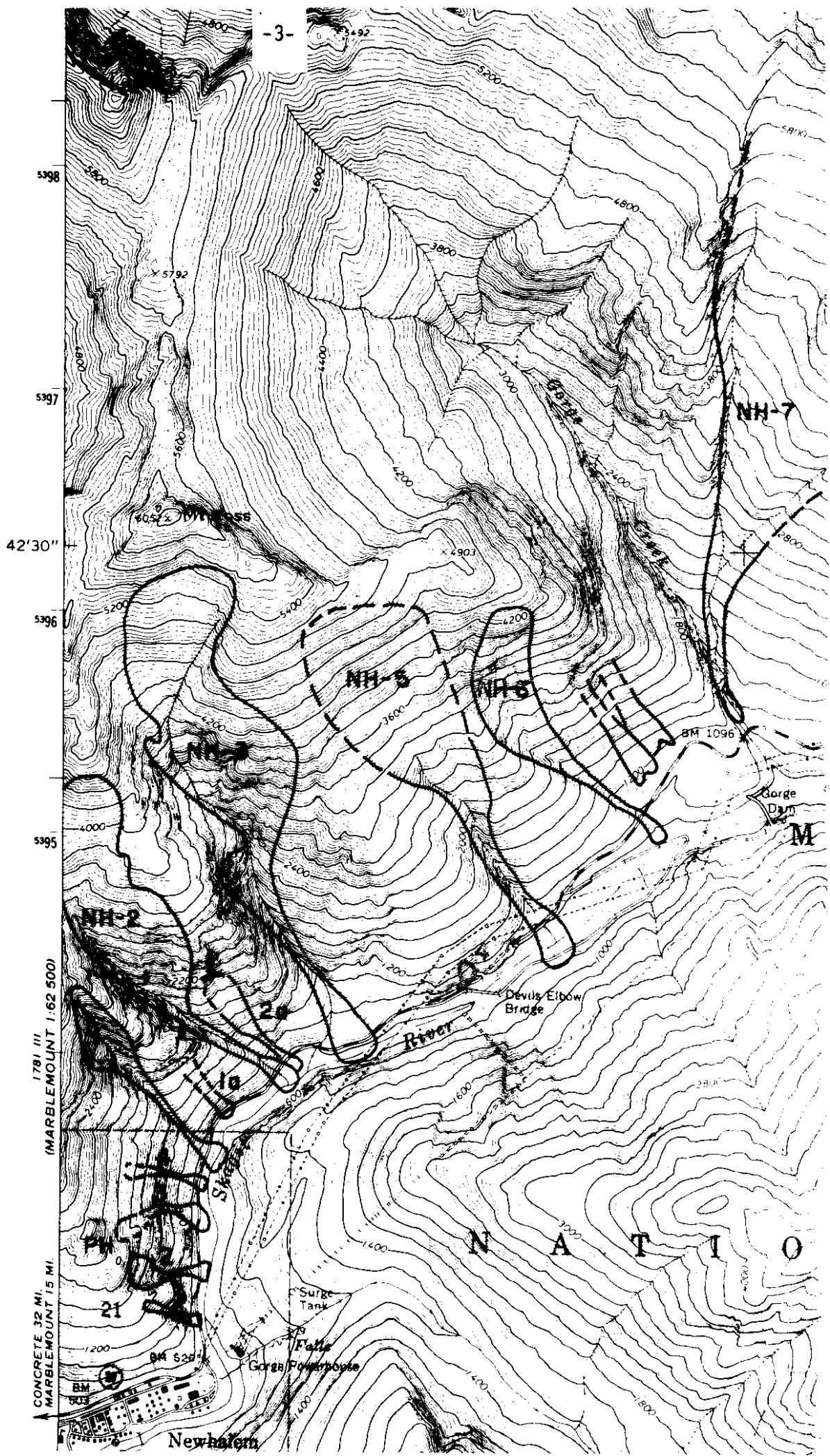
The location of each avalanche path described on a separate Summary Sheet is given in two ways. The intersection of the path centerline with the highway is identified by means of the highway survey Station Number wherever this can be ascertained. In addition, the intersection of the path centerline with the highway is identified to the nearest 10 meters by Universal Transverse Mercator (UTM) grid coordinates as determined from the applicable U. S. Geological Survey 7.5' series topographic maps. For those avalanche paths which do not intersect the highway, UTM grid coordinates are given for the lowermost tip of the avalanche path as outlined on the annotated maps.

The hazard rating given on each Summary Sheet is a subjective estimate of the encounter probability between a falling avalanche and moving highway traffic. This estimate takes into account both the likely size of the avalanche and frequency of occurrence. The hazard becomes substantially higher in all cases where non-moving vehicles are located underneath the avalanche paths. This might be the case for stalled vehicular traffic or for snow removal equipment. Additionally, at some sites, particularly between Washington Pass and Cutthroat Creek, an even higher hazard exists for snow removal equipment because the removal activity potentially may trigger avalanche release.

The vertical profiles given for many of the paths are plotted to true vertical scale and are all plotted to the same scale ($1'' = 1000'$) with the same altitude reference. Thus the profiles give true slope angles and are directly comparable. The profiles are included in this Atlas to give a graphic illustration of the relative size and steepness of the many avalanche paths, features which are not always readily discernible from the highway.

CONCRETE 32 MI.
MARBLEMOUNT 15 MI.

(MARBLEMOUNT 1:62 500)



North Cascades Highway SR-20
Avalanche Summary Sheet

Name of Path: Powerhouse No. 1

Hazard: Low, infrequent

Map: Diablo 7.5'

Location: Station _____ UTM 5392910 N , 629460 E _____

Elevation of starting zone: 1400'

Vertical fall: 800' Length: _____

Description:

This slide falls from a very narrow, rocky chute running through the cliffs just around the first curve east of the town of Newhalem. Release zone is small in area and is not apt to produce a very large volume of snow reaching the highway.

Expected Effect on Highway:

Infrequent deposit of small volume of snow on the highway, most likely during winters of unusually heavy avalanche activity in Diablo Gorge. Not expected to produce any avalanching during normal winters.

History:

This path was identified as a possible source of avalanches during the 1970 reconnaissance, but was rejected from the initial compilation because no previous avalanches had been reported here. An avalanche reached the road at this point during the heavy slide cycle in Diablo Gorge in January 1971.

North Cascades Highway SR-20

Avalanche Summary Sheet

Name of Path: Powerhouse No. 2

Hazard: Low, infrequent

Map: Diablo 7.5'

Location: Station _____ UTM 5393040 N, 629460 E

Elevation of starting zone: 1800'

Vertical fall: 1200' Length: _____

Description:

A diagonal, narrow chute falls through cliff bands to about 800' elevation, then turns downhill and fans out onto the highway. Unlike Powerhouse No. 1, this avalanche path has a substantial open slope feeding into the chute from the north in the release zone. Consequently, a larger volume of snow can be delivered to the highway. Character of the talus slope below the chute indicates avalanching has been more vigorous at No. 2 than at No. 1.

Expected Effect on Highway:

Infrequent deposit of snow on highway up to 200' or more wide, most likely during winters of unusually heavy avalanche activity in Diablo Gorge. Not expected to produce any avalanche activity during normal winters, largely due to low elevation of release zone where substantial snow accumulation is uncommon.

History:

No previous sliding at this site was reported by City Light personnel, but an avalanche reached the highway in January 1971.

North Cascades Highway SR-20

Avalanche Summary Sheet

Name of Path: Powerhouse No. 3

Hazard: Low, infrequent

Map: Diablo 7.5'

Location: Station _____ UTM 5393270 N, 629450 E

Elevation of starting zone: Around 1800'

Vertical fall: 1200' Length: _____

Description:

This slide path originates on a short, open slope broken by cliffs just north of the release zone for Powerhouse No. 2. It falls down a narrow, irregular chute through the cliff bands to reach the highway over a short talus slope. Volume of snow reaching the highway is comparable to that of PH-2. The rock faces just above the highway and immediately north of the talus slope also contribute sliding snow under favorable avalanche conditions. Thus the length of road which can be covered by avalanche snow from this path may be 300' or more.

Expected Effect on Highway:

Infrequent deposit of snow on highway up to 300' or more wide, most likely during winters of unusually heavy avalanche activity in Diablo Gorge. Not expected to produce any avalanche activity in normal winters, similar to PH-1 and PH-2.

History:

No previous sliding at this site was reported by City Light personnel, but an avalanche reached the highway in January 1971.

North Cascades Highway SR-20

Avalanche Summary Sheet

Name of Path: Powerhouse No. 4

Hazard: Low, infrequent

Map: Diablo 7.5'

Location: Station _____ UTM 5393450 N , 629450 E

Elevation of starting zone: Around 1600'

Vertical fall: 1000' Length:

Description:

This path originates in narrow chutes and gulleys among cliffs. The exact release zone is ill-defined and small in area. The falling snow reaches the highway over a steep, rocky face with little talus slope. Volume of snow apt to reach the highway is small, due to the limited area in the release zone.

Expected Effect on Highway:

Infrequent deposit of snow on highway, not likely to be much over 100' wide. Occurrence is most likely during winters of unusually heavy avalanche activity on Diablo Gorge. Not expected to produce avalanche activity in normal winters.

History:

No previous sliding at this site was reported by City Light personnel, but an avalanche reached the highway in January 1971.

Powerhouse Avalanches PH-1, PH-2, PH-3, PH-4

Winter of 1971/72:

- PH-1 This slide ran into the highway in about the same volume as the previous winter.
- PH-2 Snow was deposited onto the highway but did not reach the Skagit River.
- PH-3 An avalanche somewhat larger than the previous winter and original path estimate reached the Skagit River.
- PH-4 Slid to indicated extent of path boundary

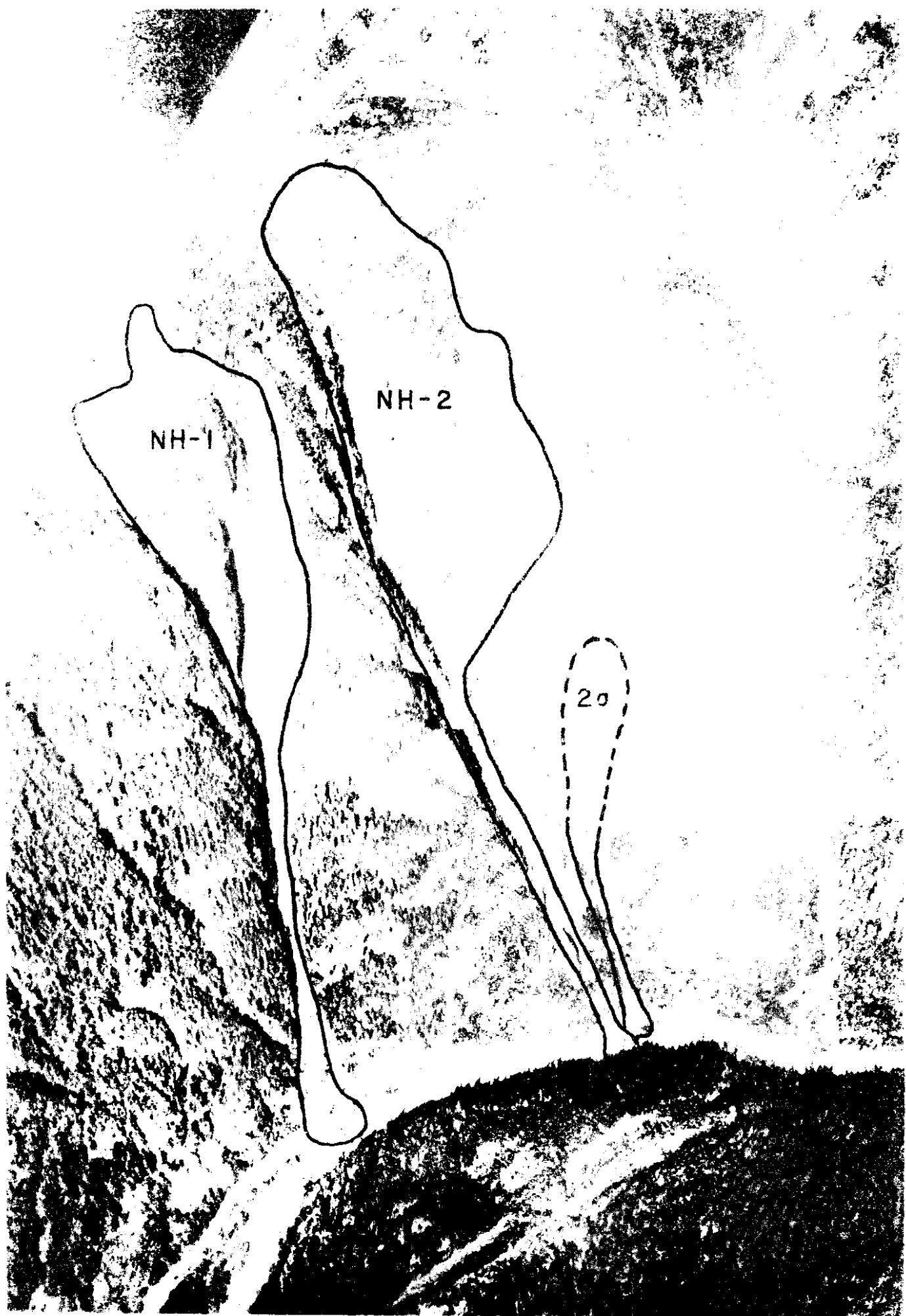
It is noteworthy that this was the second year in a row in which all four of these paths were active, although they had not been reported previously as a problem by City Light.

Winter of 1972/73:

No avalanches reported on these paths.

Winter of 1973/74:

No avalanches reported on these paths.



North Cascades Highway SR-20

Avalanche Summary Sheet

Name of Path: Newhalem No. 1

Hazard: Moderately high, annual

Map: Diablo 7.5'

Location: Station _____ UTM 5393580 N, 629480 E

Elevation of starting zone: 3200'

Vertical fall: 2600' Length: 4000'

Description:

This is the first large path encountered going up Diablo Gorge. Slides originate in a multiple release zone on south- and east-facing slopes between elevations of 1800' to 3200'. These release zones are open slopes, in some places broken by small cliffs and scattered patches of timber. Two distinct gulleys funnel into a single narrow chute at the 1800-foot level. This chute opens out onto a talus fan through a gap in the cliffs just above the highway. Size of the talus fan and character of vegetation on it indicate frequent slide activity. Normal fall of the slide is confined to the chute, but vegetation evidence suggests that occasionally the falling snow may overrun the chute and descend onto the road over the adjacent cliffs, especially on the north side. Just south of this main slide path a long, narrow chute falls through about 200' of a heavily timbered zone and reaches the same gap in the cliffs above the highway as the main path. Discharge of a small amount of sliding snow from this latter chute appears possible.

Expected Effect on Highway:

Annual deposition of snow on highway up to 400' or more wide and 20' or more deep. Moderately high hazard to moving traffic, high hazard to stalled traffic or to snow removal equipment during periods of rain or thaw. More than one slide reaching the highway within a short interval is possible.

History:

This path discharges snow onto the highway annually and possibly more often (Seattle City Light). Slide activity normally follows heavy winter rain or thaw at elevations above about 2000', following deposition of substantial amounts of snow in the release zone.

Newhalem No. 1 (NH-1) (Dead Man's Curve)

Winter of 1971/72:

Ran in full volume to Skagit River, with deposition slightly larger in extent than shown on photo (p. 8).

Winter of 1972/73:

No avalanches reported from this path.

Winter of 1973/74 (to end of March):

11/27/73---Combination of mud, rock and snow fell at 8:00 PM.
Deposition on highway was 300 ft. wide and a maximum of 12 ft. deep.

2/2/74----Small snow deposit across the highway.

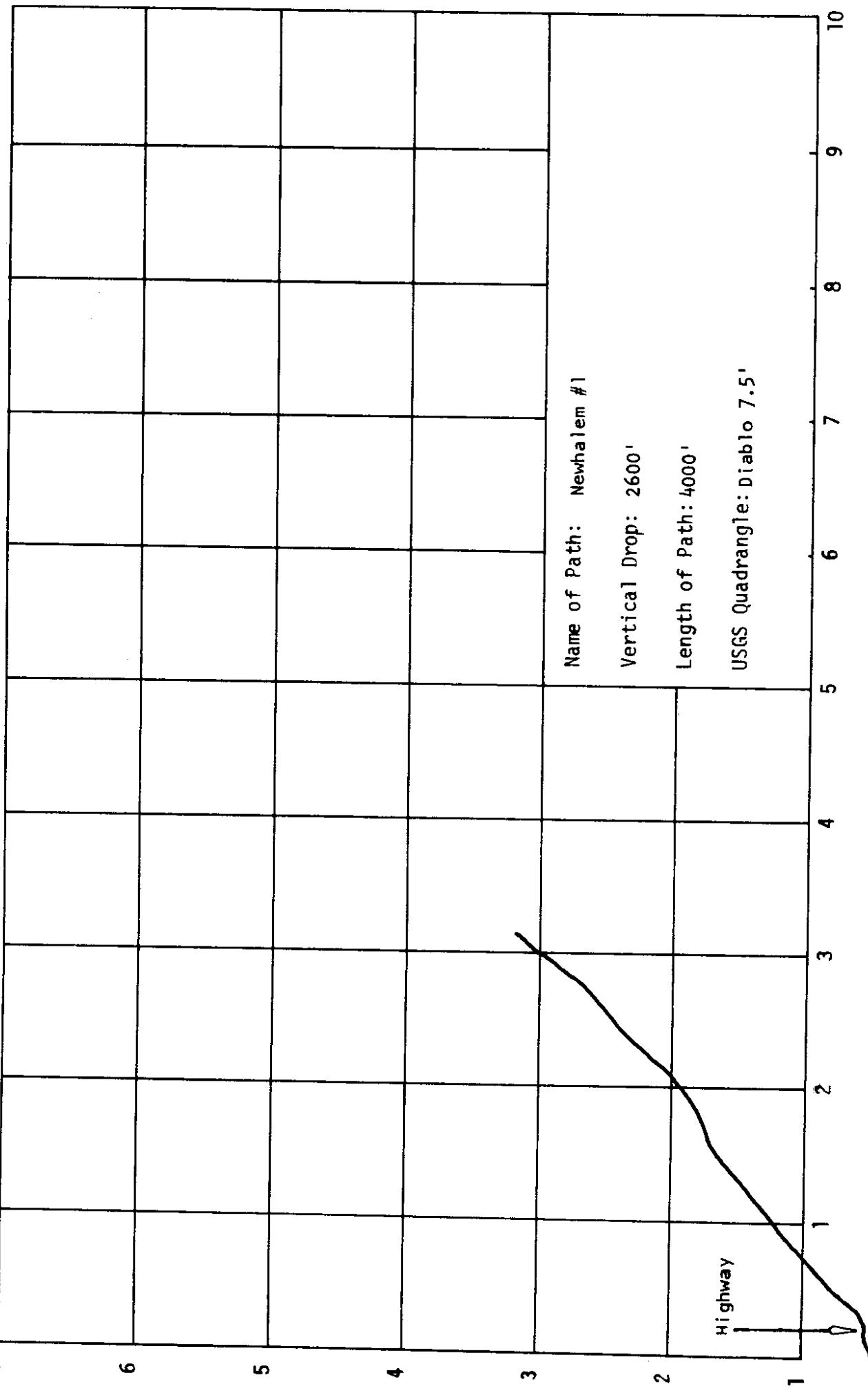
2/28/74----Snow avalanche fell but failed to reach highway.

3/10/74----Small amount of snow across highway.

Newhalem No. 1a (NH-1a)

An avalanche crossed the highway to full mapped path extent in the winter of 1971/72.

No other avalanches have been reported on this path.



North Cascades Highway SR-20

Avalanche Summary Sheet

Name of Path: Newhalen No. 1a

Hazard: Low, infrequent

Map: Diablo 7.5'

Location: Station _____ UTM 5393770 N , 629560 E

Elevation of starting zone: around 1500'

Vertical fall: 900' maximum Length:

Description:

This is a small path which originates on a series of small ledges and cliffs a short distance above the highway. There is no clearly-defined release zone. Sliding snow falls directly from the lowermost cliffs to the highway with little interception by a talus slope.

Expected Effect on Highway:

Infrequent deposition of snow on highway up to 100' or more wide. Most likely to run at times when thaw or rain follow fairly heavy snow deposition at low elevations in Diablo Gorge.

History:

No previous record of sliding at this site (Seattle City Light). An avalanche fell onto the highway in January 1971.

North Cascades Highway SR-20

Avalanche Summary Sheet

Name of Path: Newhalem No. 2

Hazard: Moderately high, annual

Map: Diablo 7.5'

Location: Station _____ UTM 5393930 N, 629800 E

Elevation of starting zone: around 2700 - 4200'

Vertical fall: 3600' maximum Length: 6600' maximum

Description:

This path has a large release zone consisting of slopes facing mostly south and south-southwest, through an elevation range of 1500'. The most active avalanche-producing slopes appear to lie below 3800'. Snow from these slopes fall into a deep narrow gulley which channels the avalanche flow southeast along a stream channel and onto the highway. Smaller avalanches are apt to come to rest in the lower part of the gulley before reaching the highway. Simultaneous discharge of avalanches from the entire release zone appears to be rare.

Expected Effect on Highway:

Annual deposition of snow on highway up to 300' or more wide and 20' or more deep. Moderately high hazard to moving traffic, high hazard to stalled traffic of snow removal equipment during periods of rain or thaw. Very limited chance of more than one slide reaching the highway in a short interval.

History:

This slide path runs to the highway annually. More than one such slide a year is possible. Slide activity normally follows heavy winter rain or thaw at elevations above about 2000', after deposition of substantial amounts of snow in the release zone.

Newhalem No. 2 (NH-2) (Falls Creek)

Winter of 1971/72:

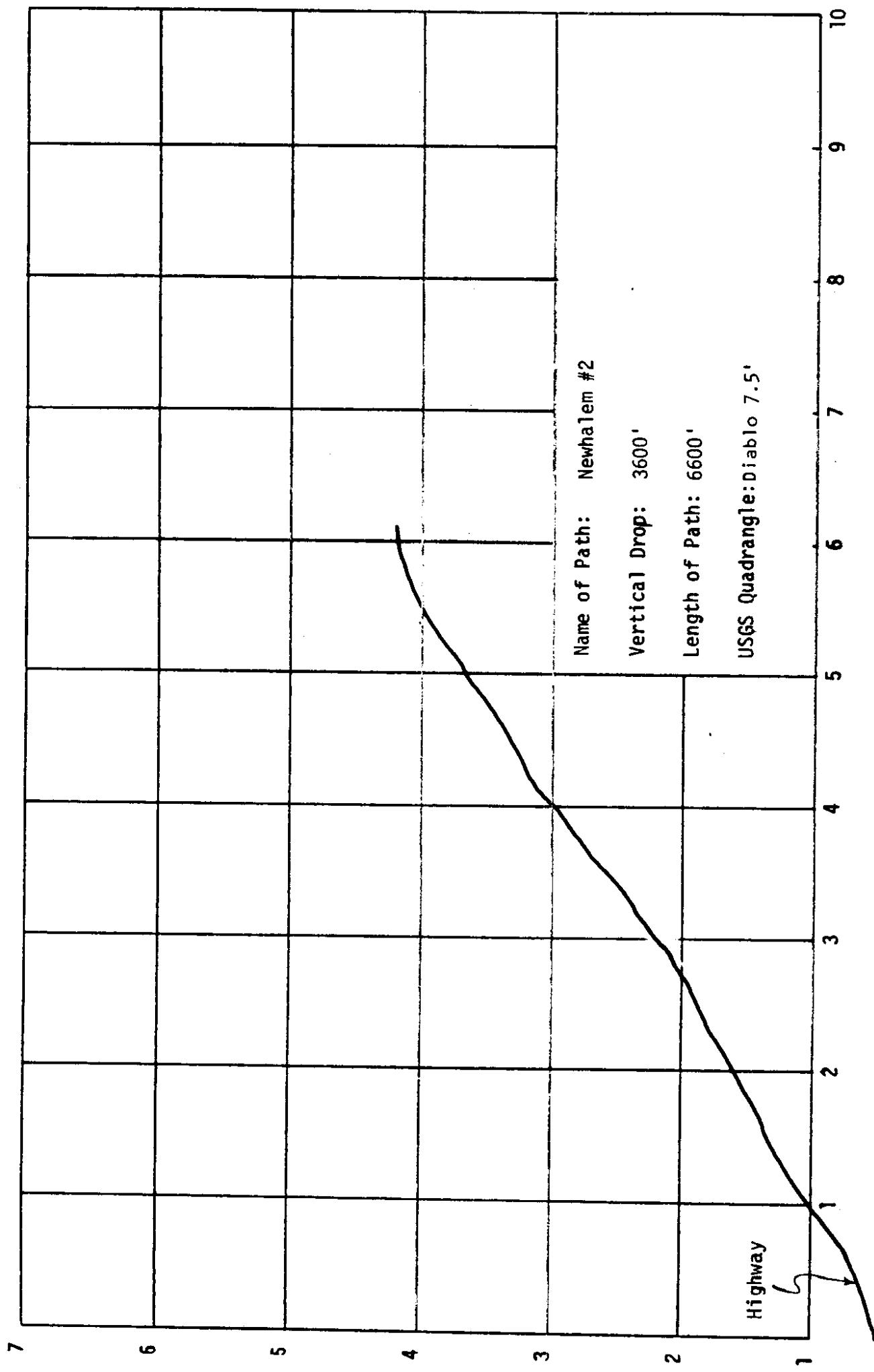
An avalanche crossed the highway with approximately the mapped width, but displaced slightly downstream from the mapped position. The bridge rail was damaged on the west side of the creek.

Winter of 1972/73:

No avalanches reported from this path.

Winter of 1973/74:

11/27/73---Mud, rock and snow avalanche at 8:00 PM (coincident with NH-1). The highway was covered 6 ft. deep and 300 ft. wide. There was considerable damage from this slide, which fell in three different channels. 200 ft. of guard rail were destroyed and a 4 foot section of reinforced concrete bridge removed.



North Cascades Highway SR-20

Avalanche Summary Sheet

Name of Path: Newhalem No. 2a

Hazard: Low, infrequent

Map: Diablo 7.5'

Location: Station _____ UTM 5394000 N, 629840 E

Elevation of starting zone: around 2000'

Vertical fall: 1400' maximum Length: _____

Description:

This path originates among a series of cliffs and sloping ledges immediately north of the gulley which channels Newhalem No. 2. The release zone is ill-defined. A much smaller release zone area than in No. 2 reduces the amount of sliding snow available, but the short, steep fall path can still result in appreciable amounts of snow reaching the highway. Lower part of the path is a narrow chute through the cliffs. Debris deposition on the highway overlaps that of No. 2.

Expected Effect on Highway:

Low to possibly moderate hazard, occasional deposition of snow on highway up to 200' or more wide. Avalanching most likely during rain or thaw following heavy snowfall at lower elevations in Diablo Gorge. Occurs frequently enough to be a nuisance, but not annually.

History:

This path is described as a "regular performer through the years" (City Light). It fell in full mapped volume in the winter of 1971/72. No avalanche was reported reaching the highway in 1972/73. On 2/2/74, a small snow avalanche crossed the highway. A larger avalanche fell on 3/10/74, leaving debris on the highway 50 ft. wide and 15 ft. deep.

-15-

NH-5

North Cascades Highway SR-20

Avalanche Summary Sheet

Name of Path: Newhalem No. 3 (Afternoon Creek)

Hazard: Moderately low, infrequent

Map: Diablo 7.5'

Location: Station _____ UTM 5394060 N, 628120 E

Elevation of starting zone: 5400' maximum

Vertical fall: 4800' Length: 9500'

Description:

This path originates on the south face of Mt. Ross and on the southwest facing flanks of a large gully which descends from Mt. Ross to Diablo Gorge. Below the principal release zones this gully channels avalanche flow for nearly one-half mile before opening out onto a large debris fan which is skirted by the highway. Large avalanches fall here annually or oftener, but most of the debris is arrested during the long traverse of the gully or on the fan and reaches the highway only infrequently. Terrain configuration and vegetations patterns suggest that very large avalanches here have reached to the Skagit River, but only at long return intervals.

Expected Effect on Highway:

Infrequent deposition of debris on highway, but possibility of a very large amount of snow - up to 800' or more wide - covering highway if an exceptionally large avalanche overruns the debris fan. Hazard moderately low on basis low incidence of snow sliding to highway.

History:

Most avalanches reported to stop in gully or on debris fan, and seldom reach highway (Seattle City Light). During the exceptionally heavy avalanche cycle in Diablo Gorge in January 1971, a large avalanche descended NH-3 but came to rest on the upper part of the debris fan.

Newhalem No. 3 (NH-3) (Afternoon Creek)

Winter of 1971/72:

An avalanche reached the upper talus cone above the highway and one narrow finger descended the stream bed to cross the highway at the west margin of the mapped slide path.

Winter of 1972/73:

No avalanches reported from this path.

Winter of 1973/74:

1/14/74----A rock, mud and snow avalanche covered the highway 350 ft. wide and up to 10 ft. deep.

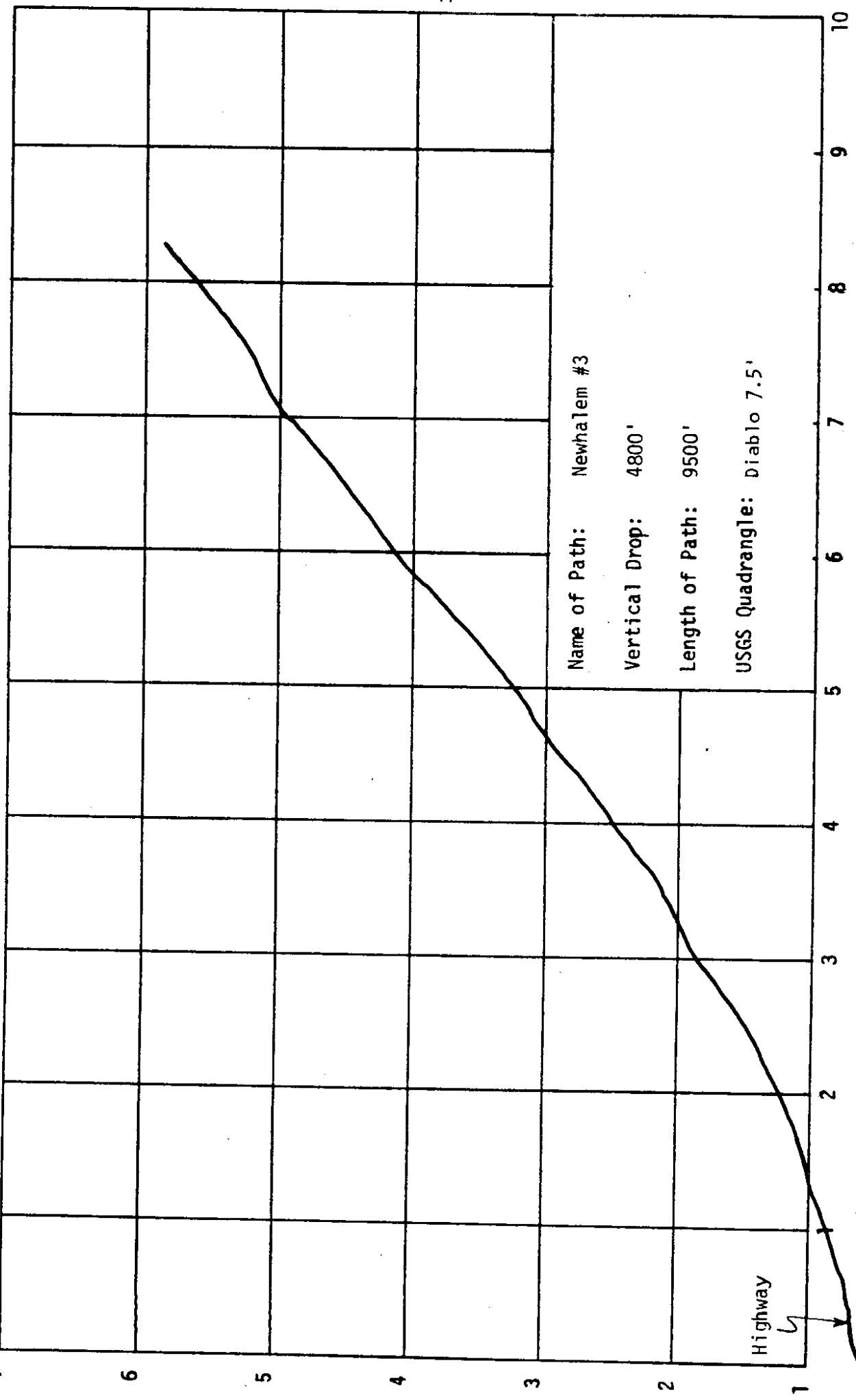
1/15/74----Snow avalanche across the highway 500 ft. wide and 10 ft. deep. There was much damage to the roadbed and shoulder.

1/24/74----An avalanche fell but did not reach the highway.

1/30/74----An avalanche fell and broke a new channel. It covered the highway 200 ft. wide and up to 25 ft. deep.

1/31/74----Another avalanche fell, but dimensions are not reported.

Scale: 1" = 1000'



North Cascades Highway SR-20

Avalanche Summary Sheet

Name of Path: Newhalem No. 4 (Devil's Elbow)

Hazard: Moderate, possibly several times a winter

Map: Diablo 7.5'

Location: Station _____ UTM 5394340 N , 630240 E

Elevation of starting zone: 1200'

Vertical fall: 400' Length:

Description:

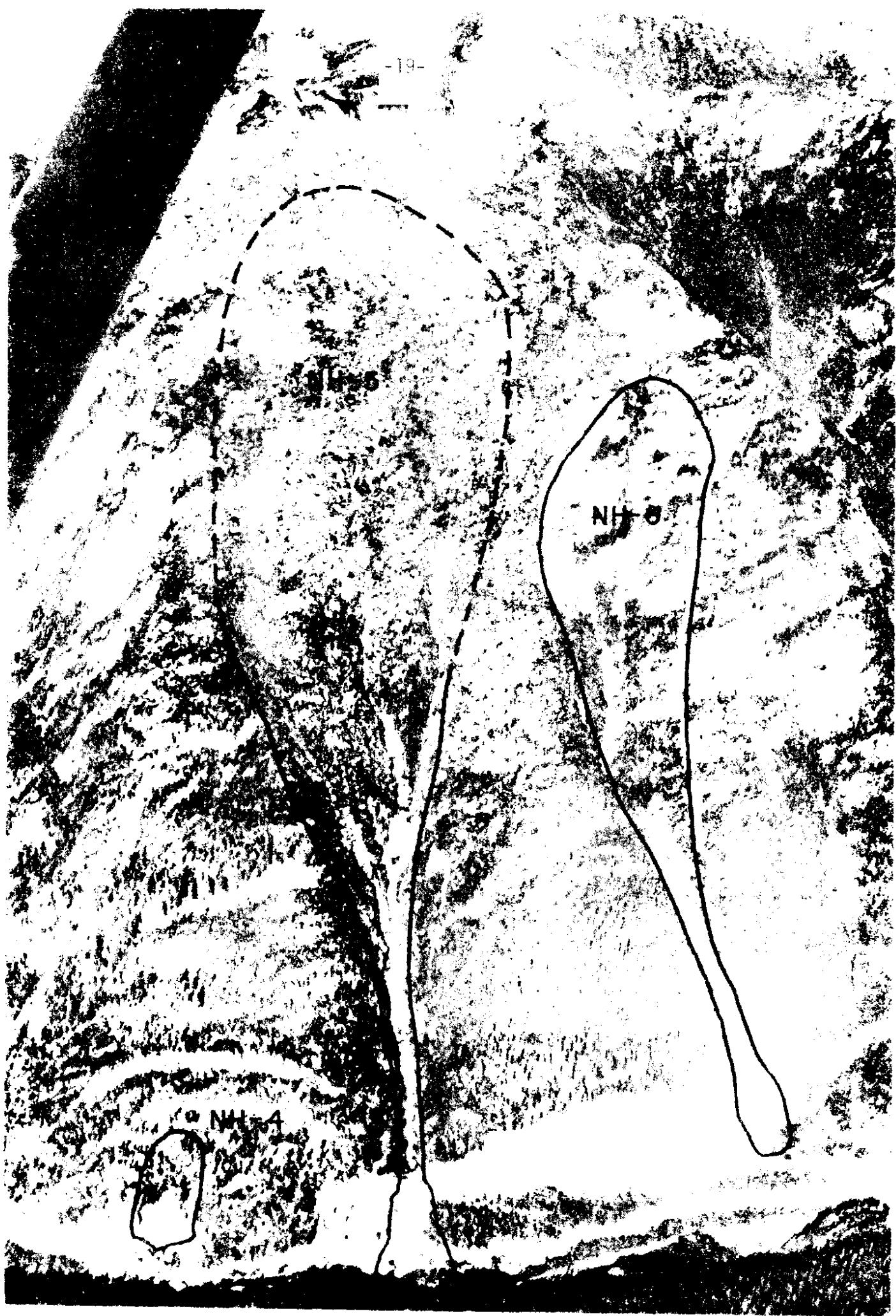
This short, steep slope between the power line and the highway discharges small avalanches onto the highway just west of Tunnel No. 1. The release zone is a very steep slope (over 45°) at the foot of a short cliff. Toe of this steep slope terminates at the highway edge.

Expected Effect on Highway:

Any appreciable snowfall at lower elevations in Diablo Gorge is apt to result in large sluffs running onto the highway. The steep release zone insures frequent discharge of snow, hence large quantities are less likely to build up prior to sliding. Not a major avalanche path like NH-2, 3 and 5, but a recurring nuisance for highway maintenance. The path is long enough to generate substantial impact forces from the sliding snow and is a definite hazard to traffic, and actually a higher hazard than some of the bigger paths due to a higher frequency.

History:

Described by Seattle City Light as a recurring sluff problem



North Cascades Highway SR-20

Avalanche Summary Sheet

Name of Path: Newhalem No. 5 (Brown's Slide)

Hazard: Moderately high, several times each winter

Map: Diablo 7.5'

Location: Station _____ UTM 5394640 N, 629960 E

Elevation of starting zone: Up to 5200'

Vertical fall: 4400' Maximum Length: 8000'

Description:

This slide originates on the broad, open slope constituting the SE flank of Mt. Ross. The release zone is not clearly defined. Avalanches can originate at one or more places on this flank and multiple releases within a short period are possible. The open slopes converge to a gulley at about the 2400' level. This gulley descends straight down the fall line, narrowing at lower elevations. Sliding snow normally is confined to the gulley but can spread to either side at the highway level if the avalanche is large. Larger avalanches usually reach the Skagit River and have been observed to cross the river and reach the old railroad grade on the other side.

Expected Effect on Highway:

Recurring deposition of snow on the highway each winter, up to 600' wide. The large release zone area and the relatively short, straight outrun gulley combine to deliver snow to the highway up to several times each winter. A distinct hazard to traffic and a serious safety problem during snow removal operations due to the possibility of recurring avalanches.

The release zone is readily visible from the highway, so status of slide activity can readily be checked. Suitable for artificial release by artillery fire from the Gorge Dam access road.

History:

Normally slides several times each winter (Seattle City Light). A large avalanche reached the Skagit River in January, 1971.

Newhalem No. 5 (NH-5) (Brown's Creek)

Winter of 1971/72:

This path ran in full volume to the valley floor. Debris was deposited on the highway slightly wider than the mapped path, both up and downstream.

Winter of 1972/73:

No avalanches reported from this path.

Winter of 1973/74:

1/14/74----Rock, mud and snow covered the highway for 300 ft. and up to 12 ft. deep.

1/15/74----Snow and debris covered the highway 350 ft. wide and up to 40 ft. deep. There was extensive damage. All culverts were filled with debris. Water flowed through Tunnel No. 1 and carried away the floor. One mile of roadbed was torn up. This slide apparently was a combination of snow and a water flood.

1/24/74----An avalanche fell but did not reach the highway.

1/29/74----An avalanche falling in the AM covered the highway 300 ft. wide and 40 ft. deep.

1/31/74----Snow avalanche fell, dimensions not reported.

2/5/74----Snow avalanche fell but did not reach highway.

2/19/74----Snow avalanche covered the highway 70 ft. wide and 20 ft. deep.

2/28/74----Snow avalanche covered the highway 60 ft. wide and 30 ft. deep.

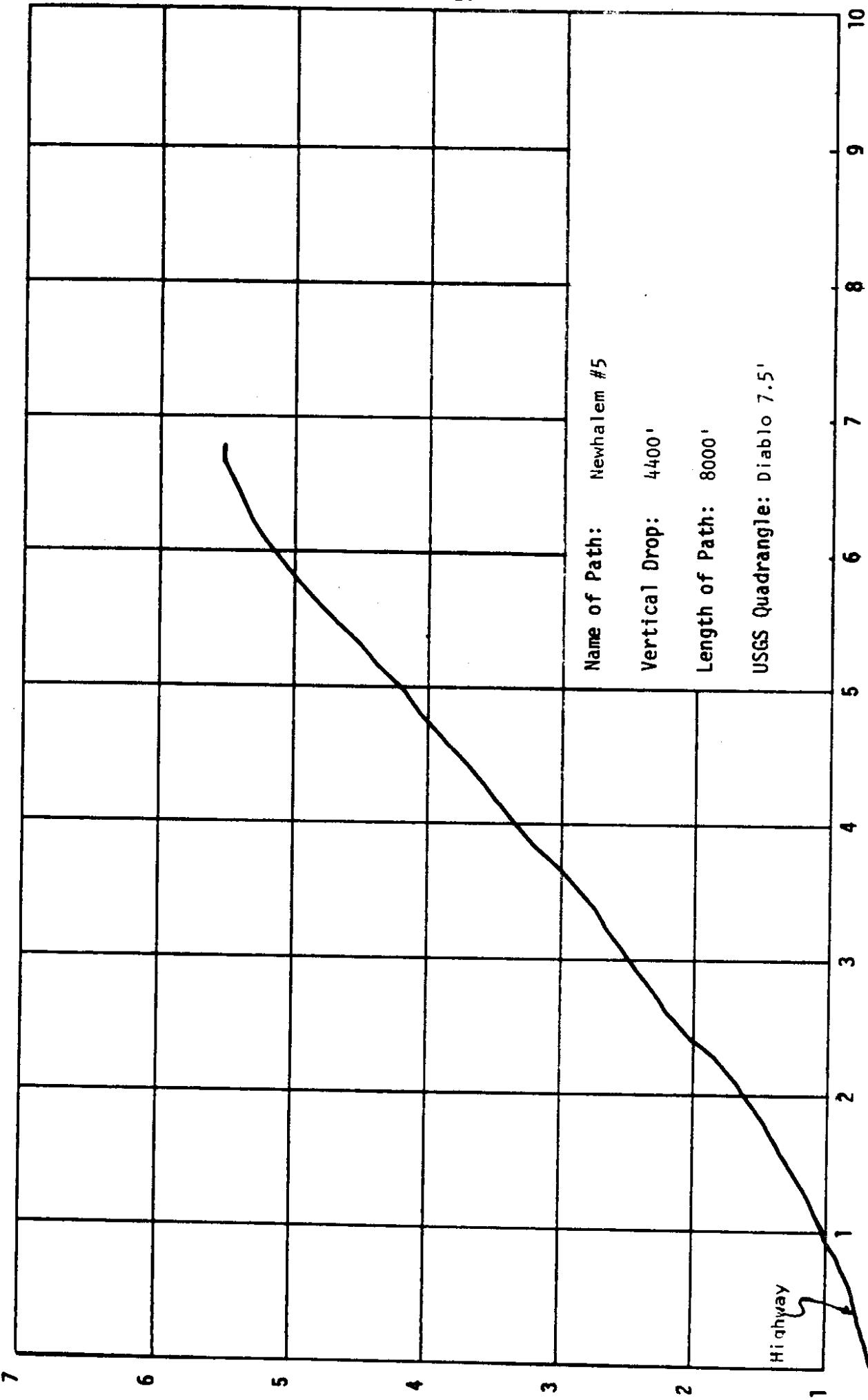
3/5/74----Snow avalanche covered the highway 350 ft. wide and 35 ft. deep.

3/7/74----Small avalanche across the highway.

3/9/74----Snow avalanche covered the highway 50 ft. wide and 15 ft. deep.

3/10/74----Snow avalanche covered the highway 350 ft. wide and 40 ft. deep.

Note: Not all of the release zone of NH-5 is visible from the highway, as stated in the Avalanche Summary Sheet.



North Cascades Highway SR-20

Avalanche Summary Sheet

Name of Path: Newhalem No. 6

Hazard: Moderate, annual

Map: Diablo 7.5'

Location: Station _____ UTM 5395160 N, 631390 E

Elevation of starting zone: 4200'

Vertical fall: 3200' Length: _____

Description:

This path originates lower on the SE flank of Mt. Ross than NH-5 and is separated from the latter by a shallow ridge. The release zone is a series of open slopes facing approximately south which below 3000' lead into a well-defined stream channel trending SE. Flow of sliding snow is normally confined to the narrow gulley in its lower reaches. Avalanches here are reported to be usually fast-moving and to leave relatively little debris on the highway.

Expected Effect on Highway:

Deposition of debris up to 100' or more wide on highway at least once each winter. Moderate hazard to moving traffic and to snow-removal operations. Avalanche snow from this path often heavily laden with debris.

Note: Immediately NE of NH-6, two small avalanche paths fall from ill-defined release zones among cliffs and ledges. Sliding snow normally is arrested in a heavy stand of timber just above the highway, but penetration of this timber to the highway should be considered possible during unusually bad avalanche conditions.

History:

Reported to run regularly once each year (Seattle City Light). Occurrence most likely with rain or thaw following heavy winter or spring snowfalls.

Newhalem No. 6 (NH-6) (No-Name Creek)

Winter of 1971/72:

This path ran in nearly full volume and covered the highway.

Winter of 1972/73:

No avalanches reported from this path.

Winter of 1973/74:

1/14/74----Rock, mud and snow on highway, 4 ft. deep and 60 ft. wide.

2/5/74-----A small snow avalanche crossed the highway.

Newhalem No. 7 (NH-7) (Gorge Creek)

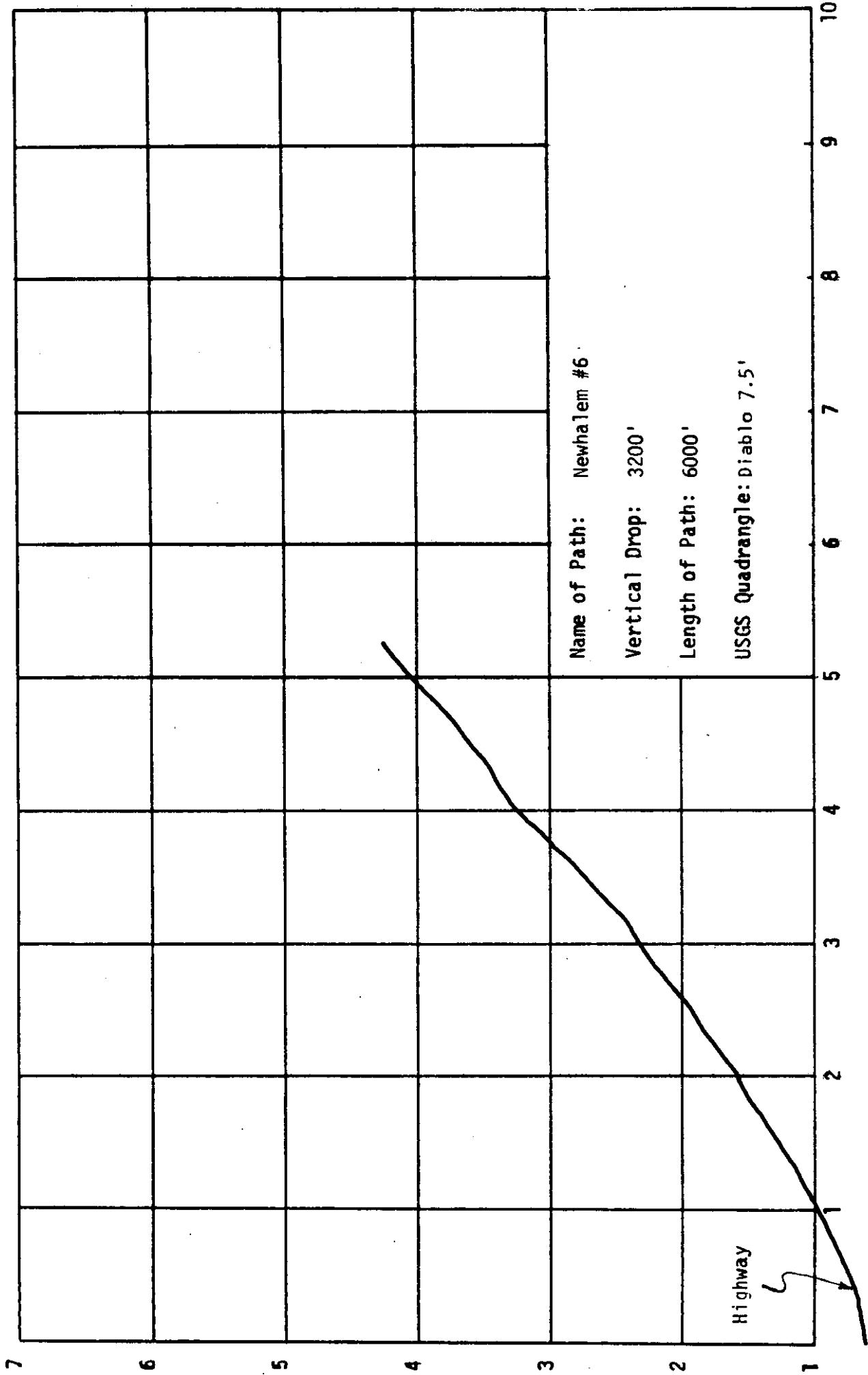
Winter of 1971/72:

A long, narrow tongue of a wet avalanche flowed over the falls and descended the stream bed almost to the bridge (full mapped extent).

Winter of 1972/73:

No avalanches reported from this path.

Winter of 1973/74:





North Cascades Highway SR-20

Avalanche Summary Sheet

Name of Path: Newhalem No. 7 (Gorge Creek)

Hazard: Very low

Map: Diablo 7.5'

Location: Station _____ UTM 5395620 N, 631730 E

Elevation of starting zone: Up to 6400'

Vertical fall: 5400' Length: 11,500'

Description:

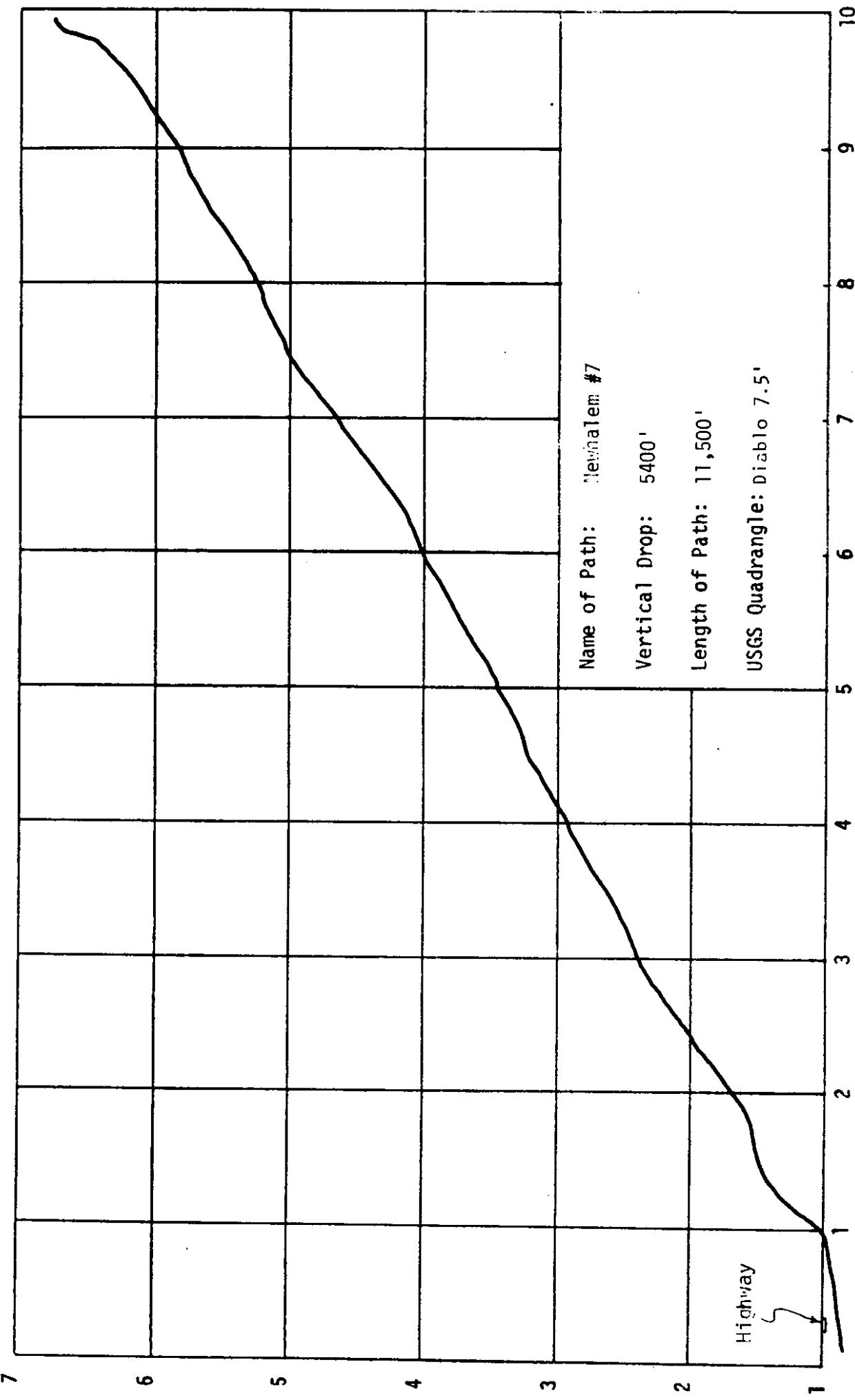
A converging pattern of gulleys on the SW flank of Davis Peak collects sliding snow from a large area and delivers it into Gorge Creek just above the falls visible from the highway bridge. This is a very large avalanche path. There is vegetation evidence that sliding snow may have overrun the falls and descended into the gorge under the present bridge site in the past. This record is partially confused by the effects of a large mud slide which came down Gorge Creek about 1957.

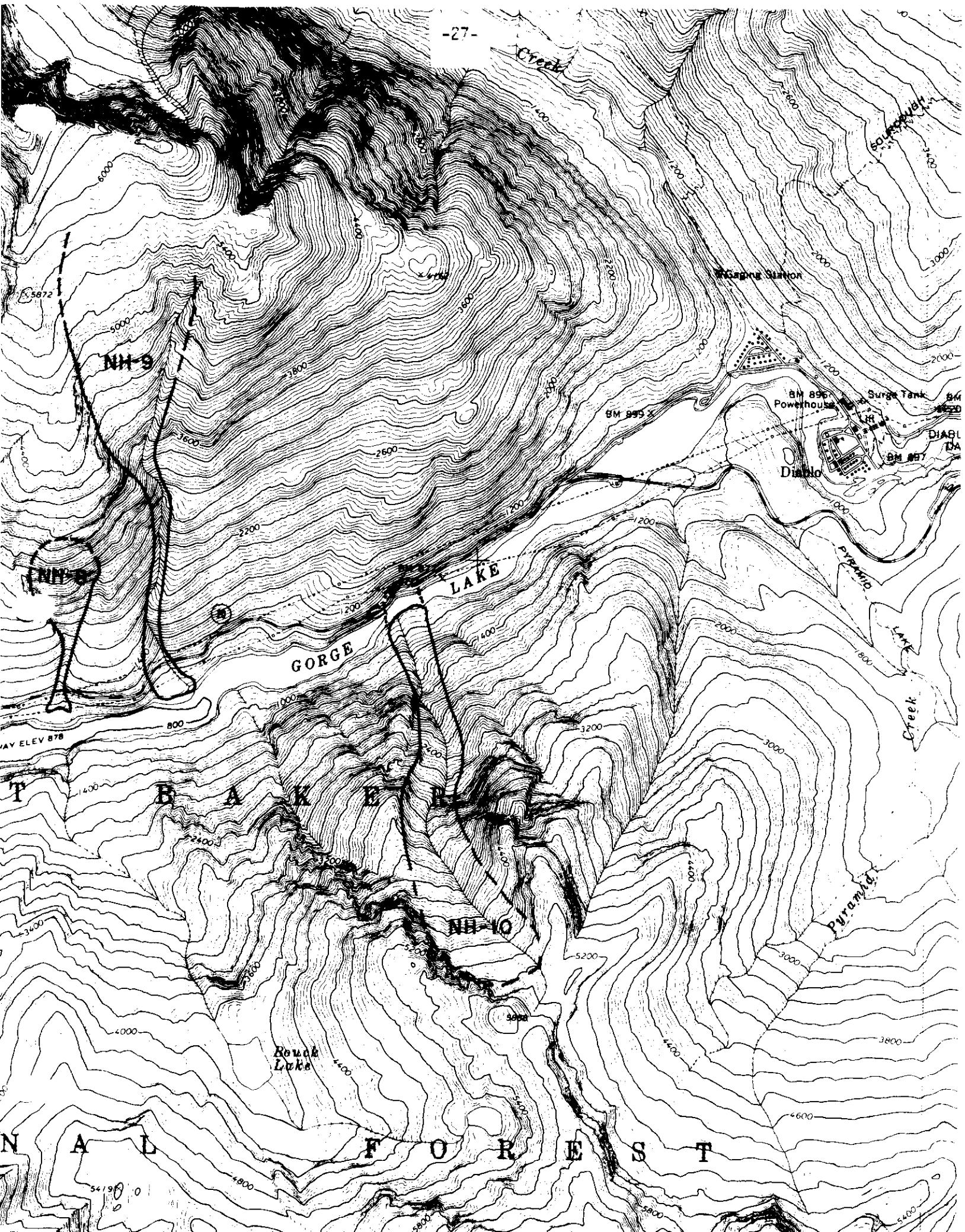
Expected Effect on Highway:

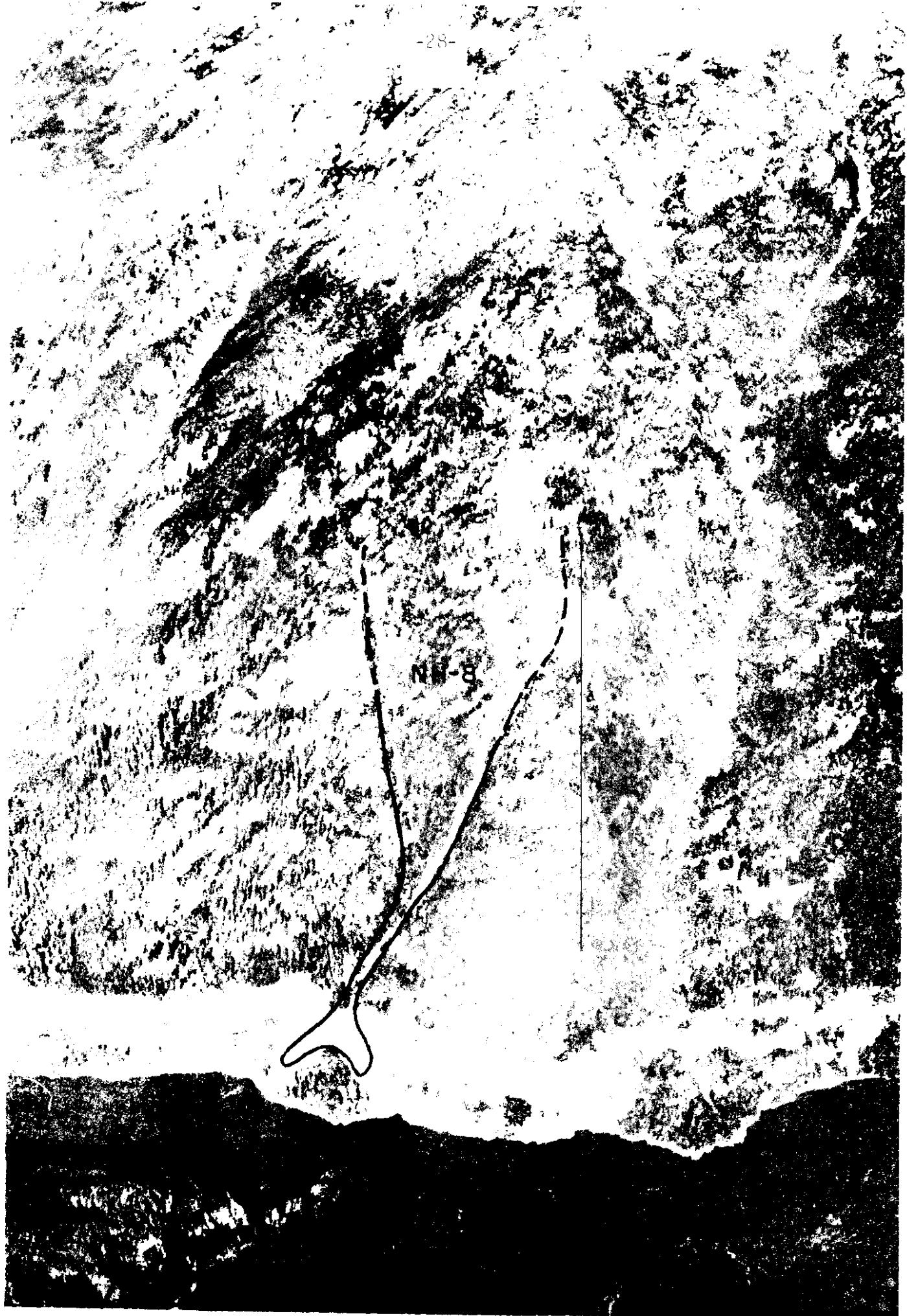
Very slight. Even a large avalanche flowing into Gorge Creek and over the falls would be expected to remain well below the bridge level and not affect the highway. The terrain configuration, however, very definitely favors funnelling of a dust cloud and possible wind blast across the bridge deck if a large dry snow avalanche should ever fall from Davis Peak. For this reason NH-7 is included in the inventory of avalanches influencing the North Cascades Highway.

History:

No avalanche have been observed to come over the falls in Gorge Creek since the highway was completed in 1958. (Seattle City Light)







North Cascades Highway SR-20

Avalanche Summary Sheet

Name of Path: Newhalem No. 8

Hazard: Moderately low, irregular intervals

Map: Diablo 7.5'

Location: Station _____ UTM 5395660 N , 632670 E

Elevation of starting zone: around 3600'

Vertical fall: 2500' Length: 3100'

Description:

This path has a poorly defined starting zone low on the south flank of Davis Peak. Sliding snow is collected in a diagonal gulley which runs SSW to the highway. This path diverges after crossing the highway and drops to Gorge Lake along two alternate paths. A heavy stand of brush and alder in the lower gulley above the highway suggest that this path does not often run in large volume.

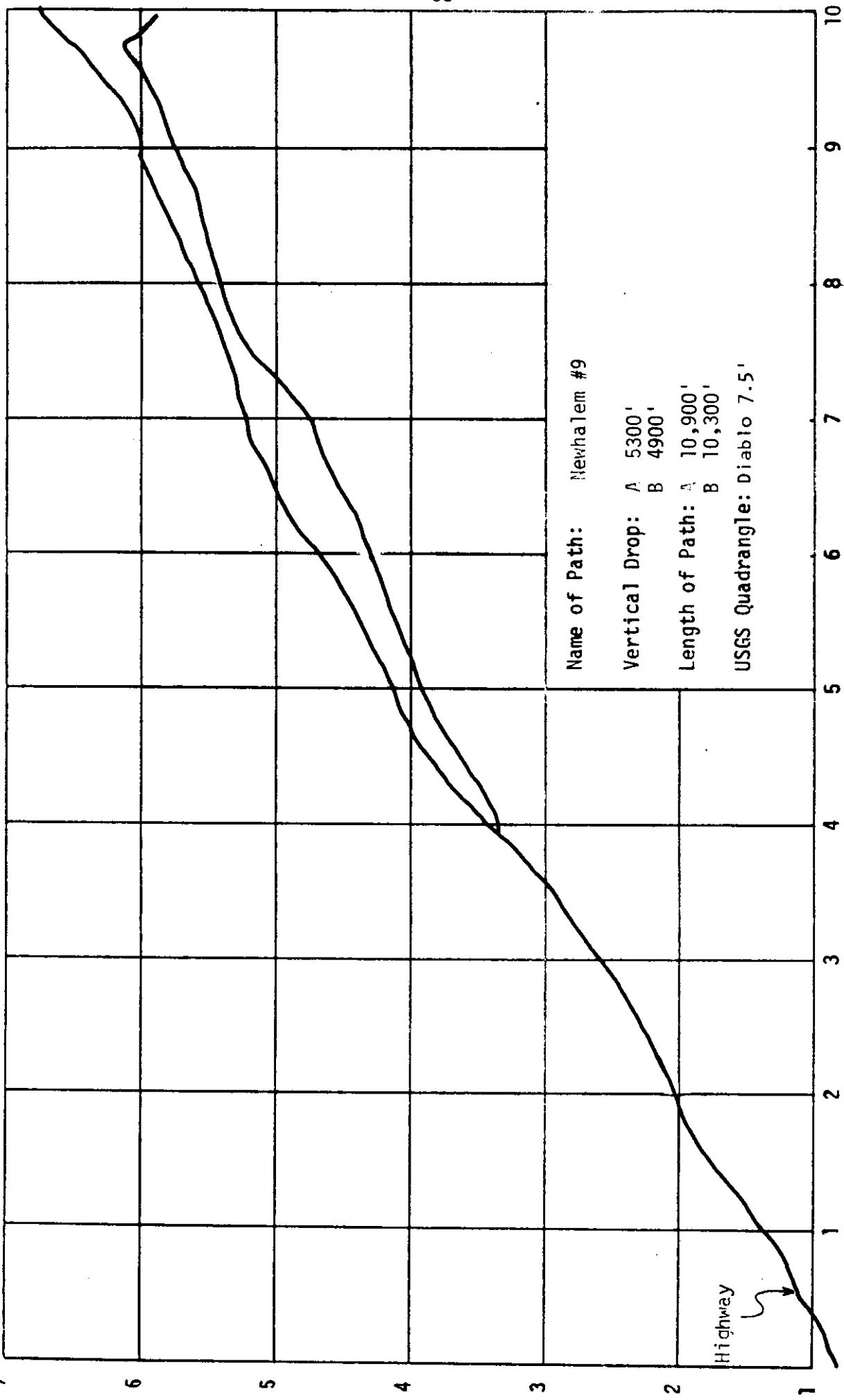
Expected Effect on Highway:

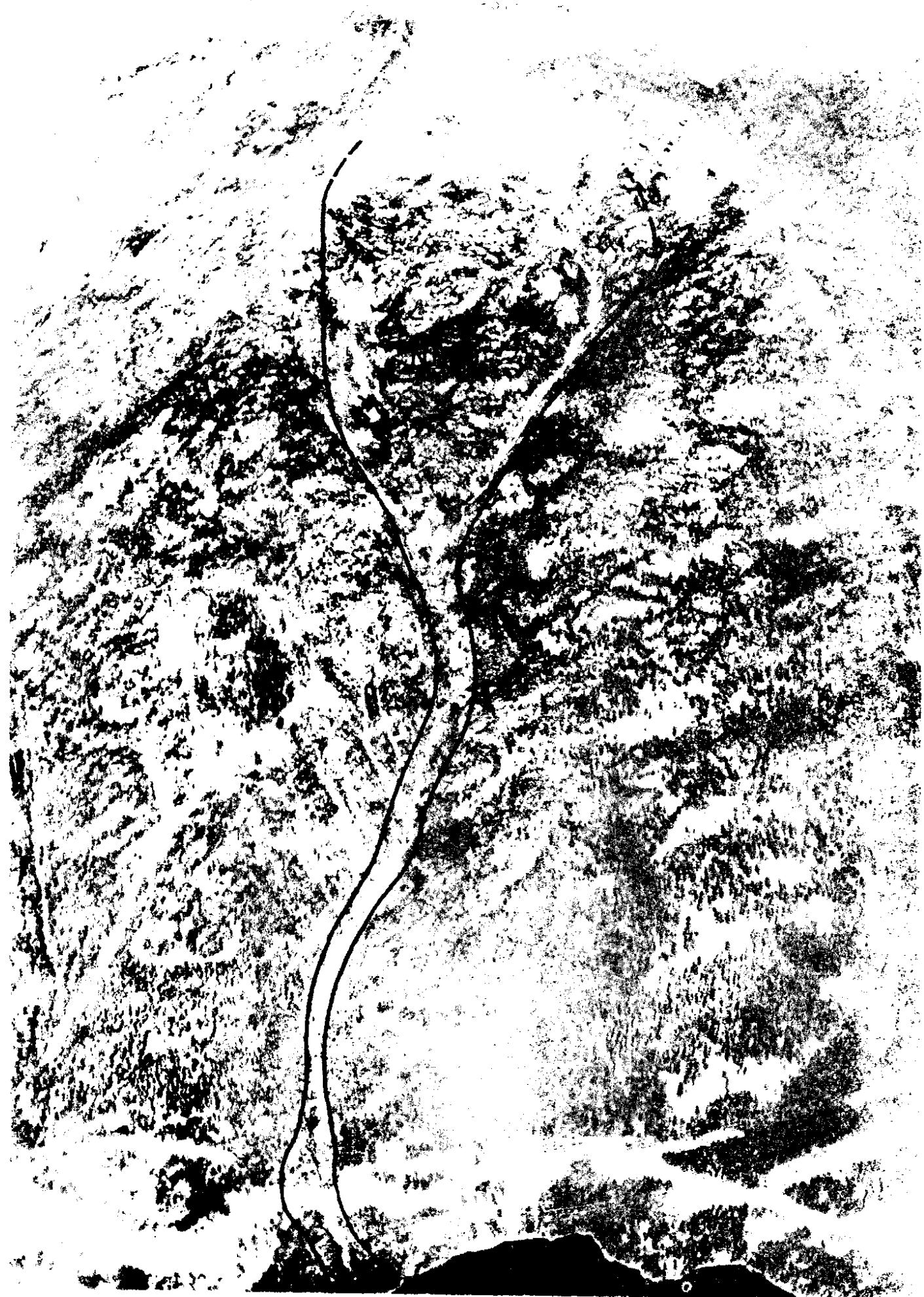
Occasional deposition of moderate amounts of snow on the highway. Occurrence appears to be sporadic and on the average less than annually. This path has not been a serious maintenance problem (Seattle City Light).

History:

Rather small avalanches at irregular intervals. Does not run every year. Several avalanches fell here, however, in the winter of 1968/69. There were few the following winter. A small avalanche crossed the highway in 1971/72. None fell in 1972/73.

-30-





North Cascades Highway SR-20
Avalanche Summary Sheet

Name of Path: Newhalem No. 9 (Davis Peak)

Hazard: Moderate, annual

Map: Diablo 7.5'

Location: Station _____ UTM 5395820 N, 633020 E

Elevation of starting zone: 6000' - 6400'

Vertical fall: 4900' - 5300' Length: 10,300 - 10,900

Description:

This path has a broad, open release zone on the upper SE flank of Davis Peak. Two separate and well-defined gullies converge at the 3400' level to form a single, winding channel which passes over a band of steep cliffs just before it reaches the highway. Separate avalanche release from the two gullies is possible. The length and character of the lower channel suggest that many avalanches may come to rest along the channel middle reach which is not visible from the highway. Normal avalanche flow is over the cliffs in the channel center and directly onto the highway. Evidence from vegetation suggests that on rare occasions an exceptionally large avalanche may spread well beyond the confines of the gully, especially to the southwest.

Expected Effect on Highway:

Deposition of snow on the highway up to 200' or more wide at least once a year and sometimes oftener. Deposition to depths of 20'30 may be expected. A moderate hazard to moving traffic, but a serious hazard for snow removal equipment due to possibility of recurring slide activity within a short period. Sliding snow at this site which overruns the road usually runs all the way into Gorge Lake.

History:

Falls to highway on an average of once a year, and occasionally twice a year. In April 1971, two large avalanches reached the road at this site within 24 hours, the second burying a tractor engaged in clearing the first. The avalanches which fell in 1971 (also in January) are the largest at this site since the highway was opened in 1958.

Newhalem No. 9 (NH-9) (Davis Peak) (also Ketchum Creek)

Winter of 1971/72:

An avalanche crossed the highway with about half the mapped width.

Winter of 1972/73:

No avalanches reported from this path.

Winter of 1973/74:

1/14/74----Snow avalanche across highway, 10 ft. deep and 150 ft. wide.

1/15/74----Snow avalanche across highway, 20 ft. deep and 350 ft. wide.

1/29/74----Snow avalanche across highway, 30 ft. deep and 300 ft. wide.

3/4/74-----A small avalanche deposited 2 ft. of snow on the highway.

3/10/74----Snow avalanche across highway, 40 ft. deep and 300 ft. wide.

North Cascades Highway SR-20
Avalanche Summary Sheet

Name of Path: Newhalem No. 10

Hazard: Very low

Map: Diablo 7.5'

Location: Station _____ UTM 5396290 N, 634480 E

Elevation of starting zone: 5200'

Vertical fall: 4300' Length: Approx. 8000'

Description:

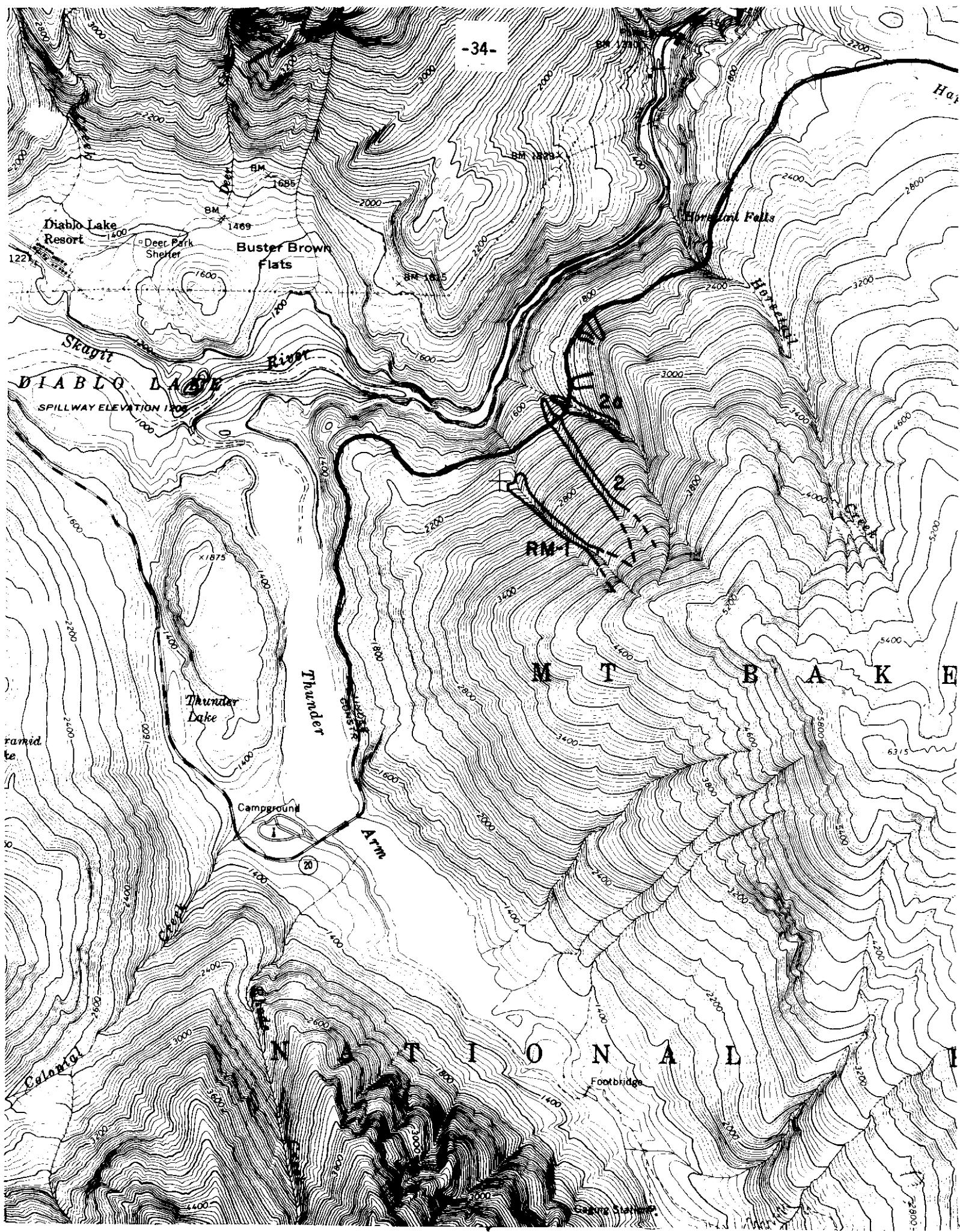
Unlike all the rest of the Diablo Gorge avalanche paths affecting the highway, this one falls from a north-facing slope. It originates in a prominent basin on the north flank of the NE shoulder of Pyramid Peak and falls to the shore of Gorge Lake directly across the lake from Tunnel No. 3. Flowing snow enters the lake at the tip of a prominent debris fan and does not affect the highway. Wind blast from a large dry snow avalanche has in the past caused destruction of timber on the north shore of Gorge Lake and would throw debris onto the highway if it occurs in this fashion again. Due to difference in exposure of the release zone, NH-10 normally will run under different snow and weather circumstances than the paths on the highway side of the gorge.

Expected Effect on Highway:

Possible deposition of wind blast debris on the highway at infrequent intervals. Also possible damage to moving vehicles from the same source.

History:

A large avalanche with wind blast destruction of timber at the present highway site fell in 1952 or 1953. There has been no such occurrence since the highway was completed in 1958. A very large wet snow avalanche fell on this path in the spring of 1971 and temporarily choked Gorge Lake with snow debris, but there was no effect on the highway. A similar but smaller avalanche reached Gorge Lake in 1972. No avalanches were reported in the winter of 1972/73.



North Cascades Highway SR-20
Avalanche Summary Sheet

Name of Path: Ruby Mountain No. 1

Hazard: Low, infrequent

Map: Ross Dam 7.5'

Location: Station 377+81 UTM 5396930 N, 641300 E

Elevation of starting zone: 4300'

Vertical fall: 2400' Length: _____

Description:

This is a very narrow path which follows a stream bed straight down the fall line from the NW shoulder of Ruby Mountain. Vegetation scars show that in the past it has penetrated about half way from the present highway grade to Diablo Lake. The release zone is a small, ill-defined area of scattered timber. Avalanche activity is probably confined to wet snow conditions. Sliding snow normally is confined to the gully but a timber trimline suggests that a large avalanche may have descended the path within the past 20 to 40 years.

Expected Effect on Highway:

Little serious effects. Some avalanching probably occurs during wet slide conditions in this path every year, but snow reaches the highway only during unusual conditions. Quantity of sliding snow will be relatively small, but most of it will be caught on the highway. 100' is probably the maximum width on the highway.

History:

Appears to have reached the highway level only at irregular intervals of several years. Spring avalanche in 1971 reached just to edge of road.

North Cascades Highway SR-20

Avalanche Summary Sheet

Name of Path: Ruby Mountain No. 2

Hazard: Low, infrequent

Map: Ross Dam 7.5'

Location: Station 383 UTM ,

Elevation of starting zone: 4800'

Vertical fall: 2900' Length:

Description:

This path originates in an ill-defined release zone among moderately open bimber. Sliding snow descends a winding stream bed which occupies a prominent ravine on the NW shoulder of Ruby Mountain. It normally is confined to the stream bed, but a trim like in the timber on the west side of the stream indicates a large avalanche overrode the stream bed possibly 15-20 years ago. Avalancheing probably occurs each year during wet snow conditions, but reaches to the highway only at longer intervals.

Expected Effect on Highway:

Little serious effect. Low probability of snow reaching the highway, and this in fairly small quantities. Earth fill over culvert normally will arrest most sliding snow before it covers the right-of-way.

History:

Appears to reach the highway level only at irregular intervals of several years. The spring slide in 1971 reached within 10' of the highway. It contained timber debris including tree trunks up to 6" - 12" in diameter, suggesting that this was the largest avalanche to have fallen here in as much as 20 years.

Ruby Mountain No. 2 (RM-2)

Winter of 1971/72:

A large avalanche overran the previous and mapped path boundaries with accompanying timber debris. About 150 ft. of the highway guard rail was destroyed.

Winter of 1972/73:

No avalanches reported from this path.

Winter of 1973/74:

1/27/74----An avalanche ran within 30 ft. of the highway.

2/13/74----An avalanche of unspecified size crossed the highway. No snow debris or other evidence was visible in mid-April.

Ruby Mountain No. 2a (RM-2a)

This path, not mapped in the original Atlas, descends a prominent gully just east of RM-2. An avalanche descended this gully in 1971/72, crossing the highway and running a short distance beyond. Lack of guard rail damage suggests this fell as a dry snow avalanche.

No avalanche was reported here in 1972/73.

An avalanche in 1973/74 ran onto the highway and caused minor guard rail damage.

RM-2a Bank Slides

Steep, rocky slopes just above the highway and just east of RM-2a discharged small avalanches onto the highway in 1971/72. Another and similar bank slide also appeared in 1971/72 just around the corner to east, beneath the microwave reflector. The latter slope is somewhat longer and generated a big enough avalanche to carry minor timber debris to the highway.

North Cascades Highway SR-20

Avalanche Summary Sheet

Name of Path: Ruby Mountain No. 3

Hazard: Low, infrequent

Map: Ross Dam 7.5'

Location: Station 545+50 UTM 5398610 N., 644010 E.

Elevation of starting zone: 3600'

Vertical fall: 1500' Length: _____

Description:

A very narrow slide path following a stream gully through heavy timber on the north flank of Ruby Mountain. The release zone is located in open scree patches among the timber. Sliding snow is confined to the stream channel and there does not appear to be any trim line in the timber resulting from a larger avalanche.

Expected Effect on Highway:

Very limited effect. Small wet slides probably occur annually; these reach the highway only at longer intervals. Amount of snow deposited on the highway in such cases is expected to be small.

History:

A spring avalanche in 1971 reached the highway and deposited a small amount of snow on the right-of-way. This slide appeared to be larger than any that had fallen here for several years.

North Cascades Highway SR-20

Avalanche Summary Sheet

Name of Path: Ruby Mountain No. 4

Hazard: Very low, infrequent

Map: Ross Dam 7.5'

Location: Station 557+0 UTM 5398540 N, 645290 E

Elevation of starting zone: 3800'

Vertical fall: 1600' Length: _____

Description:

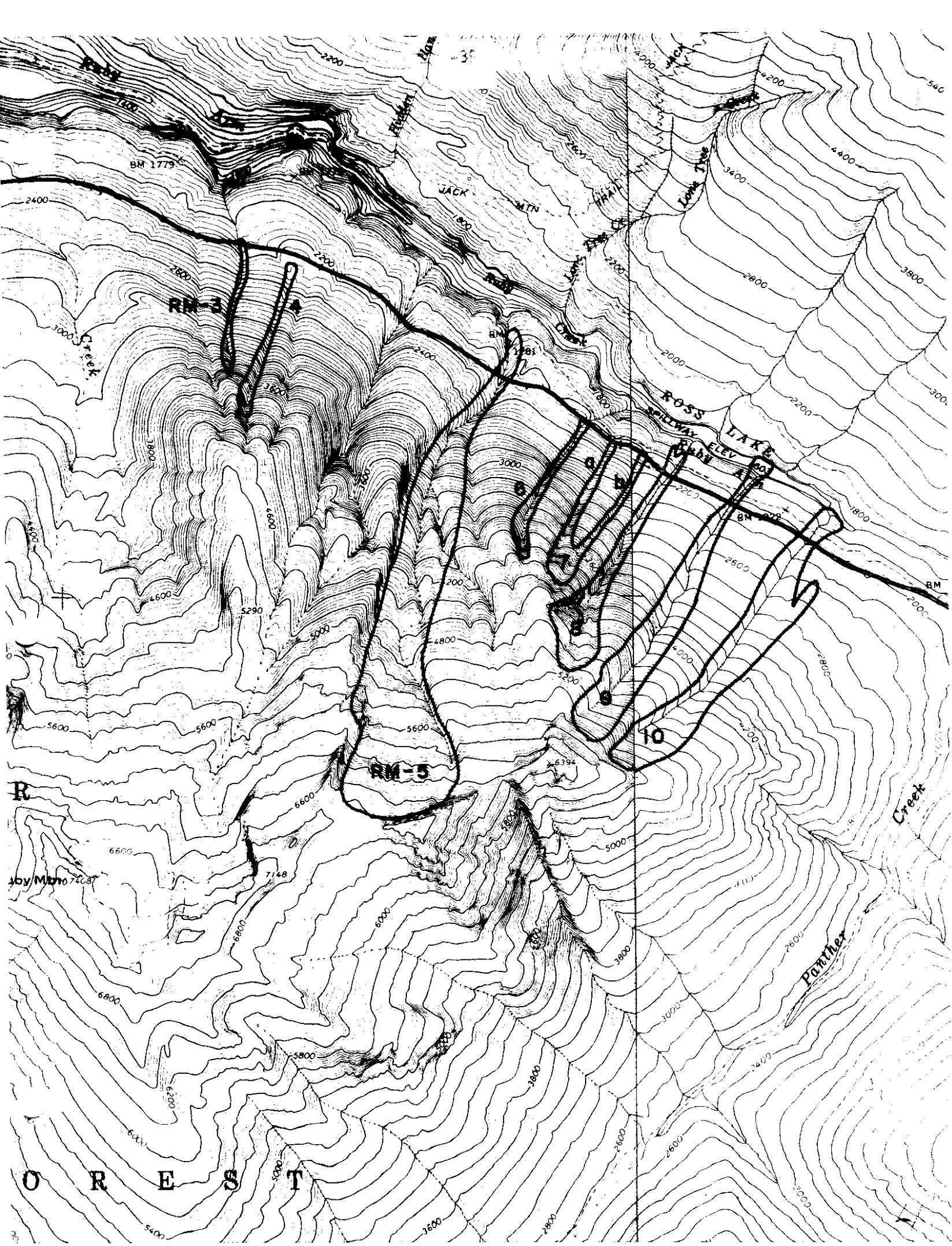
Similar to RM-3, this path descends a narrow stream bed through heavy timber on the north flank of Ruby Mountain. The release zones are adjacent, with No. 4 also originating in open scree patches. Principal slide activity appears to stop within 100 - 150' of the highway. There is a screen of heavy timber between this point and the highway, although snow may have reached the right-of-way location at Stations 557 and 558 at some time in the past. This path will predominantly be active under wet avalanche conditions.

Expected Effect on Highway:

Not likely to reach the highway except under ususually bad avalanche conditions. In such circumstances the deposited snow on the highway is not apt to be large in volume, but would be heavily laden with broken trees and branches.

History:

Slides probably occur here annually or oftener, but are apt to reach the highway only at long intervals of several to many years. The spring avalanche in 1971 in this path reached within about 100' of the highway.



Ruby Mountain No. 3 through No. 8 (RM-3 through RM-8)

Winter of 1971/72:

RM-3 and RM-7a ran in small volume just to the highway. RM-4 stopped just above the highway. RM-5 discharged a narrow wet snow avalanche which stopped at the highway fill. A narrow finger of snow crossed the highway from RM-8.

Winter of 1972/73:

No avalanches were reported from these paths.

Winter of 1973/74:

An avalanche much larger than in previous seasons of record crossed the highway at RM-3 and deposited a substantial amount of timber debris. Just east of this site a smaller avalanche reached the highway from a previously unidentified chute in the timber. It is designated RM-3a on the map.

A small avalanche ran to within 200 ft. of the highway at RM-4.

A narrow tongue of wet snow slid just to the highway fill in the gully of RM-5.

On 1/27/74, RM-6, 7a and 8 just reached the highway and closed one lane.

On 2/13/74, RM-6, 7a, and 8 discharged avalanches across the highway. By mid-April a large volume of debris still remained in the highway at RM-8 and only a small amount at RM-7a. None was visible at RM-6.



North Cascades Highway SR-20

Avalanche Summary Sheet

Name of Path: Ruby Mountain No. 5

Hazard: Moderate, infrequent

Map: Ross Dam 7.5'

Location: Station 596+29 UTM 5397890 N, 646410 E

Elevation of starting zone: 6500'

Vertical fall: 4400' Length: 9000'

Description:

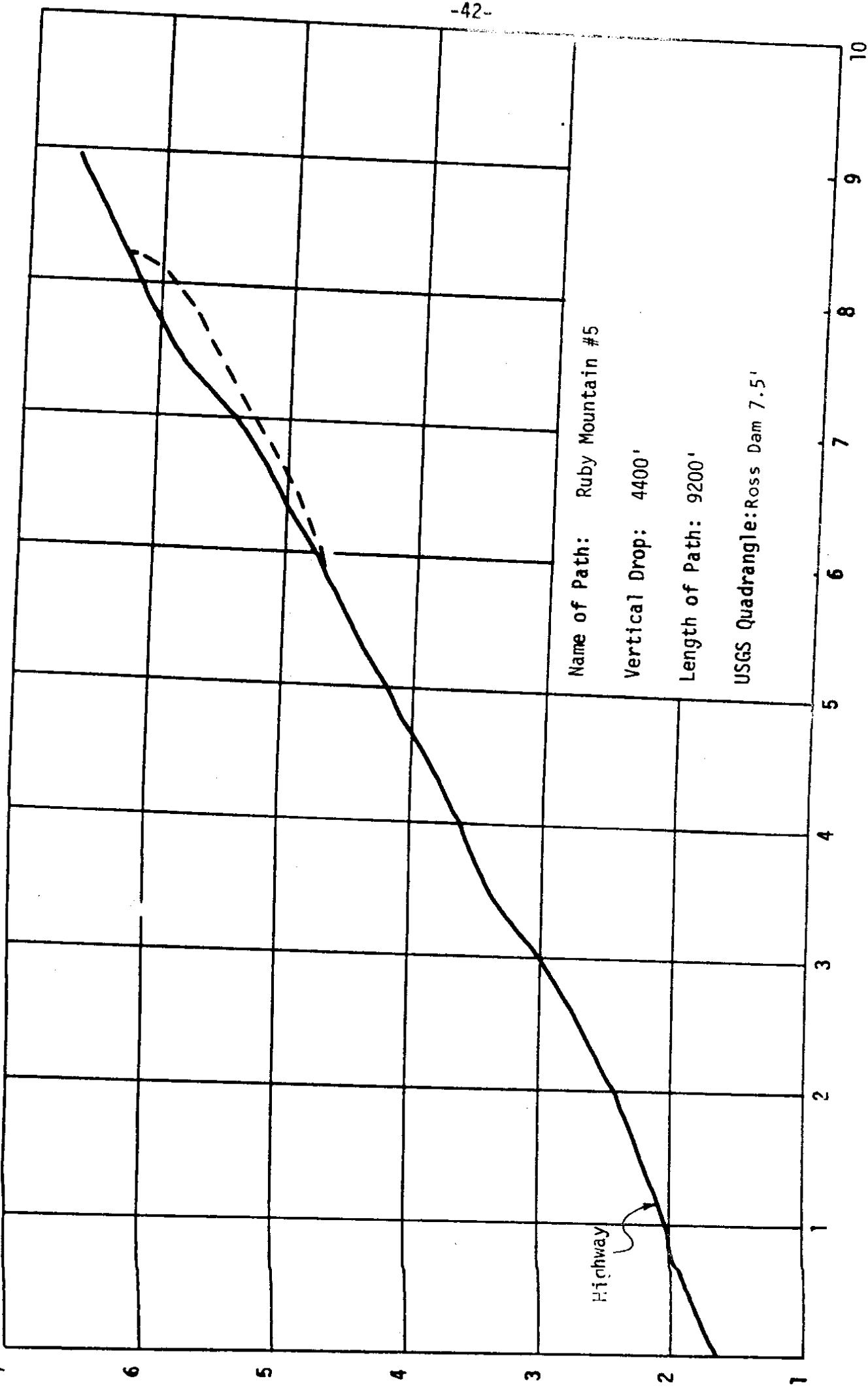
The release zone is on a north-facing, open slope above timberline nearly one-half mile wide just under the crest of the NE ridge of Ruby Mountain. Avalanche snow falls over a cliff band at timberline, then over open slopes largely cleared of timber by avalanche activity, until it runs into the confines of a gulley at about 4200'. The west bank of this curving gulley is swept clear of timber in a very sharp trim line by avalanche snow. The gulley opens out just before reaching the highway, which crosses it on a fill with a substantial catchment basin formed above the fill. The high altitude of the release zone makes this avalanche path much more likely to be the source of large dry snow avalanches as well as wet ones. A very faint trim line in the timber some 500' west of the gulley suggests that the intervening area may have been swept by a very large dry snow avalanche at some time in the past century. Wet snow avalanche is expected to be the more common occurrence.

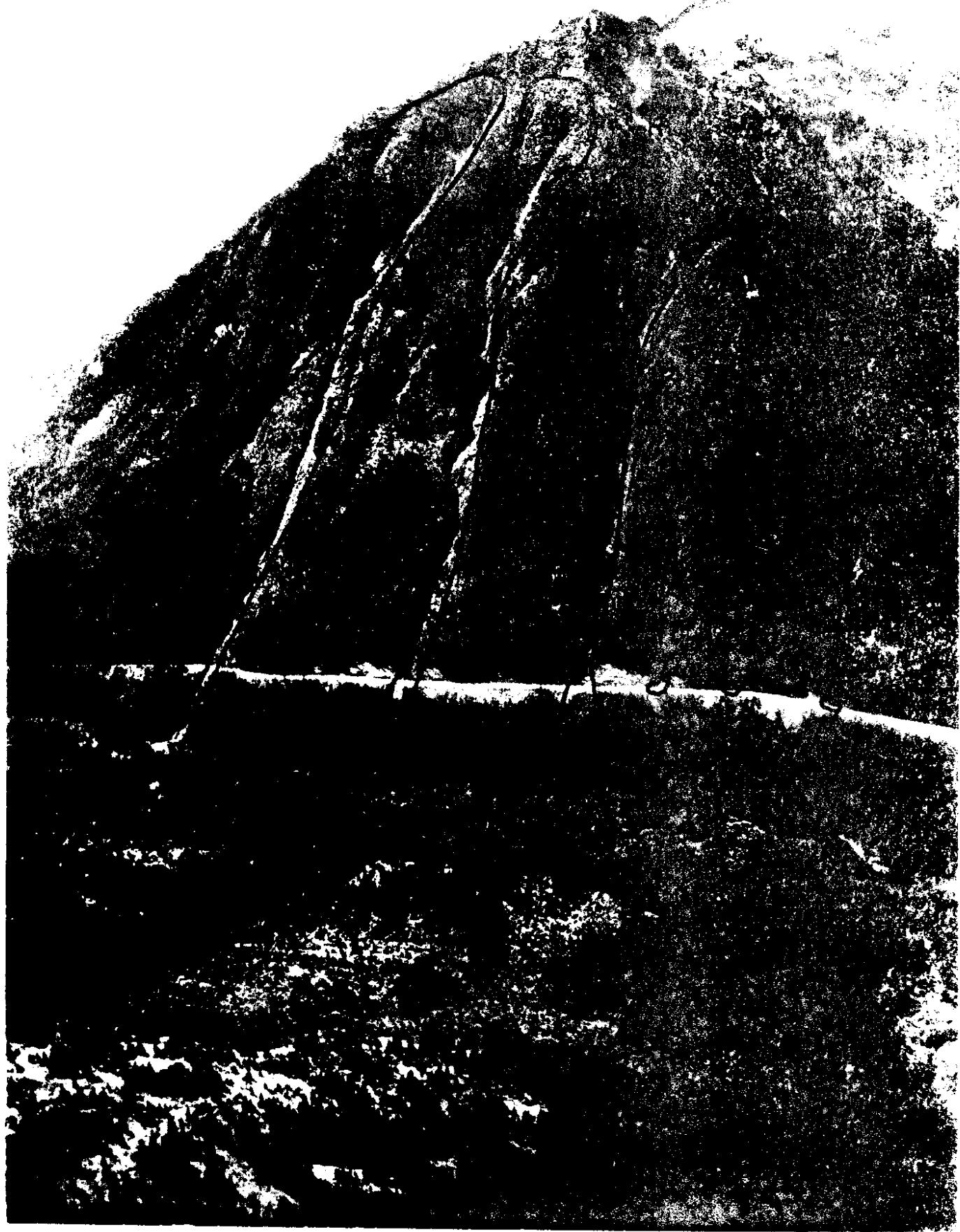
Expected Effect on Highway:

Avalanche is probably frequent at higher elevations, but sliding snow does not often reach the highway. Occasional very large avalanches can be expected, both wet and dry. When these do occur, large amounts of snow and debris can cover the highway up to 300' or more wide.

History:

Vegetation patterns suggest infrequent sliding to highway level, but occasional very large avalanches. An avalanche in the spring of 1971 completely filled the catchment basin above the highway fill and overran the highway. Quantity of tree debris in the snow suggests that is a bigger avalanche than has fallen here for many years. The previous trim line was not overrun, however.





North Cascades Highway SR-20

Avalanche Summary Sheet

Name of Path: Ruby Mountain No. 6

Hazard: Very low, infrequent

Map: Ross Dam 7.5'

Location: Station 612 UTM ,

Elevation of starting zone: 4000'

Vertical fall: 1900' Length:

Description:

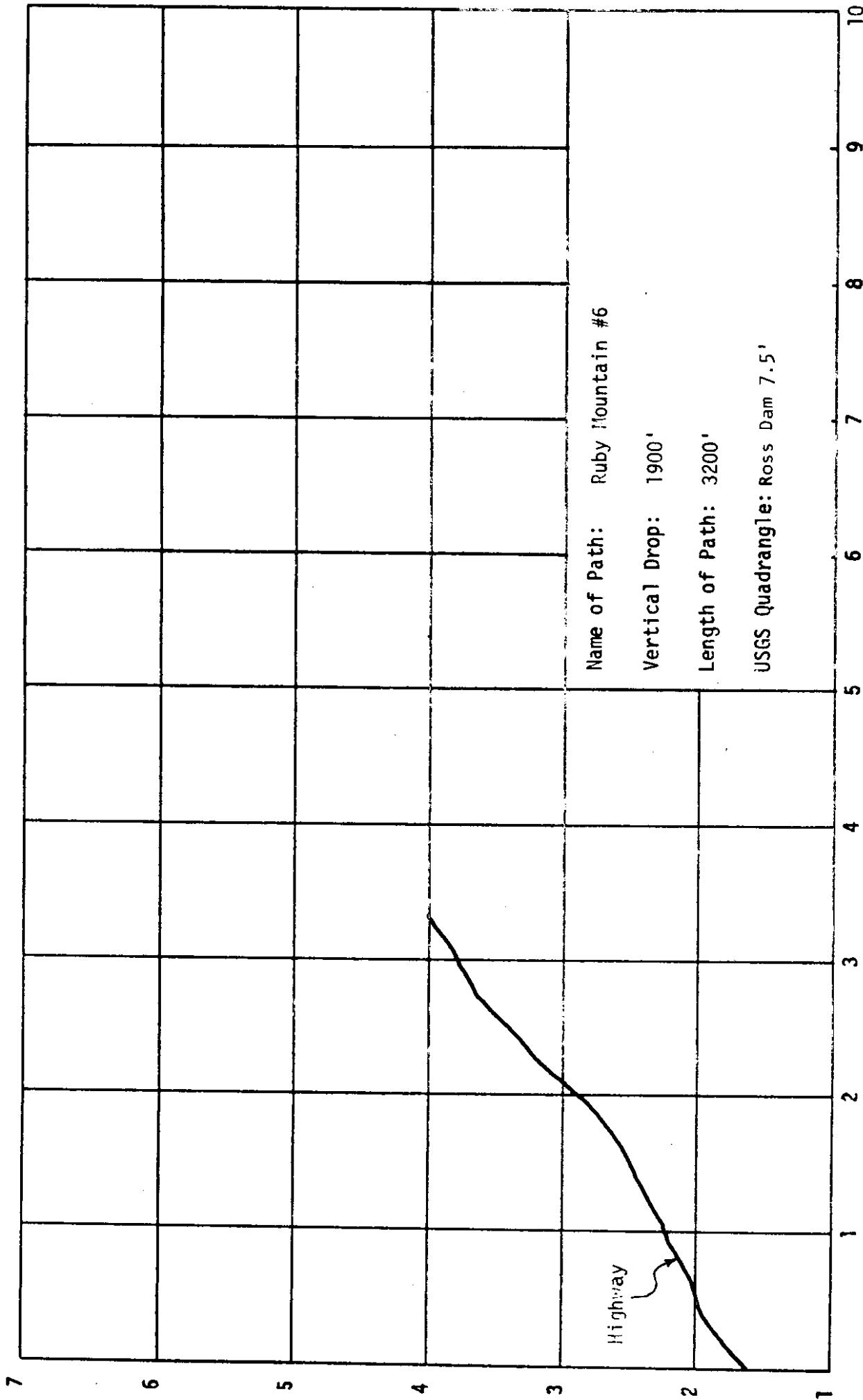
Release zone is a small, rock-rimmed gulley near the crest of the subsidiary northeast ridge of Ruby Mountain. This gulley quickly narrows into a small stream channel which descends straight through heavy timber to the highway. The small size of the release zone limits amount of available sliding snow. Character of vegetation in the path confirms very limited activity.

Expected Effect on Highway:

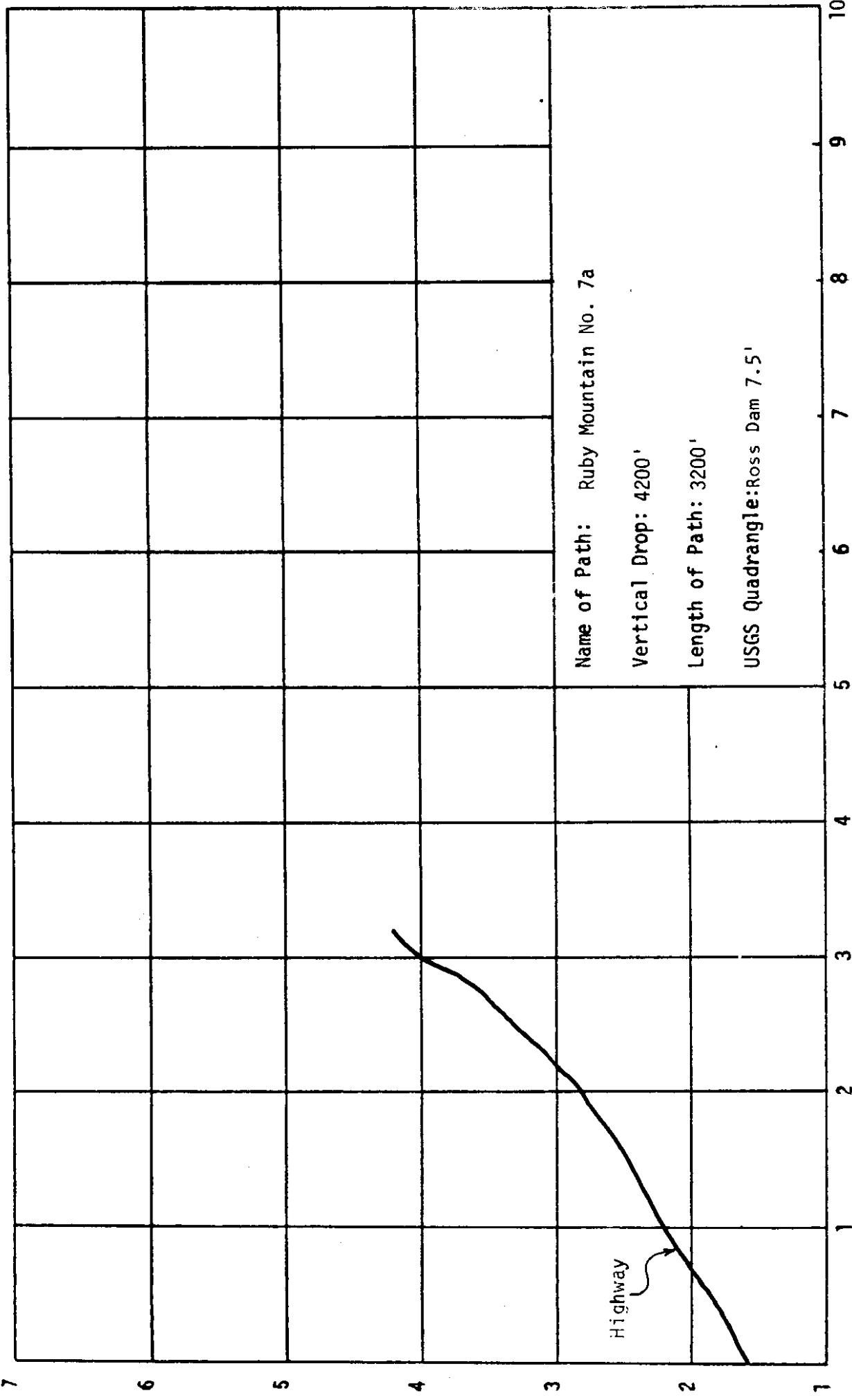
Negligible effect, but possibility of some snow being deposited on right-of-way under extreme wet slide conditions.

History:

A small wet slide descended this path in spring of 1971, but did not reach highway.



Scale: 1" = 1000'



North Cascades Highway SR-20
Avalanche Summary Sheet

Name of Path: Ruby Mountain No. 7a

Hazard: Low, infrequent

Map: Ross Dam 7.5'

Location: Station 620+00 UTM 5397540 N, 647000 E

Elevation of starting zone: 4200'

Vertical fall: 2100' Length: _____

Description:

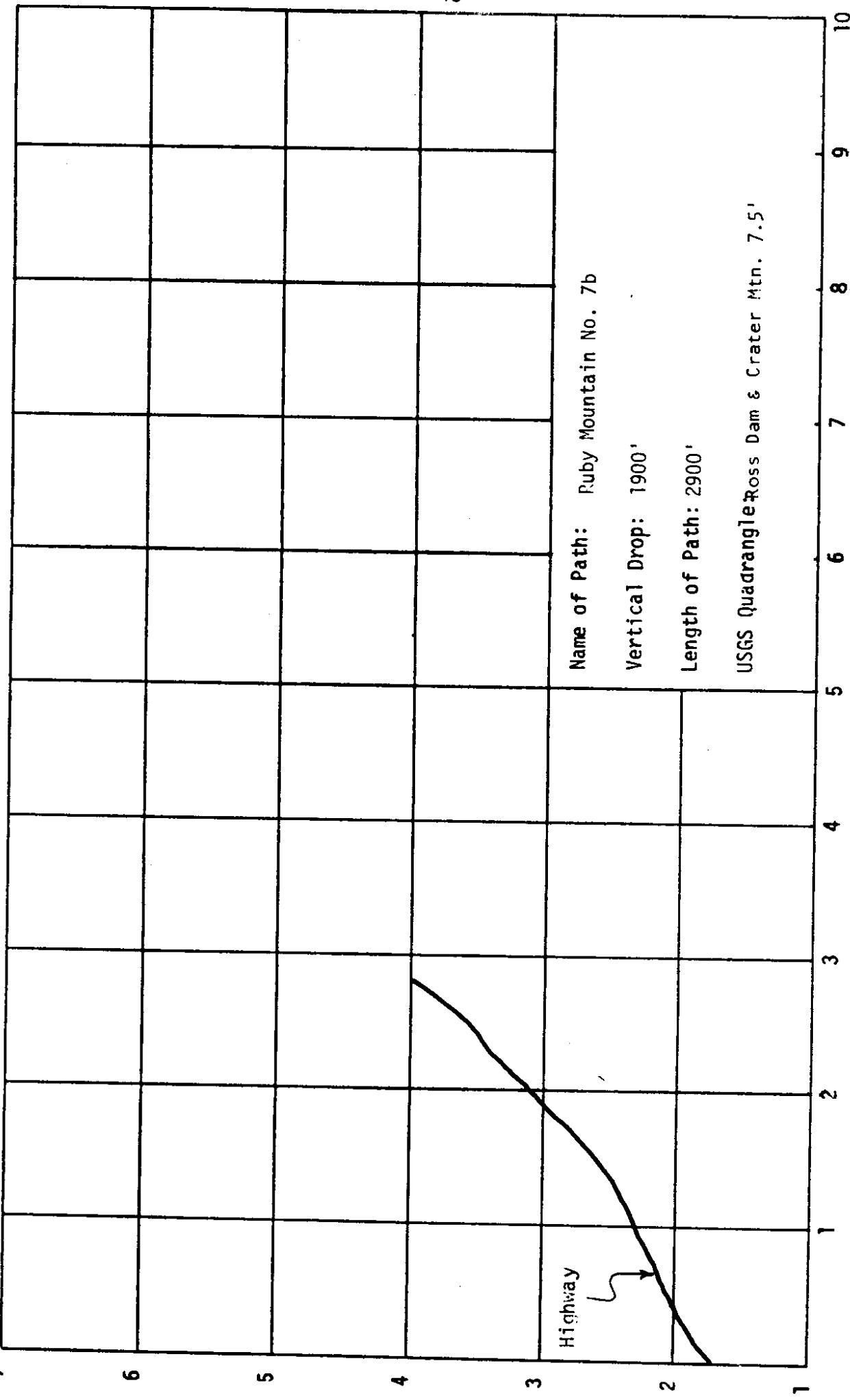
Avalanche paths 7a and 7b share a common release zone located among open patches of rocky ground and scattered cliff bands between 3600' and 4200' elevation. 7a occupies the deeper stream channel, which descends directly to the highway through a heavy timber stand. Avalanche activity is largely confined to wet snow conditions and sliding snow is confined to the stream bed.

Expected Effect on Highway:

Infrequent deposition of small quantities of snow on the highway, up to width of 100'. A moderate amount of tree debris can be expected in such snow deposits.

History:

Small wet avalanche probably occur every year, but reach the highway at less frequent intervals. A wet snow avalanche in the spring of 1971 crossed the highway and spilled debris over the outer bank over width of 50' or more. A few trees were destroyed along one margin of the stream channel. This is probably the largest avalanche in this path for several years.



North Cascades Highway SR-20

Avalanche Summary Sheet

Name of Path: Ruby Mountain No. 7b

Hazard: Low, infrequent

Map: Ross Dam and Crater Mountain 7.5'

Location: Station 624 UTM 5397480 N, 647160 E

Elevation of starting zone: 4200'

Vertical fall: 2100' Length: _____

Description:

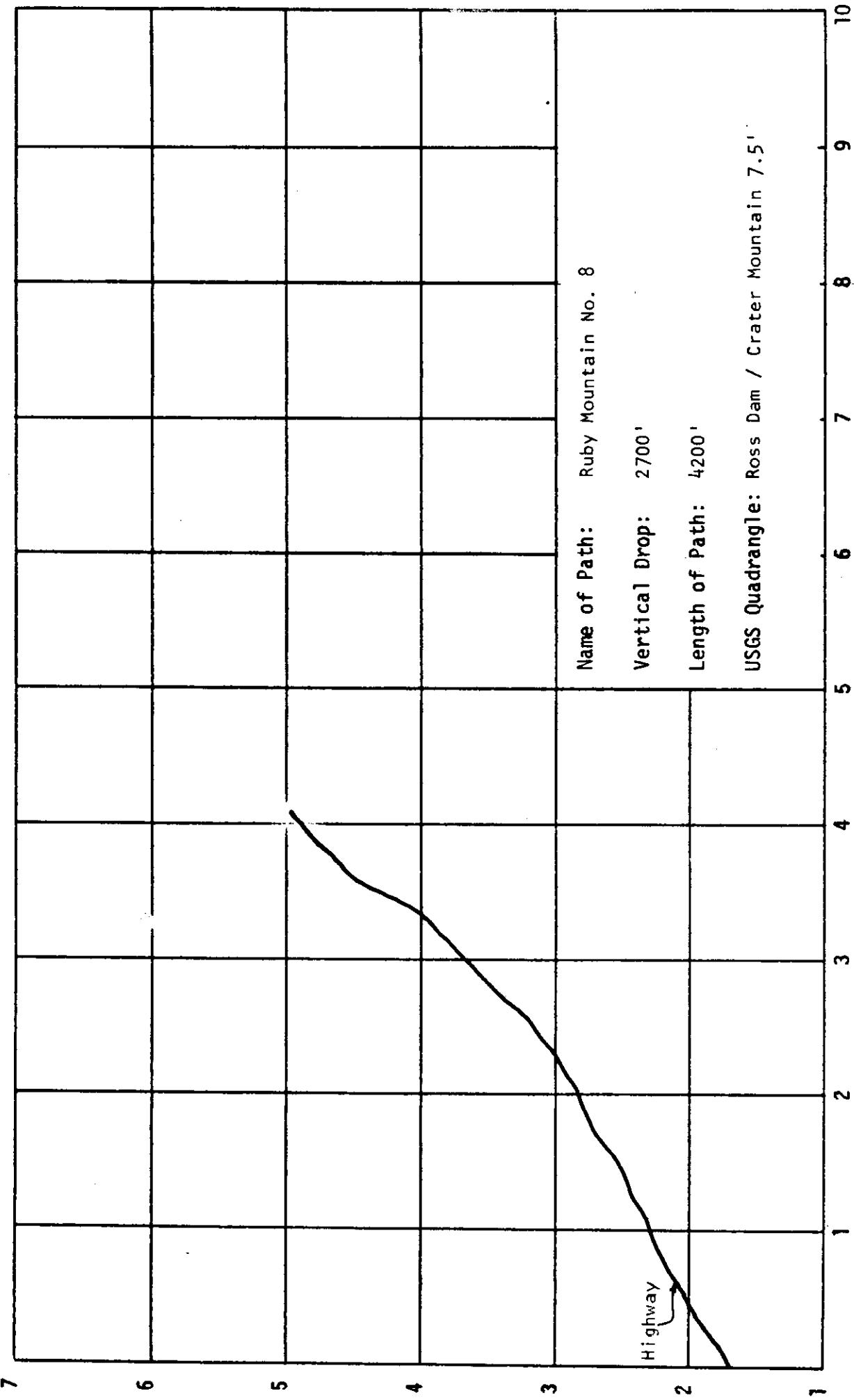
See Ruby Mountain No. 7a. No. 7b descends from the same release zone along a slightly winding and shallower stream channel than 7a, reaching the highway about 800' farther east. Less avalanche snow generally will descend 7b than 7a.

Expected Effect on Highway:

Infrequent deposition of small quantities of snow on the highway. There is a high probability that 7a and 7b will avalanche simultaneously, though only one may reach the road at a given time.

History:

Small wet avalanches probably occur annually, but seldom reach the highway. A wet snow avalanche in the spring of 1971 reached just to the edge of the highway.



North Cascades Highway SR-20

Avalanche Summary Sheet

Name of Path: Ruby Mountain No. 8

Hazard: Moderately low, possibly annual

Map: Ross Dam and Crater Mountain 7.5'

Location: Station 631+60 UTM 5397410 N, 647320 E

Elevation of starting zone: 4800'

Vertical fall: 2700' Length: 4200'

Description:

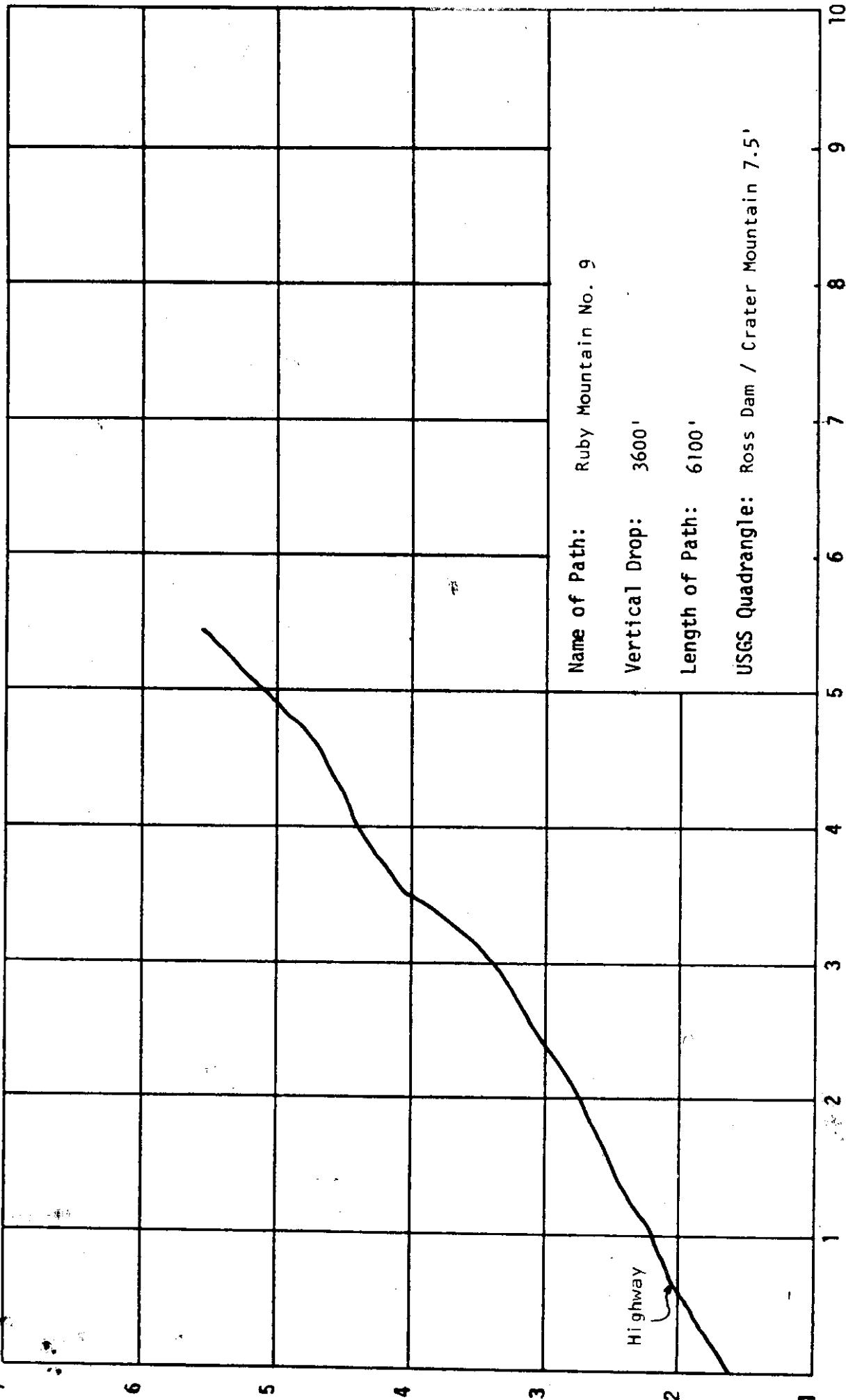
Release zone is a basin dissected by gullies and cliffs just below the ridge crest running north from point 6394 on the NE shoulder of Ruby Mountain. This basin converges to large, well-defined gulley at 3800' which falls in nearly a straight line to the highway and on to Ruby Arm of Ross Lake. Avalanching wet snow is largely confined to the stream bed in the gulley, but a well-defined wider trim line indicates that this path is swept at infrequent intervals by the front of dry snow avalanches.

Expected Effect on Highway:

Wet snow avalanches can be expected in this path every year, but they may not always reach the highway, although annual deposition of some snow on the highway seems a possibility. When a larger, dry snow avalanche falls, large volumes of snow heavily laden with timber debris can be expected on the highway up 200' or more wide.

History:

Age of young conifers within the trim line indicate the last major avalanche on a wide front fell here at least 15 - 20 years ago. Wet avalanching in 1971, probably in January, deposited a moderate amount of snow on the road with very little entrained debris.



North Cascades Highway SR-20

Avalanche Summary Sheet

Name of Path: Ruby Mountain No. 9

Hazard: Moderate, annual

Map: Ross Dam and Crater Mountain 7.5'

Location: Station 643+30 UTM 5397270 N, 647660 E

Elevation of starting zone: 5600'

Vertical fall: 3600' Length: 6100'

Description:

The principal release zone lies in a shallow basin on the open NE face of Point 6394 at timberline. A secondary release zone, largely for wet snow avalanches, is also possible on the broad slopes of the main gully around 4000'. Sliding wet snow is confined to the stream bed, but a much wider trim line indicates occasional fall of dry snow avalanches on a broader front. Continuation of a clearly-defined path beyond the highway to Ruby Arm suggests that avalanches commonly fall all the way to lake level.

Expected Effect on Highway:

A substantial depth of snow up to 200' wide will probably be deposited on the highway annually and possibly oftener, with the avalanche normally overrunning the road and descending to the lake. Entrainment of heavy timber debris is unlikely in normal slide situations. Occurrence of large dry snow avalanches on a broader front with large amounts of entrained debris is possible on rare occasions.

History:

Wet snow avalanches reaching at least to the highway appear to be an annual occurrence. Such an avalanche in January 1971 covered the highway for a width of 150', descended to Ruby Arm, and choked the Arm from bank to bank with snow. This avalanche was probably larger than average for this path.

North Cascades Highway SR-20

Avalanche Summary Sheet

Name of Path: Ruby Mountain No. 10

Hazard: Moderate, annual

Map: Ross Dam and Crater Mountain 7.5'

Location: Station 658+50 UTM 5396070 N, 648070 E

Elevation of starting zone: 5600'

Vertical fall: 3600' Length: 6500'

Description:

Release zone of RM-10 is very similar and adjacent to that of RM-9, but is slightly larger in area. Two small gulleys come together at the 4800' level to form a single stream bed which falls straight to the highway. Wet snow avalanching is normally confined to the stream bed, but a much wider trim line indicates past occurrence of major dry snow avalanches. Avalanches will commonly overrun the highway and fall to Ruby Creek.

Expected Effect on Highway:

Annual deposition of snow from wet avalanches on highway up to 200' wide. There is not likely to be heavy timber debris in this snow under normal conditions. More than one avalanche a winter is possible. Rarely, a large dry snow avalanche may fall over a path up to 300' or more wide. Such an avalanche would carry large amounts of timber debris onto the highway.

History:

Several avalanches probably fall each year on the upper slopes, and one wet one at least each year is apt to reach the highway. In January 1971, a wet snow avalanche deposited snow 150' wide on the highway and descended to the banks of Ruby Creek.

Ruby Mountain No. 9 and No. 10 (RM-9 and 10)

Winter of 1971/72:

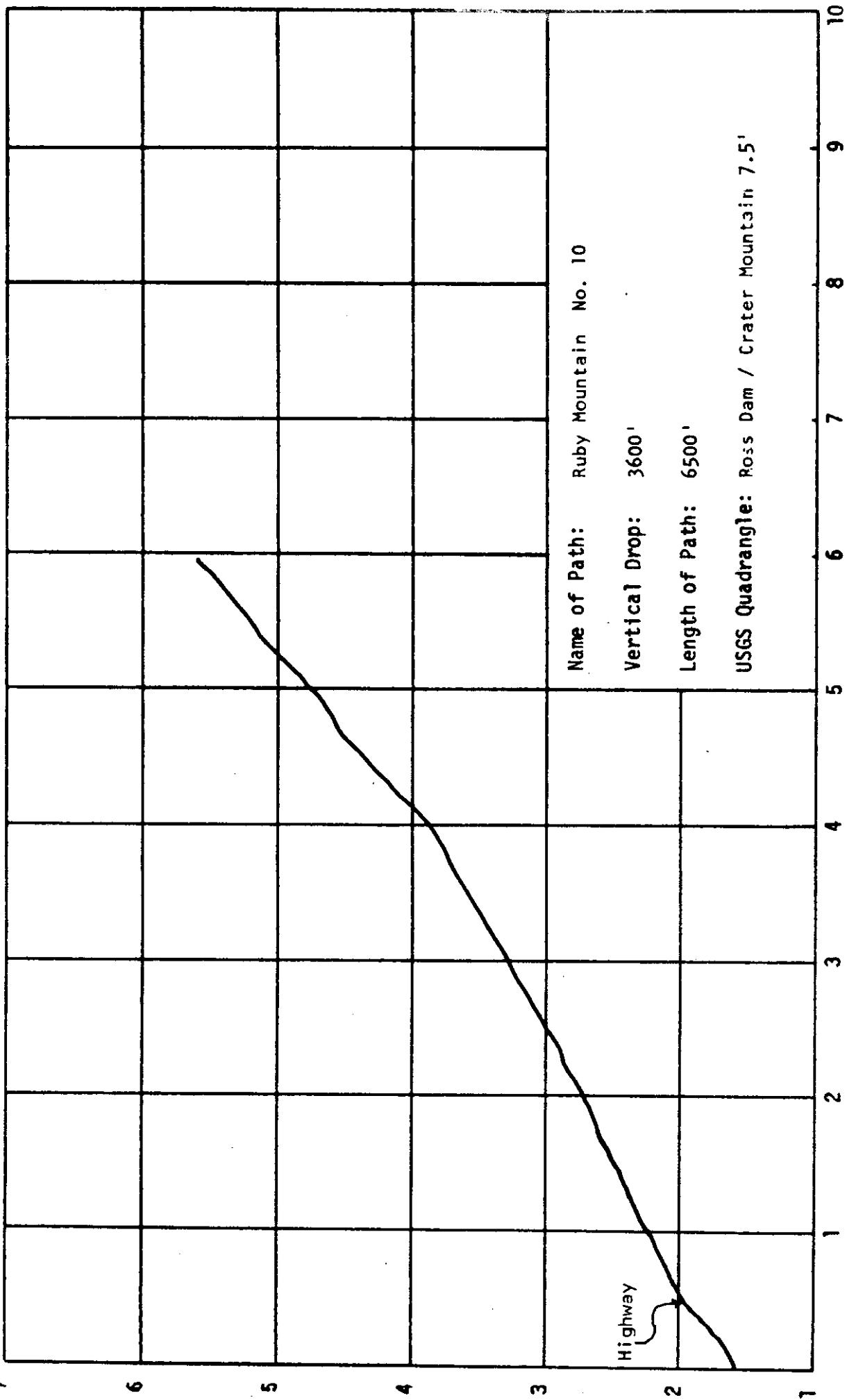
Both RM-9 and RM-10 ran to full extent of mapped path, reaching Ruby Arm and depositing large quantities of snow on the highway.

Winter of 1972/73:

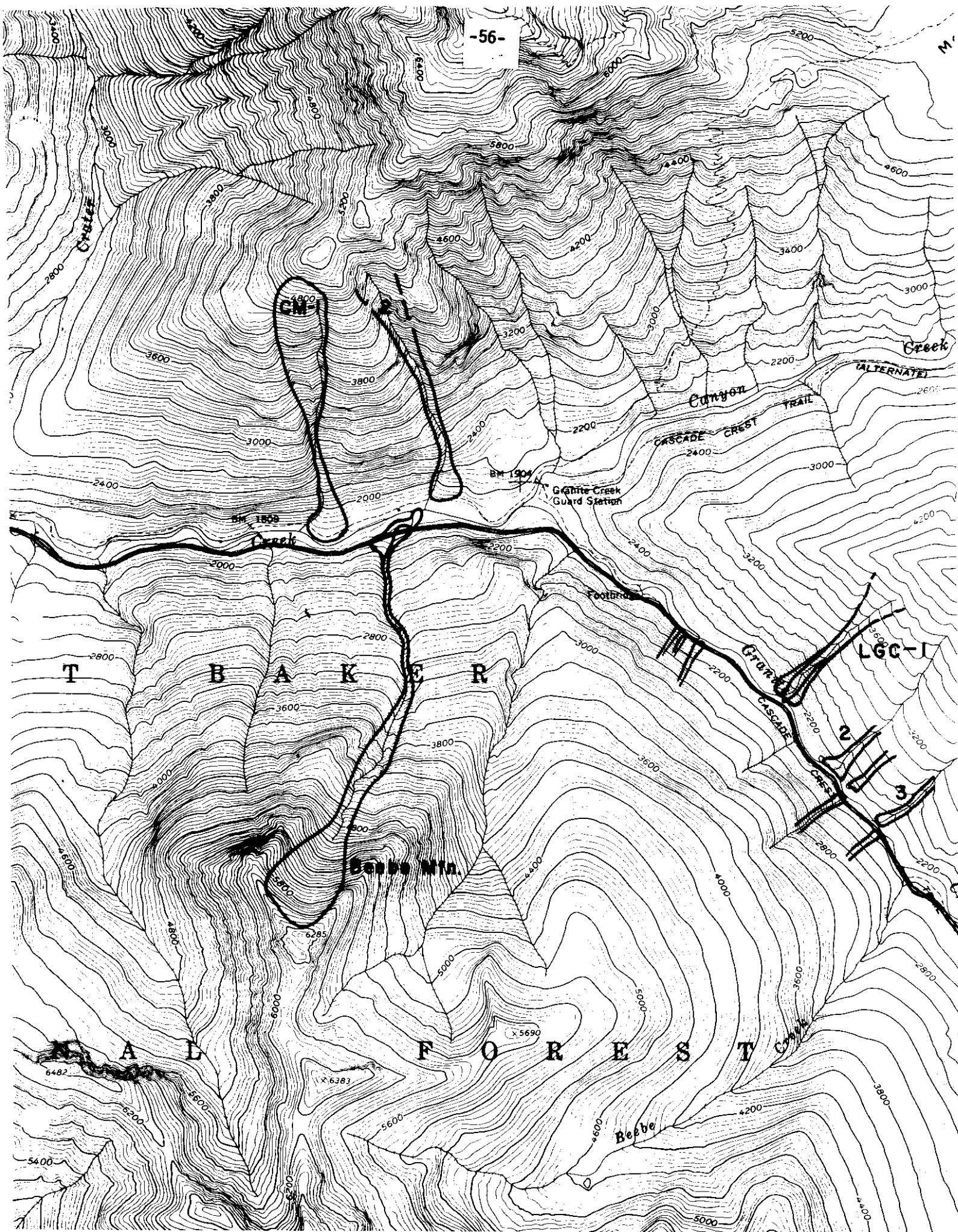
RM-9 fell in moderate size and crossed highway but did not reach Ruby Arm. No avalanching was reported from RM-10.

Winter of 1973/74:

On 1/27/74, major avalanches fell from both paths. RM-9 left snow on the highway 350 ft. wide and up to 45 ft. deep. 350 ft. of guard rail was swept away. RM-10 left a deposit on the highway 400 ft. wide and up to 40 ft. deep. The guard rail was also destroyed here for 400 ft. Layering in the debris of RM-9 visible in April indicated that two separate avalanches may have reached the highway. Debris from RM-10 was still 18 ft. deep at the centerline in mid-April.



Scale: 1" = 1000'



North Cascades Highway SR-20

Avalanche Summary Sheet

Name of Path: Beebe Mountain

Hazard: Low, infrequent

Map: Crater Mountain 7.5'

Location: Station 812+47 UTM 5396630 N, 652631 E

Elevation of starting zone: 6000'

Vertical fall: 4100' Length: _____

Description:

There is a large amphitheater on the north flank of Point 6285, a peak at the end of the ridge running north from Beebe Mountain. The center part of this amphitheater consists of down-sloping rock slabs free of vegetation. A ridge with heavy snow cornice formation rims the southwest edge of this large basin. All of these features favor generation of large avalanches each winter which normally descend to about the 3200' level. Exceptionally large wet-snow avalanches can continue descent of the winding stream bed for 2/3 mile and reach the highway at 1900' elevation.

Expected Effect on Highway:

During winters of heavy snow a wet snow avalanche can deposit a large amount of snow on the highway up to 250' or more wide.

History:

In January 1971 a large wet snow avalanche reached the highway and covered it for more than 200 ft. Avalanching took place during thaw conditions when the entire snow cover slid off the rock slabs in the amphitheater. Although this appeared at the time to be an unusually large avalanche for this path, an even larger one fell in the winter of 1971/72, covered a wider stretch of the highway, and reached Ruby Creek. Vegetation evidence suggested that there had been no similar avalanches on this path in recent years prior to 1971. No avalanche was reported in winter of 1972/73. An avalanche reached just to the highway in 1973/74, the wet snow spreading out to leave a wide but shallow deposition.

North Cascades Highway SR-20

Avalanche Summary Sheet

Name of Path: Crater Mountain No. 1

Hazard: Very low, infrequent

Map: Crater Mountain 7.5'

Location: Station Opposite 795 UTM 5396580 N, 652200 E

Elevation of starting zone: 4800'

Vertical fall: 3000' Length: _____

Description:

This is a south-facing avalanche path of low activity falling from the southwest shoulder of Crater Mountain. It descends directly to Ruby Creek across a talus fan with heavy vegetation cover. The infrequent avalanches stop well short of Ruby Creek, but exceptionally large ones could reach the creek and cross it onto the highway. There is no evidence of this happening in the recent past, but the terrain configuration favors it if snow conditions should be right for a large avalanche, especially a dry snow one.

Expected Effect on Highway:

Negligible except under extreme conditions, when snow heavily laden with timber debris may reach the highway.

History:

There is no evidence of this path having crossed Ruby Creek to reach the highway site in recent years. In the winter of 1971/72, an avalanche of substantial size ran as far as Ruby Creek.

North Cascades Highway SR-20
Avalanche Summary Sheet

Name of Path: Crater Mountain No. 2

Hazard: Very low, infrequent

Map: Crater Mountain 7.5'

Location: Station Opposite 820 UTM 5396810 N, 652860 E

Elevation of starting zone: 4800'

Vertical fall: 3000' Length: _____

Description:

CM-2 is very similar to CM-1 except that the path is narrower and less snow is apt to reach Ruby Creek or the highway.

Expected Effect on Highway:

Negligible except under extreme conditions.

History:

Occasional avalanches to top of talus fan. In the winter of 1971/72, an avalanche ran to the full mapped extent and reached Ruby Creek.

North Cascades Highway SR-20

Avalanche Summary Sheet

Name of Path: Lower Granite Creek (LGC)

Hazard: Low

Map: Crater Mountain 7.5'

Location: Station 900 UTM 5395730 N, 654770 E

Elevation of starting zone: 4000'

Vertical fall: 2000' Length: 2900'

Description:

Several small avalanche paths exist among the timbered cliffs and rocky gullies both east and west of Granite Creek just above its junction with Canyon Creek. The most prominent paths are on the east side, where the three most active gullies have been designated LGC-1, 2 and 3. Release zones for the east paths are ill-defined among the timbered gulleys. The west paths, mapped but not numbered, are less active than those on the east and would discharge snow onto the highway only during winters of heavy snow at these elevations.

Expected Effect on Highway:

To reach the highway, the east-side avalanches would need to cross Granite Creek and ascend a short distance up the opposite slope. The probability of this happening is small, given the small size of the path and volume of snow involved. This hazard would principally develop when large depths of unconsolidated snow existed down to 2000'. The west-side avalanches will deposit snow on the highway whenever they are active.

History:

Probably some small wet slides among the upper gulleys each year, with occasional avalanches reaching Granite Creek during winters of heavy snowfall.

Lower Granite Creek (LGC)

The heavy snowfall winter of 1971/72 brought considerably more slide activity in the lower Granite Creek area than previously anticipated.

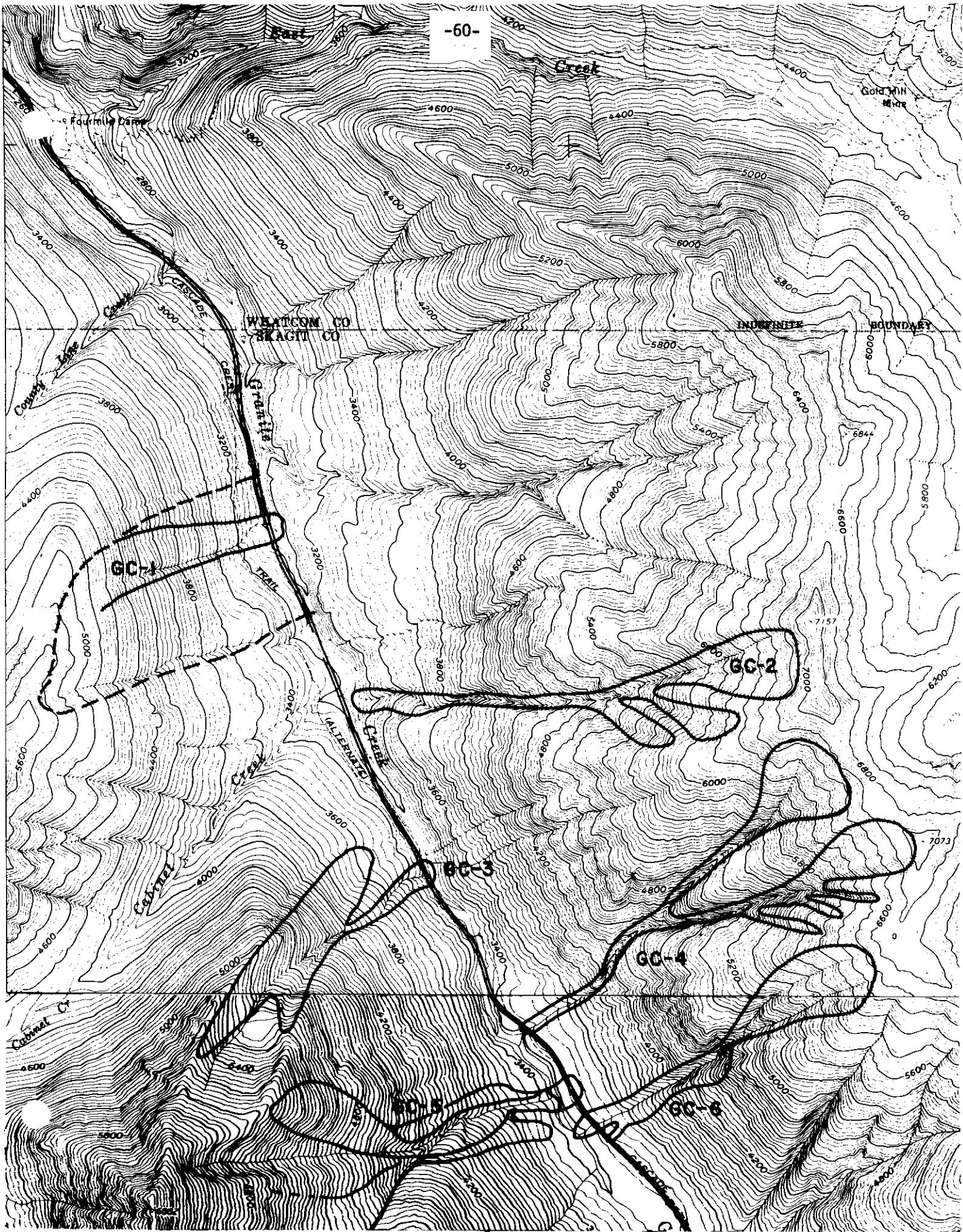
In addition to the mapped LGC-1, 2 and 3, several other gullies discharged avalanches into Granite Creek. The largest avalanche fell from LGC-2. None of these avalanches falling from the east side of Granite Creek reached the highway on the west side.

Several small avalanches also descended from the steep but heavily-timbered gullies on the west side of lower Granite Creek and deposited moderate amounts of snow on the highway. The largest of these fell from the water course west and just upstream from the largest avalanche mentioned above which fell from the east side. There were also some small bank slides running from the high cutbanks generated by highway construction in this narrow part of Granite Creek valley. None of the observed avalanches on the west side would constitute a serious problem in snow removal, but can be expected to have a nuisance value for blocking the highway in winters with heavy snowfall at these elevations.

No significant avalanche activity was reported in 1972/73.

In 1973/74, LGC-2 discharged an avalanche reaching to just above the banks of Granite Creek.

-60-



Granite Creek No. 1, No. 2, No. 4 and No. 6 (GC-1, 2, 4 and 6)

Winter of 1971/72:

- GC-2 A long, narrow tongue from a wet snow avalanche ran to Granite Creek.
- GC-4 A wet snow avalanche ran the full extent of the mapped path and crossed the highway.
- GC-6 A wet snow avalanche descended the streambed, flowed along the south branch of this path and deposited snow on the highway.

Winter of 1972/73:

No avalanche activity affecting the highway was reported from these paths.

Winter of 1973/74:

- GC-1 Two avalanches, respectively about 250 ft. and 400 ft. wide at the highway, fell from shallow gulleys in the north part of this wide avalanche path and reached Granite Creek. Both were very fast dry snow avalanches carrying a heavy burden of finely broken timber debris. Date of occurrence is not documented but presumed to be in January. Debris up to 10 ft. deep remained on the highway in mid-April.
- GC-2 A long, narrow tongue of wet snow ran into Granite Creek, somewhat larger in volume than in 1971/72. Snow debris on the bank of Granite Creek was 15 ft. high in April.
- GC-6 A wet snow avalanche descended the south branch of this path to within about 200 ft. of the highway.

-61-

GC-1

North Cascades Highway SR-20

Avalanche Summary Sheet

Name of Path: Granite Creek No. 1

Hazard: Low

Map: Azurite Peak 7.5'

Location: Station 1116 + 22 UTM 5390310 N, 657940 E

Elevation of starting zone: 4600 - 5100'

Vertical fall: 2100' maximum Length: 4500' maximum

Description:

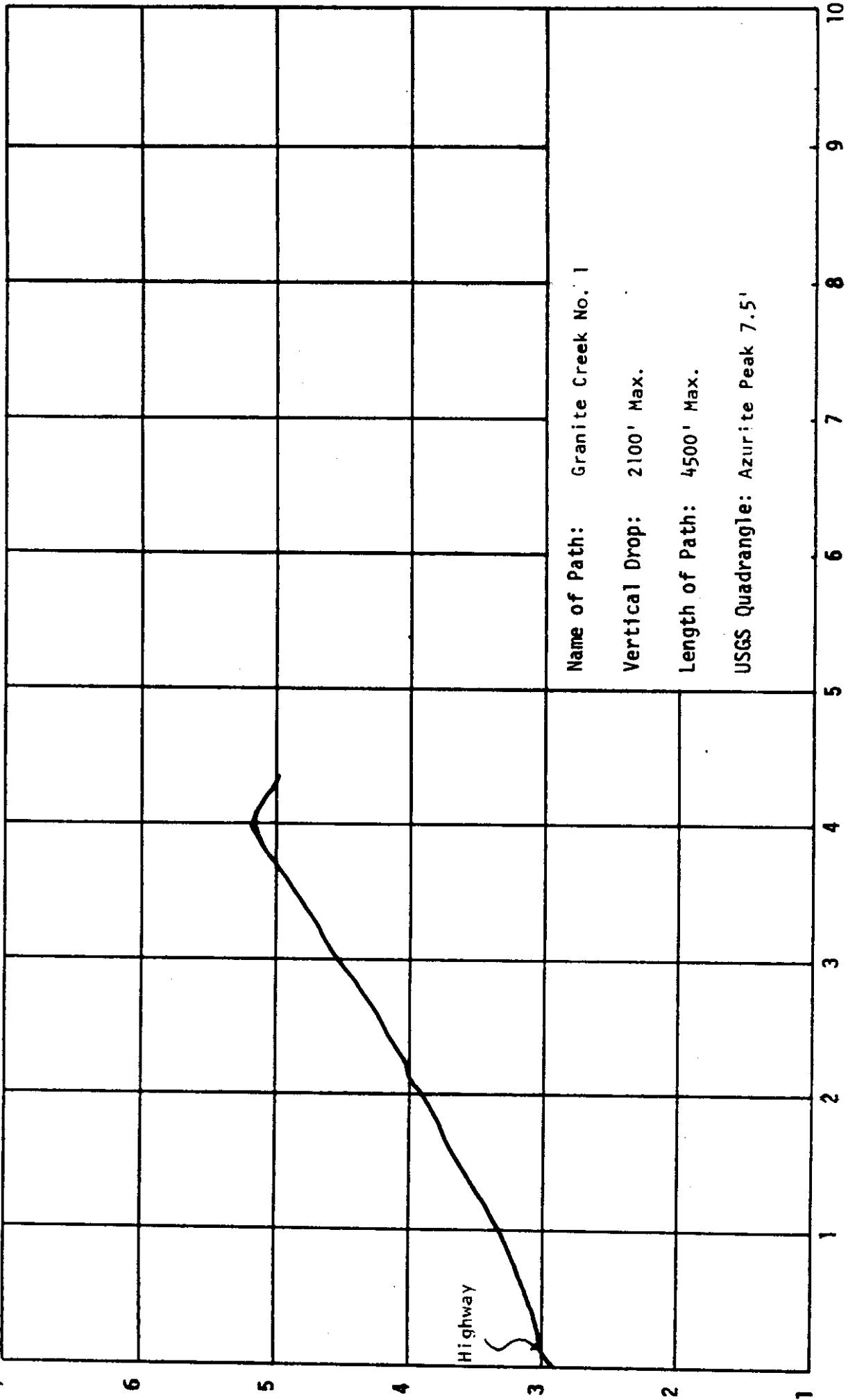
This slide path embraces an old burn area about one-half mile wide on the east flank of a ridge trending north from Point 6570. Local avalanching is probably frequent on the upper parts of this path, contributing to the inhibition of natural reforestation of the burn. Systematic avalanching to lower elevations appears confined to a shallow stream gully which intersects the highway at Station 1116 + 22. On occasions sliding snow may reach the highway at this point.

Expected Effect on Highway:

Some avalanche snow with a load of brush and small timber debris may reach the highway along the stream channel on infrequent occasions. There is a small possibility that a large avalanche may originate along the ridge crest and sweep to the highway along the entire half-mile front of the path. In this case a very large amount of timber debris would be deposited on the highway. There is no evidence of such an avalanche in the recent past, but such an occurrence cannot be ruled out for this terrain and vegetation pattern.

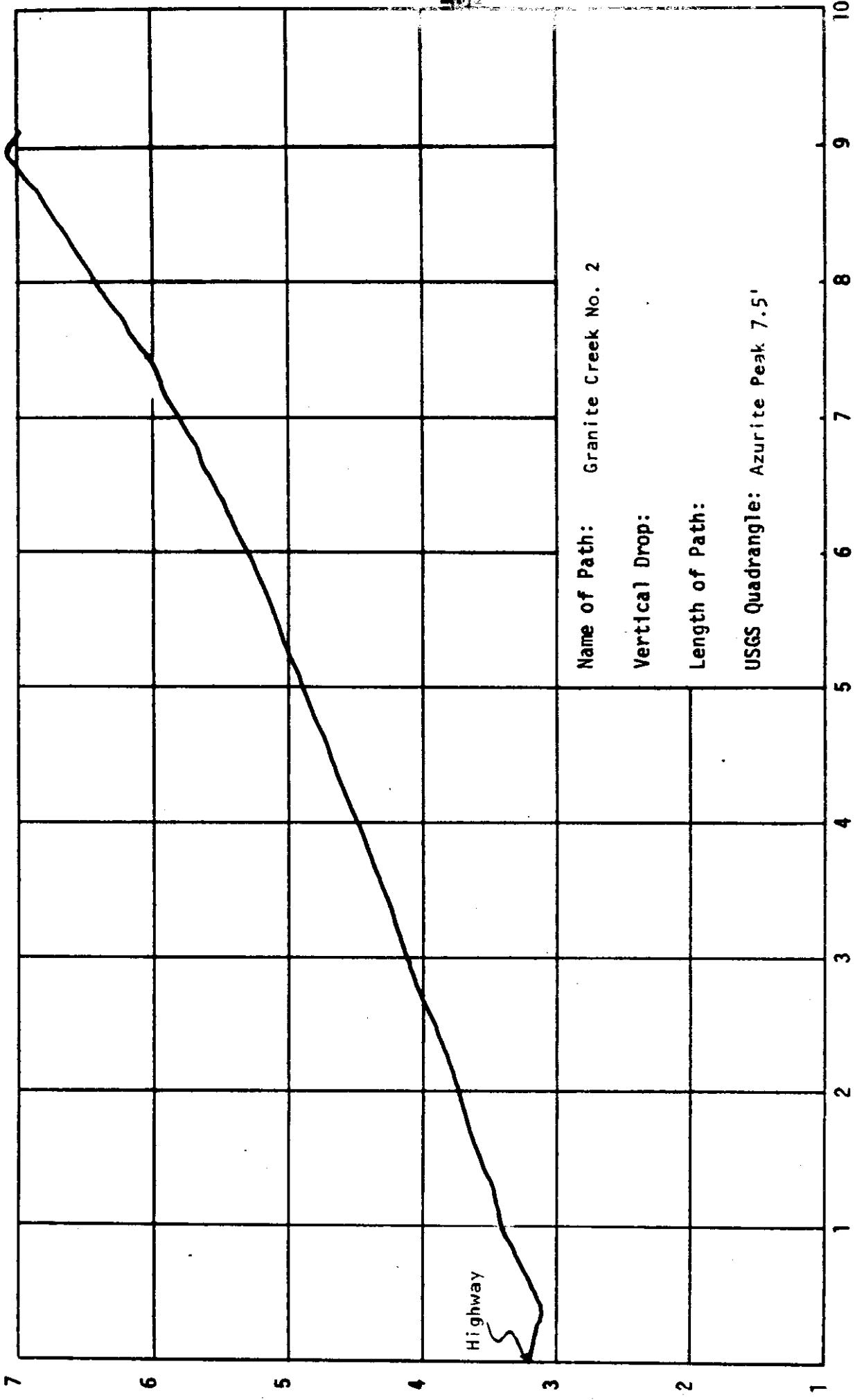
History:

About 50 to 75 years ago a large avalanche along the stream channel (solid line on map) reached Granite Creek and deposited a large amount of timber debris on the far bank. The effects of forest fire and avalanche are not easy to distinguish on other parts of the path. A more accurate history can be constructed only after a careful investigation of vegetation patterns throughout the path.



Scale: 1" = 1000'





North Cascades Highway SR-20

Avalanche Summary Sheet

Name of Path: Granite Creek No. 2

Hazard: Low

Map: Azurite Peak 7.5'

Location: Station 1149 UTM 5389410 N, 658430 E

Elevation of starting zone: 7000'

Vertical fall: 3800' Length: 9500'

Description:

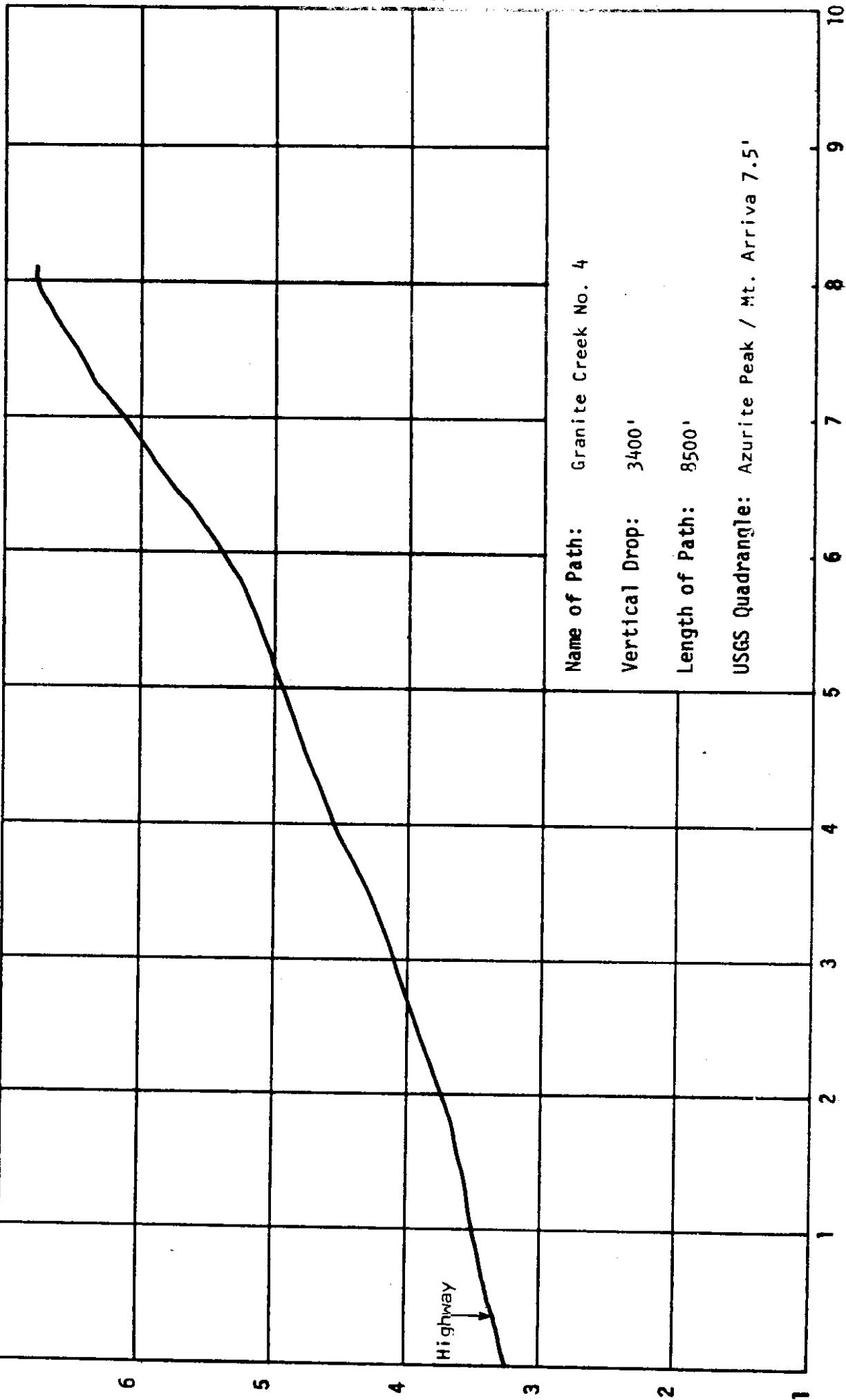
Granite Creek No. 2 is the first of a series of large avalanche paths on the east side of Granite Creek with similar topographic features and behavior. GC-2 is typical. A large basin in the release zone funnels into a narrow stream gulley which descends a long and winding path to the valley floor. In this case two subsidiary, north-facing basins join the main drainage channel. Avalanching is common in the high basins, generated by snow deposition on slopes lee to the storm winds. Such avalanching at higher elevations occurs every winter and in places more than once a winter. Less frequently a large, usually wet, avalanche descends the long stream gulley all the way to Granite Creek. A timber trimline indicates a large dry avalanche reached Granite Creek on a broader front perhaps 20-30 years ago.

Expected Effect on Highway:

GC-2 has to cross the creek and ascend the opposite slope a short distance to reach the highway. It probably runs in large enough volume to do so only rarely. If such a slide should reach the highway, it will be heavily laden with timber debris. Expected width at the highway in such a case might be up to 300-400'.

History:

Avalanches occur annually or oftener in the upper basin above about 5000' elevation but do not affect the highway. Wet slides may descend the stream bed to about 3800' every year or so. Vegetation patterns suggest that such slides large enough to reach Granite Creek occur perhaps once in ten years. A wet avalanche ran to Granite Creek in January of 1971.



Scale: 1" = 1000'



North Cascades Highway SR-20

Avalanche Summary Sheet

Name of Path: Granite Creek No. 3

Hazard: Low

Map: Azurite Peak / Mt. Arriva 7.5'

Location: Station 1191 + 50 UTM 5388450 N, 658870 E

Elevation of starting zone: 5500'

Vertical fall: 2250' Length: 5500'

Description:

This is a complex path with apparently two separate zones of origin in separate basins along the NE ridge of Point 6882. These two basins converge to a narrow gully at 4000' from which the lower avalanche path descends to the highway. A large open slope from the end of the NE ridge also shows signs of avalanche activity down to about 3500' but does not directly affect the highway. Avalanche activity is apt to be frequent in the upper bowls, but sliding snow seldom descends below about the 4000' level. The release zones face to the east and north, where they will receive heavy snow loads from prevailing SW storm winds.

Expected Effect on Highway:

Very infrequent avalanching to the highway, but a distinct timber trim line indicates a large avalanche has fallen here in the past and may do so again. Such an avalanche would cover the highway for up to 500' and would contain large amounts of timber debris.

History:

Tree ring analysis and old debris deposits indicate that a large avalanche swept down this path about 30-50 years ago, crossed the present highway grade and Granite Creek, and deposited a large number of destroyed trees on the east bank of the creek. There is no evidence of a similar occurrence since.



North Cascades Highway SR-20

Avalanche Summary Sheet

Name of Path: Granite Creek No. 4

Hazard: Moderately Low

Map: Azurite Peak / Mt. Arriva 7.5'

Location: Station 1222 + 85 UTM 5387630 N, 659460 E

Elevation of starting zone: 6800'

Vertical fall: 3400' Length: 8500'

Description:

This path has two large, separate basins as release zones. Sliding snow from these two basins comes together at the 4500' level and descends a winding stream channel. The southern basin appears to be the more active zone of origin. Wet snow avalanching confined to the stream channel appears to be the primary activity, and the path is narrow at the highway.

Expected Effect on Highway:

A narrow deposit of wet snow loaded with small timber debris and brush may reach close to or onto the highway every two or three years, and possibly oftener. In an active avalanche winter, there is a distinct possibility of more than one avalanche reaching the highway within a short period time.

History:

Wet snow avalanches descend to the 3600-3800' level frequently, possibly each year. Debris accumulation in the stream channel suggests that some of these avalanches reach as far as the highway. Tree ring counts show small conifers 15-20 years old in the slide path, many of them damaged by repeated avalanching.



North Cascades Highway SR-20

Avalanche Summary Sheet

Name of Path: Granite Creek No. 5 (Three-Legged Bear)

Hazard: Low

Map: Mt. Arriva 7.5'

Location: Station about 1240 UTM 5387240 N, 659650 E

Elevation of starting zone: 5600

Vertical fall: 2200' Length: 5500'

Description:

This avalanche originates along the eastern flank of Point 6882 in a series of slopes and gullies facing SE. Flowing snow from this area reaches a larger stream channel at 4200 ft. and turns to follow this channel eastward to Granite Creek. Major avalanches on this path can descend to Granite Creek and in rare circumstances ascend the opposite slope to reach the highway.

Expected Effect on Highway:

Negligible hazard except under unusual conditions leading to major dry-snow avalanches from SE slopes. There is a possibility of wind blast depositing debris but little snow on the highway. Any avalanche snow which does reach the highway will be heavily laden with large timber debris.

History:

Prior to the winter of 1971/72, a well-developed trim line indicated that this path occasionally ran as far as Granite Creek, though probably not annually. In 1971/72, a major avalanche enveloping the whole extent of the Point 6882 flanks and stream channel overran the earlier trimline, causing extensive destruction in a mature forest stand. This avalanche crossed Granite Creek and the highway, depositing large amounts of timber debris in the lower part of the path and on the highway. No avalanche activity was reported on GC-5 in 1972/73. In 1973/74, a small avalanche reached the lower transition zone in the center of the path.



GC-7

GC-6

North Cascades Highway SR-20

Avalanche Summary Sheet

Name of Path: Granite Creek No. 6

Hazard: Moderately low

Map: Azurite Peak / Mt. Arriva 7.5'

Location: Station 1244 + 45 UTM 5387140 N, 659840 E

Elevation of starting zone: 6600'

Vertical fall: 3200' Length: 6500'

Description:

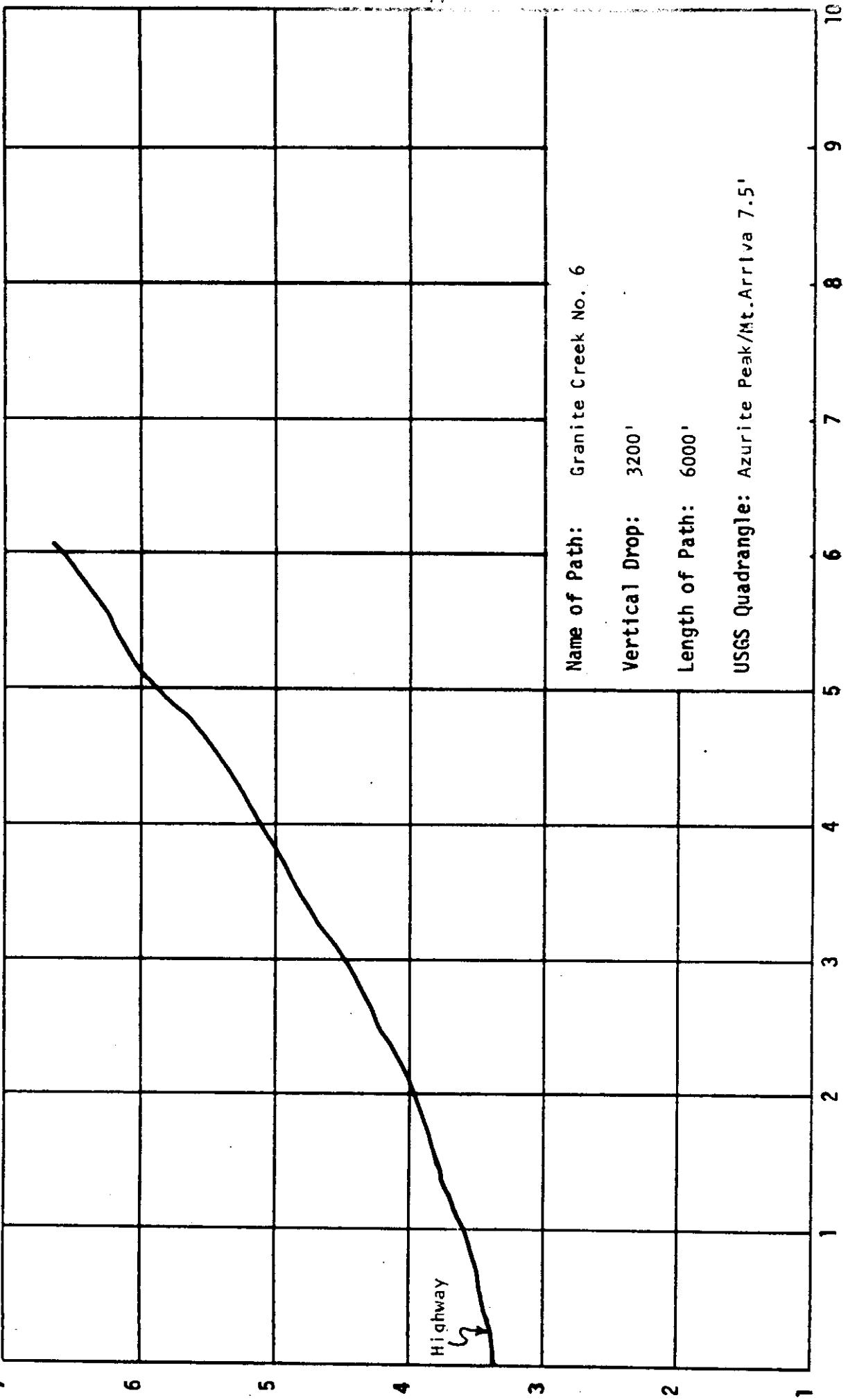
This path originates in a shallow basin on the end of the ridge which bounds on the south basin of GC-4. Several shallow gullies within the basin funnel into a common stream channel at 4700'. The release zone is steep, open, and falls directly into the outrun path and toward the highway. The stream channel makes a sharp kink passing through a shallow cliff band at 4400'. Wet snow avalanches follow this channel, but a timber trimline shows that at least one dry avalanche in the past has overridden the cliff band and descended to Granite Creek on a much broader front. A substantial amount of old timber debris is scattered along the outrun of this path clear to Granite Creek.

Expected Effect on Highway:

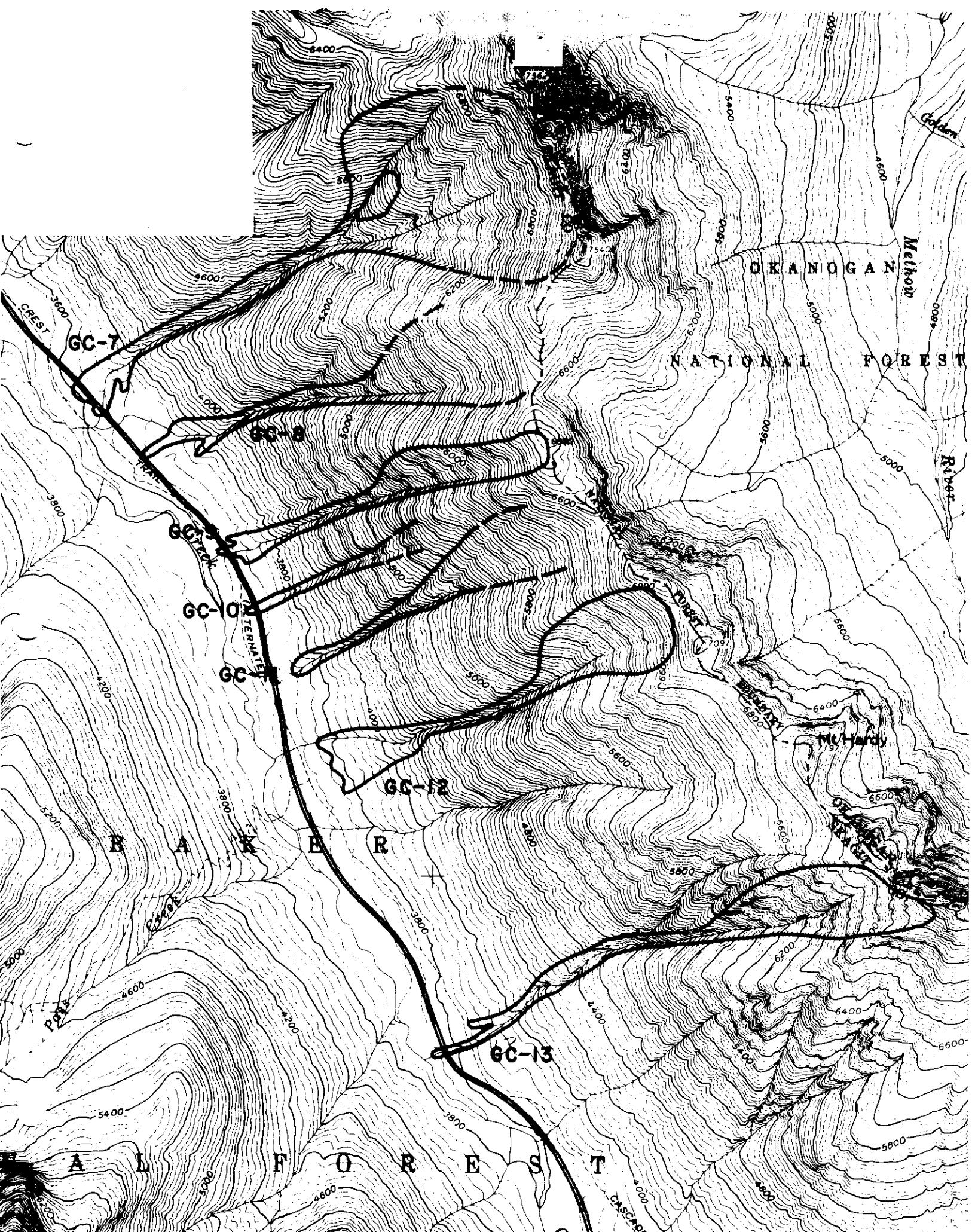
Some avalanche snow probably descends this path to at least 3600' elevation, and often to the highway, every year. Such sliding is mostly confined to wet snow, which can be expected to carry a moderate amount of brush and timber debris. A branch of the path diverges to the east just above the highway and may often be the site of wet snow deposits. Infrequently, a large and destructive dry snow avalanche can fall here which would carry heavy timber debris onto the highway over a width of 500' or more.

History:

Vegetation patterns suggest wet snow avalanches may run here annually. Tree ring analysis shows the last major dry snow avalanche with extensive timber destruction occurred 25-30 years ago.



Scale: 1" = 1000'



Granite Creek No. 7 through No. 13 (GC-7 through 13)

Winter of 1971/72:

GC-7 Two separate avalanches reached the highway. A dry snow avalanche spilled some snow into the cut and onto the highway. A wet snow avalanche fell in a long, narrow tongue which turned just above the highway cut to follow a shallow stream channel along the edge of the highway, but no snow was deposited on the road bed.

GC-9, 9 and 10

No avalanching reported.

GC-11 A small avalanche ran to the lower part of the path, but reached neither the maximum mapped extent nor the highway.

GC-12 Deposition from a wet snow avalanche reached the maximum path extent along the north side of the path, but did not break through the timber screen to the highway.

GC-13 A narrow flow of wet snow descended the outrun gully and crossed the highway approximately 30 ft. wide and 12 ft. deep.

Winter of 1972/73:

No avalanches reached the highway.

Winter of 1973/74:

One small avalanche was reported reaching the highway from GC-10, but no snow debris remained from this in mid-April.

GC-7

North Cascades Highway SR-20

Avalanche Summary Sheet

Name of Path: Granite Creek No. 7

Hazard: Low

Map: Mt. Arriva 7.5'

Location: Station 1304 + 50 UTM 5385750 N, 661000 E

Elevation of starting zone: 7200'

Vertical fall: 3600' Length: 9900'

Description:

The release zone is a large basin on the west flanks of Points 7562 and 7540. Numerous gullies converge toward the bottom of this basin at 5000' elevation, from whence a long, winding stream channel descends to Granite Creek, crossing a long talus fan of gentle gradient before it reaches the highway. Avalanching is common in the upper part of the path, but flowing snow seldom traverses the long outrun to reach the highway location.

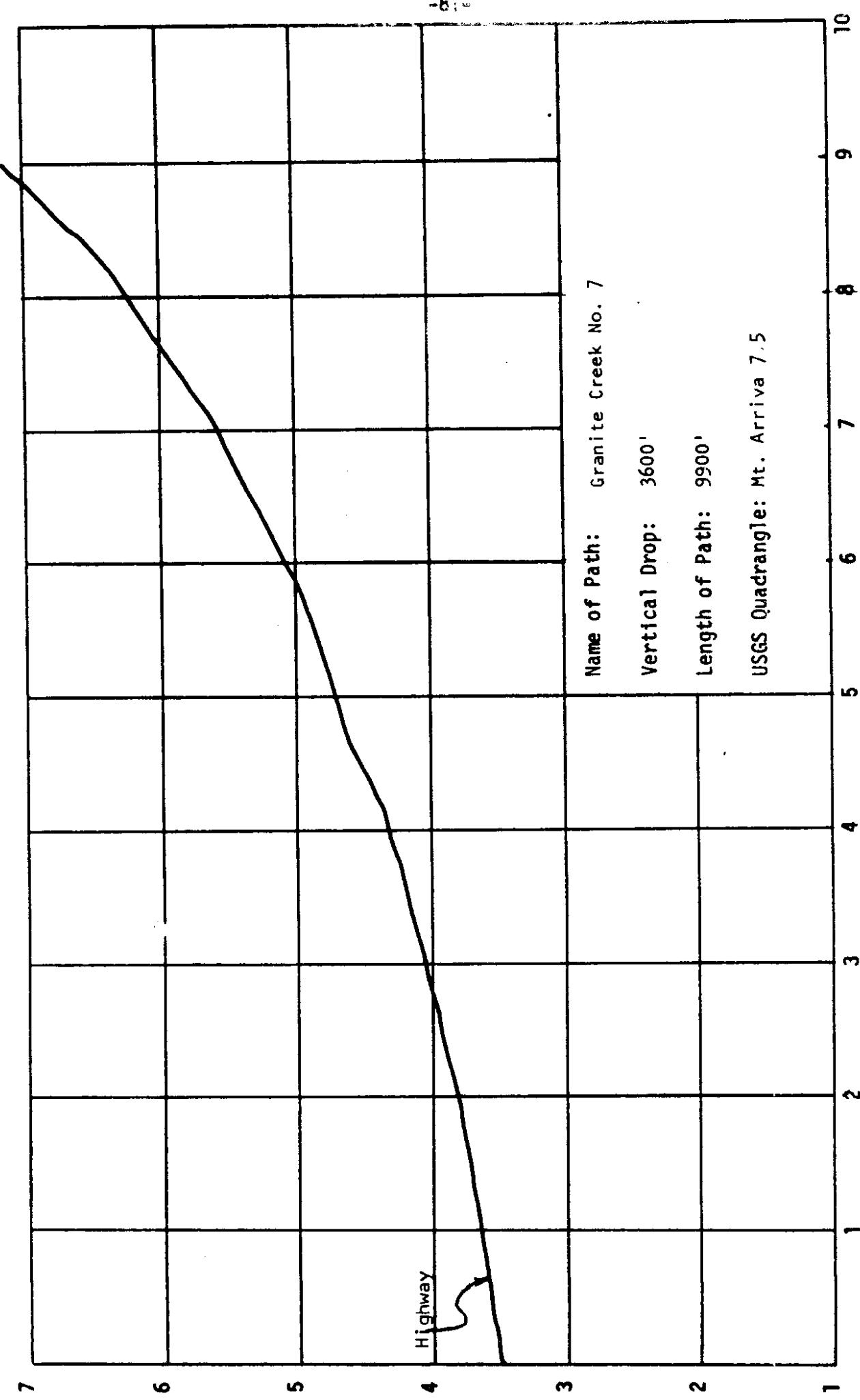
Expected Effect on Highway:

Very low probability of avalanches reaching the highway in normal years, but the path is subject to infrequent large avalanches which could deposit snow on the highway for 700-800' or more. In the latter case a substantial amount of timber debris can be expected in the snow. Important: The highway traverses the outrun of GC-7 by means of a large cut throughout the talus cone. A major avalanche at this site could fill the cut with snow 50' or more deep and present a formidable clearing problem.

History:

Frequent avalanching on upper part of path which does not affect the highway. A single tree-ring count in the outrun suggests that the last large avalanche which established the present timber trimline at the highway level probably occurred about 20 years ago.

Scale: 1" = 1000'



North Cascades Highway SR-20

Avalanche Summary Sheet

Name of Path: Granite Creek No. 8 Granite Creek No. 8

Hazard: Low

Map: Mt. Arriva 7.5'

Location: Station 1322 UTM 5385430 N, 661310 E

Elevation of starting zone: around 6200'

Vertical fall: 2600' Length: 6200'

Description:

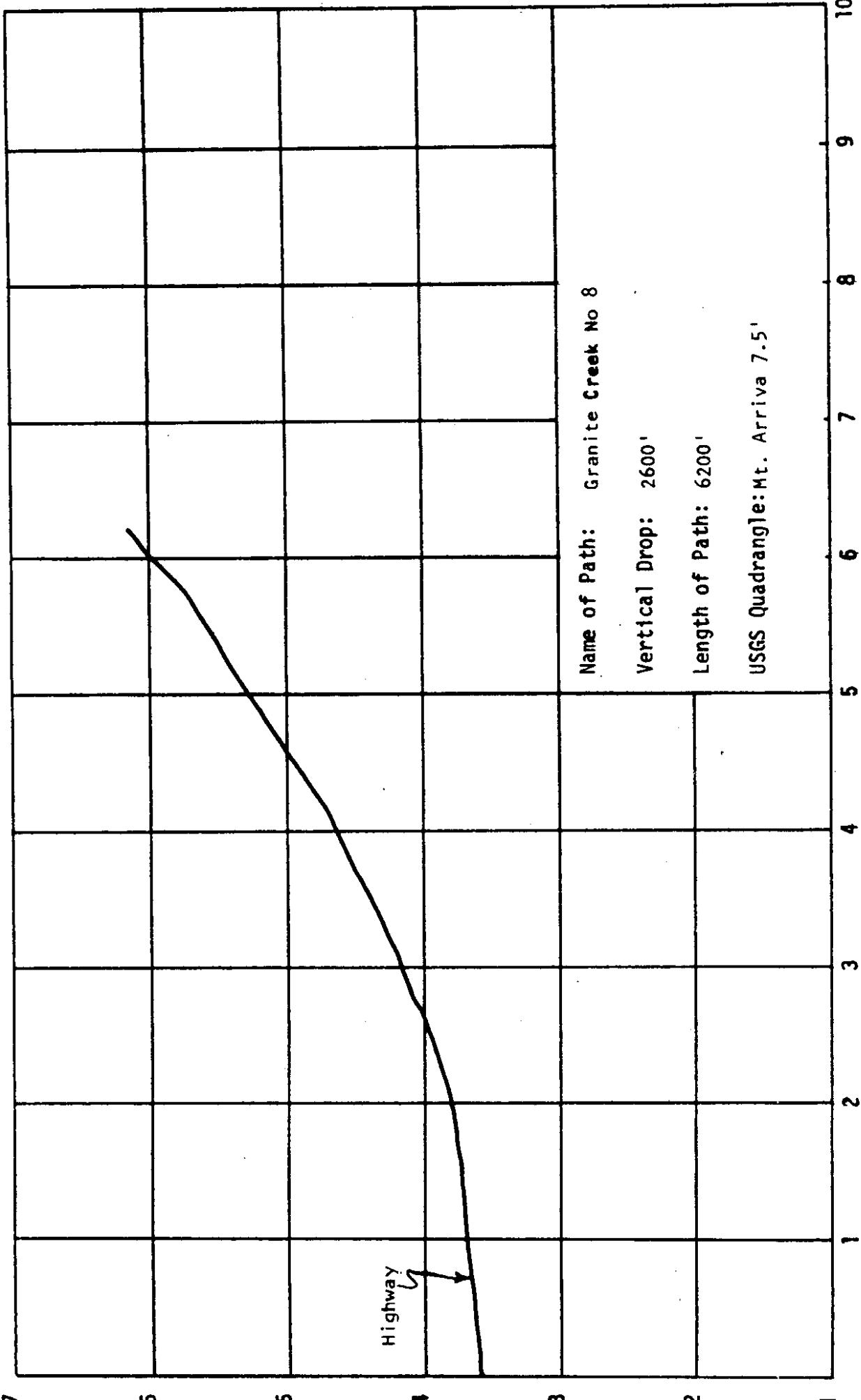
This path originates in a shallow, partially timbered basin on the NW flank of Point 6880. There is no clearly-defined release zone. Avalancheing probably starts near the ridge crest at 6200-6500', but no clearly defined path is established amongst the timber. Sliding snow converges into a stream channel and descends directly to the highway, which represents approximately the maximum penetration of avalancheing in recent years. Avalancheing is most apt to occur with thaw conditions on the SW-facing slopes of the basin. Volume of snow reaching the highway is seldom large. An aerial survey snow stake located in the outrun of this path above the highway is vulnerable to slide damage.

Expected Effect on Highway:

Infrequent deposition of debris-laden snow on highway from wet snow avalancheing. Width not likely to exceed 200' at highway in normal circumstances. A remote possibility exists of a larger dry snow avalanche reaching the highway along a broader front and carry large amounts of timber debris.

History:

Frequent avalancheing of wet snow on upper slopes, probably reaching to 3800' or lower at least once each year, but seldom bringing large quantities of snow to the highway level.





North Cascades Highway SR-20

Avalanche Summary Sheet

Name of Path: Granite Creek No. 9

Hazard: Low

Map: Mt. Arriva 7.5'

Location: Station 1340 + 85 UTM 5384940 N, 661750 E

Elevation of starting zone: 6800'

Vertical fall: 3200' Length: 6000'

Description:

Similar in characteristics to GC-8, this path falls directly from Point 6880 along a shallow basin and stream channel directly toward the highway. Release zone is close to the ridge crest and sliding is largely with wet snow. Maximum recent extent appears to be no farther than the present highway grade.

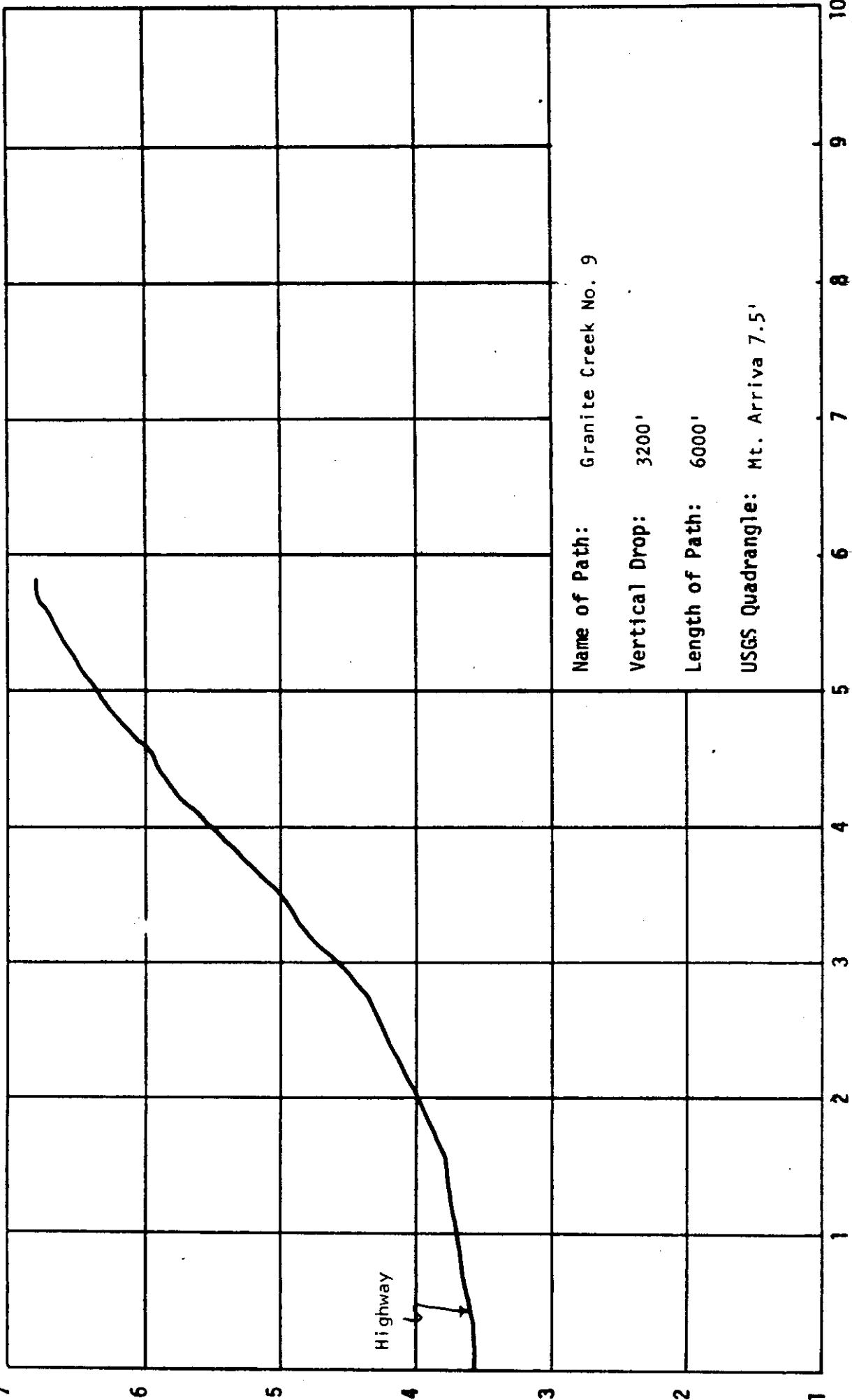
Expected Effect on Highway:

Infrequent deposition of wet snow avalanches with timber debris on highway up 200' wide at most. Remote possibility of dry snow avalanche reaching highway over wider front with heavy load of timber debris.

History:

Frequent avalanching of wet snow on upper slopes, reaching to 3800' level as often as every year. Infrequent larger wet slides which reach the highway level. Tree ring analysis suggests that the last large avalanche to reach maximum extent of this path occurred about 20-25 years ago.

Scale: 1" = 1000'





North Cascades Highway SR-20

Avalanche Summary Sheet

Name of Path: Granite Creek No. 10

Hazard: Low

Map: Mt. Arriva 7.5'

Location: Station 1353 UTM 5384650 N, 661890 E

Elevation of starting zone: around 5200'

Vertical fall: 1500' Length: 3400'

Description:

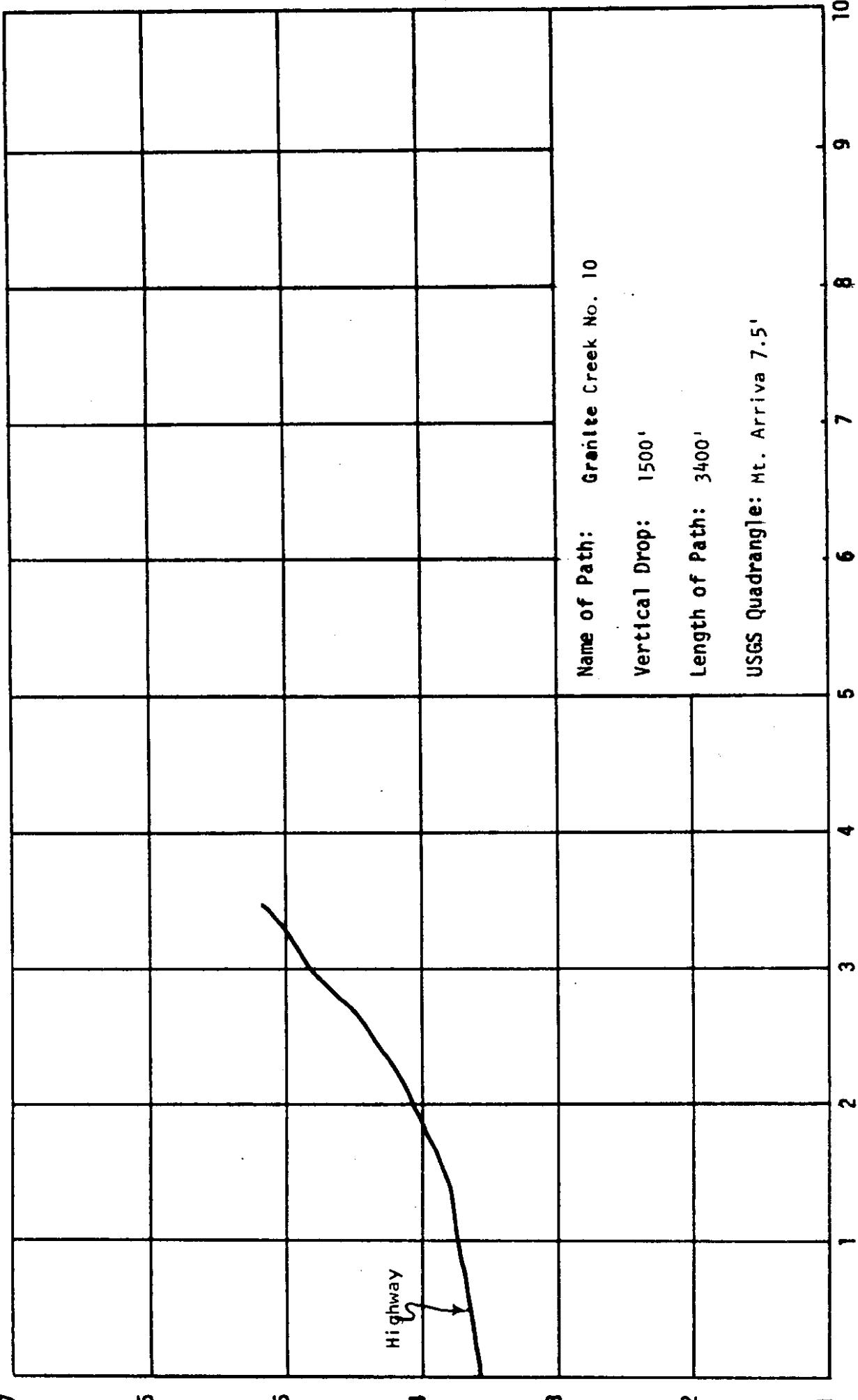
This is a short, straight path with an ill-defined release zone in timber around 5200-5400' elevation. It falls directly to the highway along a very narrow stream channel. The limited size of the release zone and character of the outrun suggest that avalanching here is confined to limited volumes of snow.

Expected Effect on Highway:

Infrequent small wet snow avalanches reaching highway on a very narrow front.

History:

Probably annual occurrence of small wet snow avalanches reaching to 3800' level, but seldom to highway.



Scale: 1" = 1000'

North Cascades Highway SR-20

Avalanche Summary Sheet

Name of Path: Granite Creek No. 11

Hazard: Low

Map: Mt. Arriva 7.5'

Location: Station 1362 UTM 5384340 N, 662100 E

Elevation of starting zone: 6400' maximum

Vertical fall: 2600' Length: about 5500'

Description:

The well-defined timber trim line of this path stops about 400' short of the highway. There is no evidence that it has penetrated beyond this point in the recent past. Like many of the other Granite Creek avalanches on this side of the valley, this one originates in an open basin near the ridge crest and the sliding snow is funnelled into a narrow stream channel at lower elevations. Wet snow avalanching is probably common in the upper basin, but reaches only infrequently to the full extent of the path.

Expected Effect on Highway:

Little hazard except in the event of unusual conditions which generate an avalanche big enough to overrun the present path and reach the highway. This would be most apt to occur on a large scale with a dry snow avalanche. In any case, an overrun reaching the highway would bring with it a large amount of heavy timber debris.

History:

No data other than inferences given above.



North Cascades Highway SR-20

Avalanche Summary Sheet

Name of Path: Granite Creek No. 12

Hazard: Low

Map: Mt. Arriva 7.5'

Location: Station 1379 + 16 UTM 5883820 N, 662310 E

Elevation of starting zone: 6800'

Vertical fall: 3200' Length: about 6000'

Description:

This path originates in a basin just south of Point 6990, with a configuration and outrun very similar to GC-11, except that GC-12 is much wider at the lower end with a well-defined trim line apparently generated by a large dry snow avalanche in the recent past. Like GC-11, lower end of the path as demarcated by the trim line stops short of the highway, in this case by about 600'. There is less vegetation in the upper parts of the GC-12 release zone and it can be expected to generate larger avalanches than GC-11.

Expected Effect on Highway:

Little hazard except in the event of unusual conditions which generate an avalanche big enough to overrun the present path and reach the highway. There is a possibility of this happening over a front up to 1000' wide in the event of a very large dry snow avalanche. Deposition of timber debris on the highway would be extensive.

History:

Frequent wet slide activity in upper parts of path, probably reaching 4200' level each year. The narrow tongue of wet snow avalanche descended to 3900' elevation in 1971. (Highway is about 3700' opposite center of this path.)

North Cascades Highway SR-20

Avalanche Summary Sheet

Name of Path: Granite Creek No. 13

Hazard: Low

Map: Mt. Arriva 7.5'

Location: Station about 1435 UTM 5382360 N, 662950 E

Elevation of starting zone: 7800'

Vertical fall: 4000' Length: about 10,000'

Description:

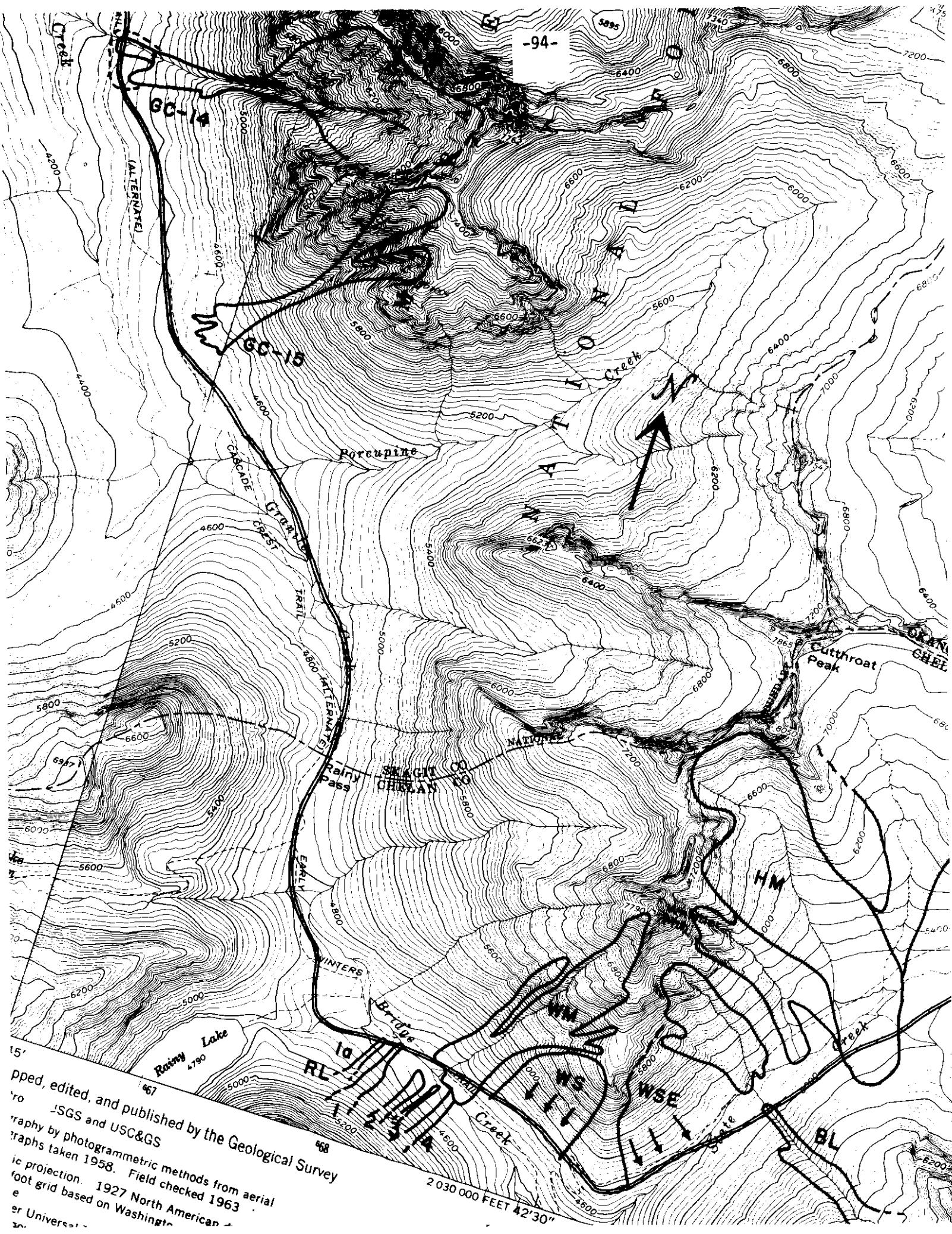
This path originates in a high basin above timberline on the rocky west flank of an unnamed 8000' peak. Avalanche snow descends a long, winding stream channel which reaches a zone of gentle gradient below about 4200'. The altitude and character of the release zone suggest that both wet and dry snow avalanches may be common here. Trim line evidence in the timber indicates dry snow avalanches have regularly overrun the confines of the stream channel down to about 4300'. Below this elevation, the path is very narrow and confined to the stream channel.

Expected Effect on Highway:

A narrow wet snow avalanche may reach the highway as often as annually, and quite probably at least every two or three years. The chance of a large dry snow avalanche descending to the highway over a broader front appears to be small due to the length and character of the path.

History:

Frequent wet and dry snow avalanching to at least the 4300' level. Moderately frequent, possible annual descent of wet snow avalanches beyond this point and occasionally to the highway. Vegetation patterns in the lower reach of the path indicate repeated avalanche damage from sliding wet snow. A wet snow avalanche about 100' wide and 35-40' high was deposited on the highway in 1971.



Granite Creek No. 14 and No. 15 (GC-14 and 15)

Winter of 1971/72:

GC-14 A small avalanche reached the outrun zone but did not extend to the full mapped extent of the path.

GC-15 An avalanche ran the full extent of the path along its north side.

Neither of these avalanches reached the highway.

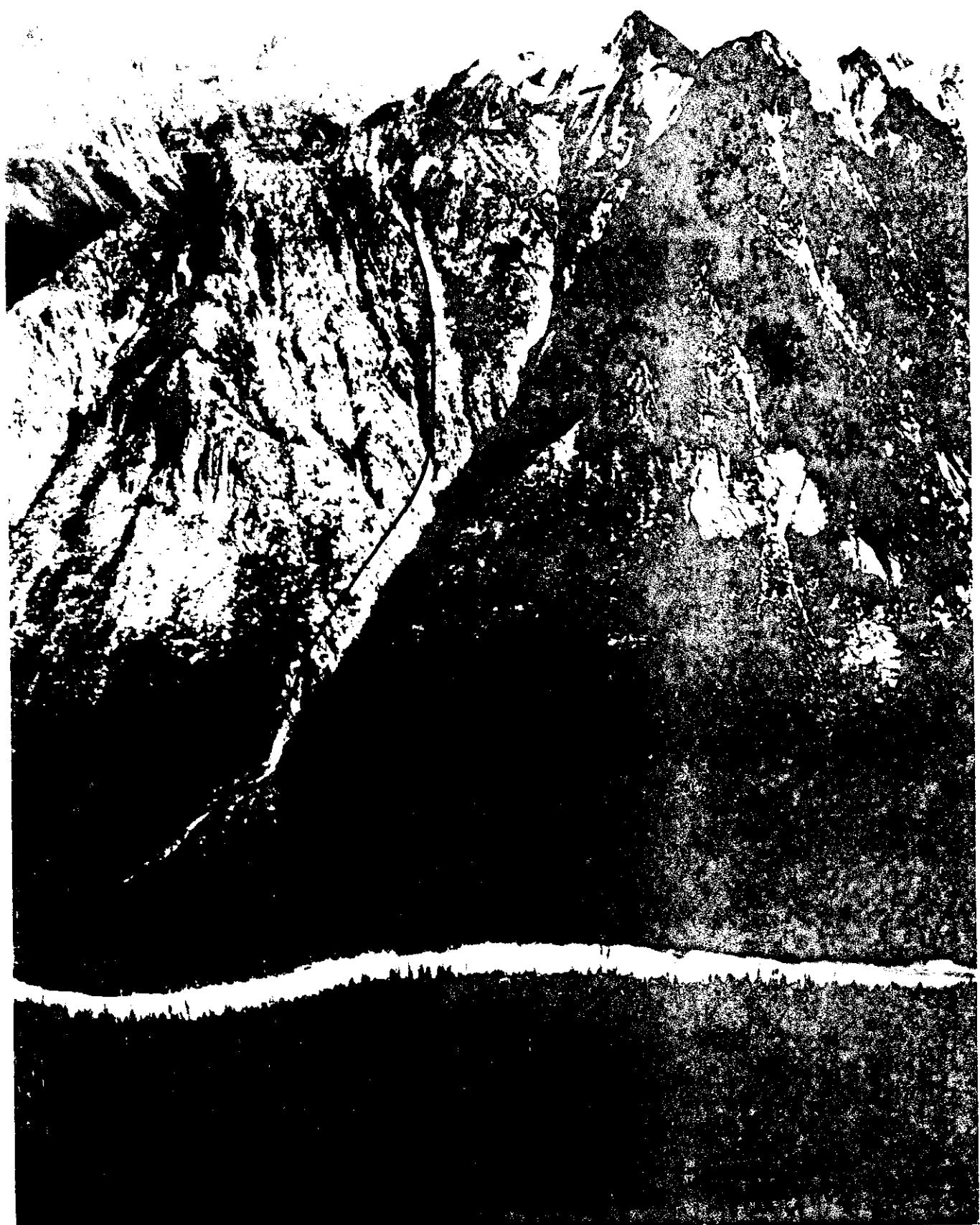
Winter of 1972/73:

No avalanches were reported from these paths.

Winter of 1973/74:

In January a dry snow avalanche with high velocity accompanied by wind blast fell the full length and width of GC-14, broke a new path through the timber about 100 ft. wide, and carried timber-laden snow debris onto the highway. The wind blast also penetrated the timber without major destruction over the full path width and carried many small branches and twigs onto the highway.

No avalanches were reported from GC-15.



North Cascades Highway SR-20

Avalanche Summary Sheet

Name of Path: Granite Creek No. 14

Hazard: Low

Map: Mt. Arriva / Washington Pass 7.5'

Location: Station 1557 + 85 UTM 5379340 N, 665120 E

Elevation of starting zone: 7400'

Vertical fall: 3200' Length: about 9000'

Description:

This path originates at the head of a large, deep ravine located on the rocky west flank of Point 7762. Much of the slide path is above timberline. The ravine converges to a narrow channel just below timberline at 4700'. Below this point a timber trimline demarcates the boundary of the path which spreads out into several fingers, the lowermost reaching to an elevation of about 4300' but stopping short of the highway.

Expected Effect on Highway:

Little hazard to the highway except in unusual conditions which generate a large enough avalanche to overrun the existing path and reach the highway at a lower elevation. Given the configuration and size of the release zone, this is a distinctly greater possibility than in the case of GC-11 and 12. In such circumstances a large amount of timber debris would be carried onto the highway.

History:

Frequent avalanching in upper parts of path, with either dry or wet snow avalanches reaching at least to the 4500' level each year. Has not reached to the highway level in the recent past. A large dry snow avalanche ran almost the full length of the path in 1971.



North Cascades Highway SR-20

Avalanche Summary Sheet

Name of Path: Granite Creek No. 15

Hazard: Low

Map: Mt. Arriva / Washington Pass 7.5'

Location: Station 1613 + 45 UTM 5378140 N, 665870 E

Elevation of starting zone: 7400'

Vertical fall: 2900' Length: about 7000'

Description:

GC-15 is very similar in characteristics to GC-14. Release zone is a steep, rocky ravine above timberline, in this case shallower and more broken by subsidiary ravines. Sliding snow converges to a single stream channel near timberline, and then flows out to form an irregular trimline reaching down to the 4500' level but stopping several hundred feet short of the highway. Both wet and dry snow avalanches are a normal feature of this path.

Expected Effect on Highway:

Little hazard except in unusual snow conditions which generate avalanches large enough to overrun the present limits of the path and reach the highway. This may occur with either wet or dry snow. The latter is apt to produce overrun on a broad front. Any avalanche snow reaching the highway will be heavily laden with large timber debris. The chance of such an overrun occurring is substantially higher than for paths in similar locations farther down Granite Creek (GC-11 & 12).

History:

Frequent dry and wet snow avalanches above timberline, probably reaching below timberline as often as annually. In 1971 a large dry snow ran almost the full length of the existing path.

North Cascades Highway SR-20

Avalanche Summary Sheet

Name of Path: Rainy Lake No. 1, 2, 3 and 4

Hazard: Low

Map: Washington Pass 7.5'

Location: Station about 107 (No. 1) UTM 5374760 N, 668290 E

Elevation of starting zone: 5600-5800'

Vertical fall: about 1000' (No. 1) Length: around 2000'

Description:

The Rainy Lake avalanches fall from the north flank of the peak immediately east of Rainy Lake. Release zones are diffused among broken and partially timbered cliffs and steep slopes. A series of fingers penetrate the timber below about 5000' to form trim lines. Only RL-1 appears to offer any immediate hazard to the highway. This path penetrates the timber along a narrow path all the way to the highway. The rest of these paths to the east fall into Bridge Creek and normally should not produce enough snow volume to cross the creek and reach the highway.

Expected Effect on Highway:

Possible avalanche reaching the highway on No. 1. Debris load probably confined to branches and small timber debris unless avalanche overruns existing path.

History:

Terrain and vegetation indicate very frequent avalanching on upper slopes, but large volumes of snow seldom run to the end of the paths.

-100-



North Cascades Highway SR-20

Avalanche Summary Sheet

Name of Path: Whistler Mountain (WM)

Hazard: Moderately High

Map: Washington Pass 7.5'

Location: Station 116 UTM 5374730 N, 668650 E

Elevation of starting zone: 7600' maximum

Vertical fall: 3100' Length: 5300'

Description:

This avalanche originates above timberline among the cliffs and gulleys on the south face of Whistler Mountain. Sliding snow sweeps directly across a nearly timber-free transition to the highway. Gulleys in the rock face parallel to the fall line channel the sliding snow some extent and have contributed to the maintenance of small islands of timber in the center of the path. Major avalanches will usually involve the entire path, but smaller ones may involve only segments.

Expected Effect on Highway:

Good probability of either wet or dry snow avalanches reaching the highway at least annually and perhaps oftener. Both types of avalanche can be expected, with the dry ones more likely to reach the highway. Release patterns will be related to both major storms and to thaw periods following storms. Smaller avalanches will carry only a light load of debris, but major ones will bring a substantial load of brush and small to medium timber.

History:

Vegetation patterns and tree ring analysis indicate frequent avalanching with large quantities of snow running to the highway level. In 1971 a very large dry snow avalanche caused extensive damage to the timber islands and deposited a large amount of debris on the highway. Comparison of timber damage suggests this is the largest avalanche to have fallen here in as much as 15 or 20 years.

Whistler Mountain (WM)

Winter of 1971/72:

A major dry snow avalanche ran almost to full extent of the path along its eastern half and deposited snow for 300 ft. or more on the highway. This avalanche was not as large as the one which fell in 1970/71. An avalanche from RL-4 on the opposite side of the valley crossed Bridge Creek and overlapped the debris from WM but did not reach the highway.

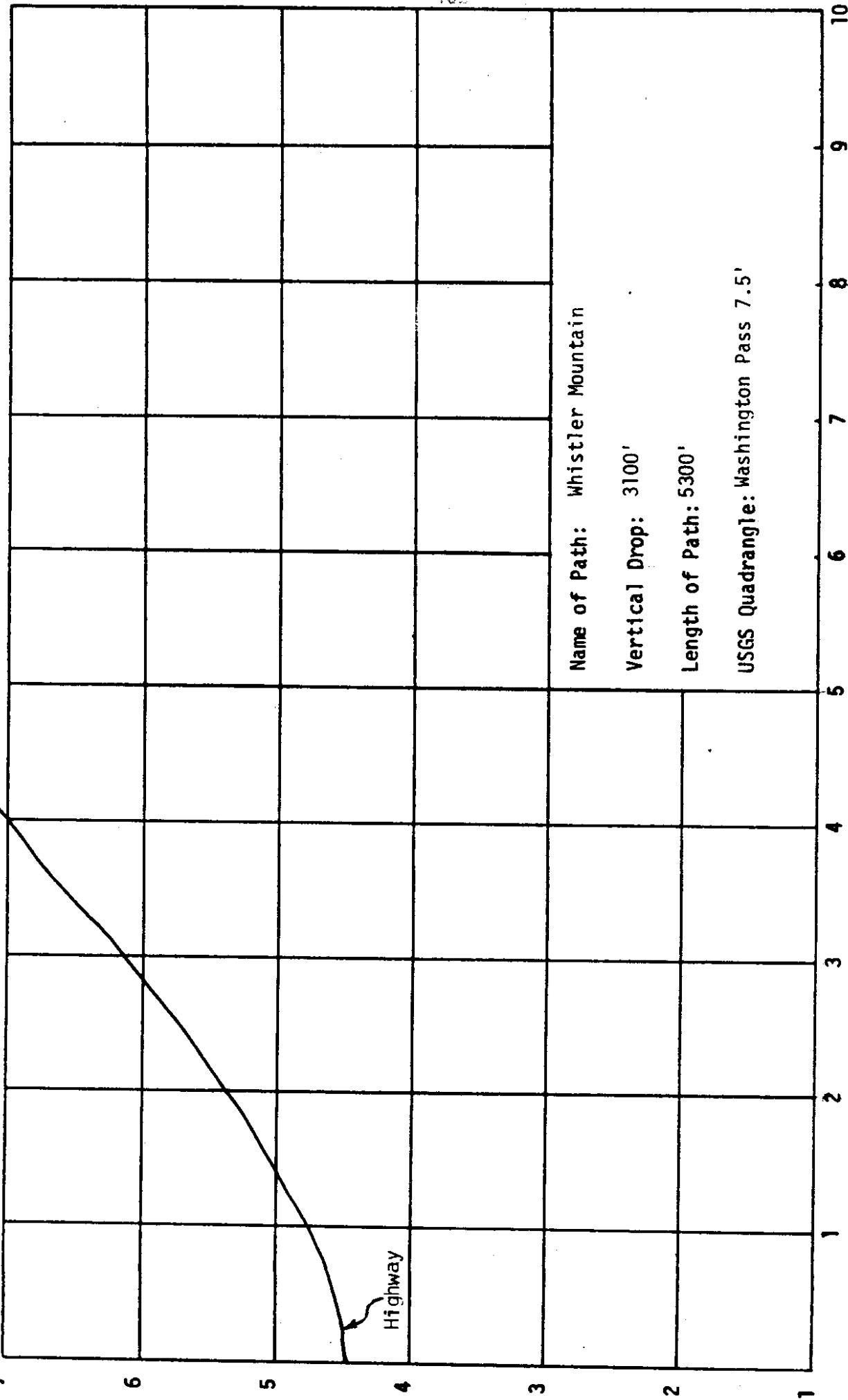
Winter of 1972/73:

A dry snow avalanche in December ran to within 150 ft. of the highway.

Winter of 1973/74:

An avalanche on Dec. 7 fell to within 200 ft. of the highway. On Jan 14 a major avalanche deposited snow on the highway for a distance of 2000 ft. and up to 10 ft. deep.

Note: Also on Jan 14 an avalanche from RL-1, across the highway and just above WM, reached the highway 50 ft. wide and 5 ft. deep. A parallel avalanche also reached the highway just above (west) RL-1. This is a new designation on the map, RL-1a (p. 94).



Scale: 1" = 1000'

-103-

WSE

North Cascades Highway SR-20

Avalanche Summary Sheet

Name of Path: Whistler Shoulder (WS)

Hazard: High

Map: Washington Pass 7.5'

Location: Station 127 UTM 5374640 N, 669080 E

Elevation of starting zone: 6000'

Vertical fall: 1400' Length: 2000'

Description:

This path is a short, steep, rocky slope which falls directly to the highway. Timber is sparse except for scattered stands just above the highway. There is no single, clearly-defined release zone. Small avalanches fall frequently from one section or another of the open slopes. Several adjacent small avalanches may often occur at the same time or over a short period. Both wet and dry snow avalanche conditions will produce activity. There is very little transition zone at the foot of the slope; most avalanching bigger than sluffs will end up on the highway.

Expected Effect on Highway:

Frequent small avalanches reaching the highway each winter, possible as often as each major storm or thaw period, the latter especially in the spring. In most cases debris content of the sliding snow will be low. During highly unstable snow conditions, there is a chance of avalanche release being triggered by snow-removal operations. Volume of individual avalanches normally will not be large and many of them will not pass beyond the highway.

History:

Terrain and vegetation indicated frequent avalanching each winter. Numerous small avalanches deposited snow on the highway here in 1971.

Whistler Shoulder (WS)

Winter of 1971/72:

Numerous small avalanches deposited snow on the highway during the winter, leading to a discontinuous deposit of snow across the whole width of the path.

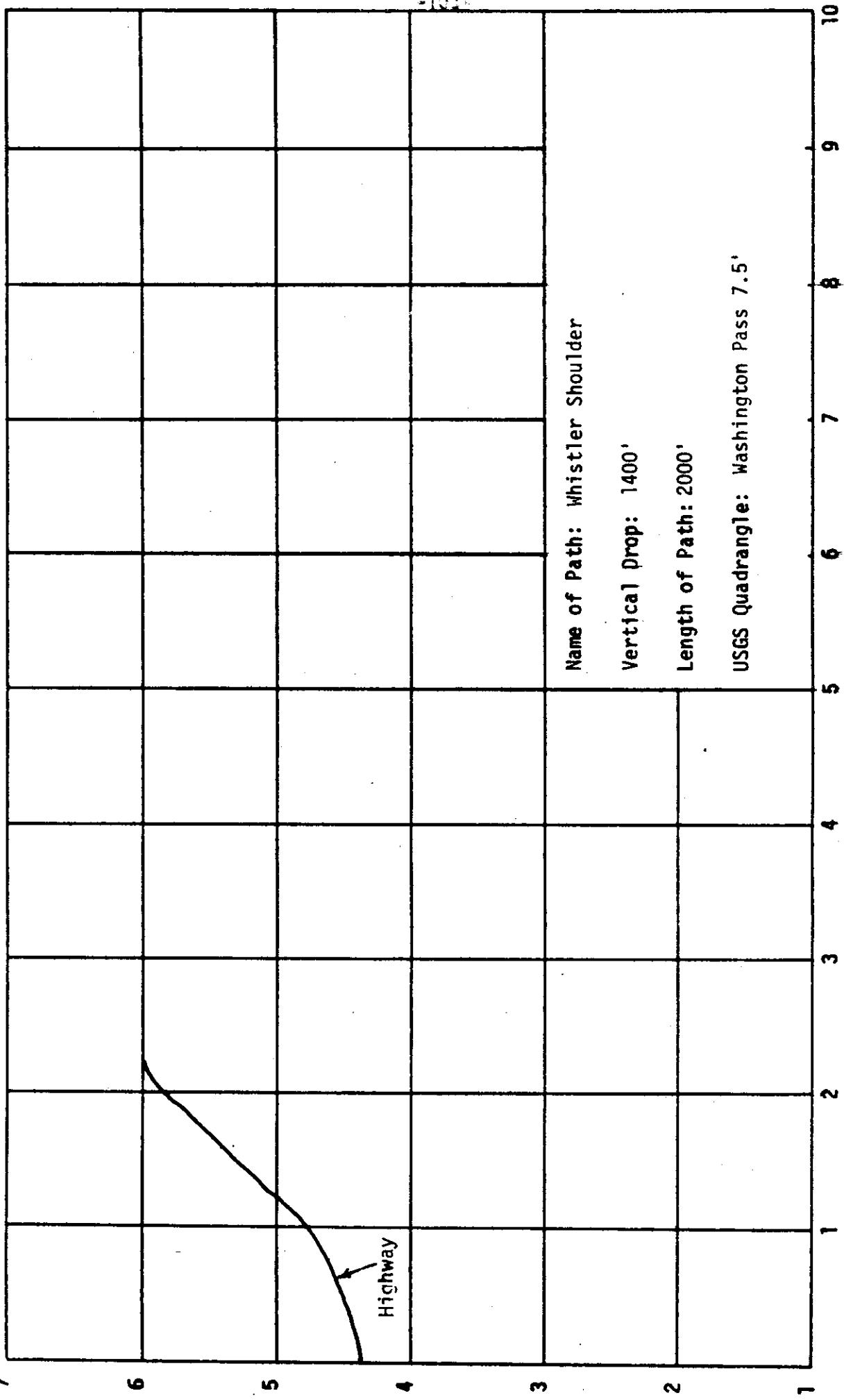
Winter of 1972/73:

Three narrow slides deposited a small amount of snow on the highway in December. A larger trio of slides fell in late January, leaving deposits from 15 to 30 ft. wide and up to 10 ft. deep. The result was an irregular deposition of snow on the highway over most of the width of the path.

Winter of 1973/74:

Activity on this path was heavier than in previous winters of record. By mid-April a continuous layer of debris up to 15-20 ft. deep covered the highway for the full width of the path and extended slightly beyond the mapped width both east and west. Major avalanche events occurred on Nov. 27 and 28, on Dec 7, 15 and 24, on Jan. 14, Feb. 10 and on Mar. 18. The heaviest avalanching occurred on Jan. 14, when timber-laden debris 1000 ft. wide and up to 20 ft. deep reached the highway.

Scale: 1" = 1000'



North Cascades Highway SR-20

Avalanche Summary Sheet

Name of Path: Whistler Shoulder East (WSE)

Hazard: Low

Map: Washington Pass 7.5'

Location: Station about 154 UTM 5374710 N, 669940 E

Elevation of starting zone: 5800'

Vertical fall: 1000' Length: about 1500'

Description:

The general character of this path is similar to Whistler Shoulder, but the release zones face to the SE and there is a more continuous stand of timber across the lower slopes, through which sliding snow penetrates in narrow fingers to the highway. There are two such fingers toward the west side of the path and a broader one just adjacent to the culvert carrying State Creek under the highway. The release zones are among cliffs above about 5400'. Wet snow avalanche activity should be especially common here, although dry snow avalanches are also probable.

Expected Effect on Highway:

Frequent avalanching on upper slopes, usually with every storm, and occasional narrow avalanche tongues reaching to highway, possibly annually or oftener.

History:

Vegetation pattern indicates frequent small avalanches. All three fingers of the path described above avalanched to the highway in 1971.

Whistler Shoulder East (WSE)

Winter of 1971/72:

All three principal release zones in this area discharged avalanches which deposited moderate amounts of snow on the highway. Several avalanches just east of WSE and west of Helicopter Meadows ran to State Creek. These latter paths are not normally expected to affect the highway.

Winter of 1972/73:

Avalanches in December and February ran into the timber on the lower parts of the paths but did not reach the highway.

Winter of 1973/74:

Dec. 15 Small avalanches ran to within 200 ft. of the highway.

Jan. 14 The west chute on WSE discharged an avalanche across the highway, with deposition 50 ft. wide and 5 ft. deep.

-106b-

North Cascades Highway SR-20

Avalanche Summary Sheet

Name of Path: Blue Lake (BL)

Hazard: Low

Map: Washington Pass 7.5'

Location: Station about 175 UTM ,

Elevation of starting zone: 7200'

Vertical fall: 2200' maximum Length: 4000'

Description:

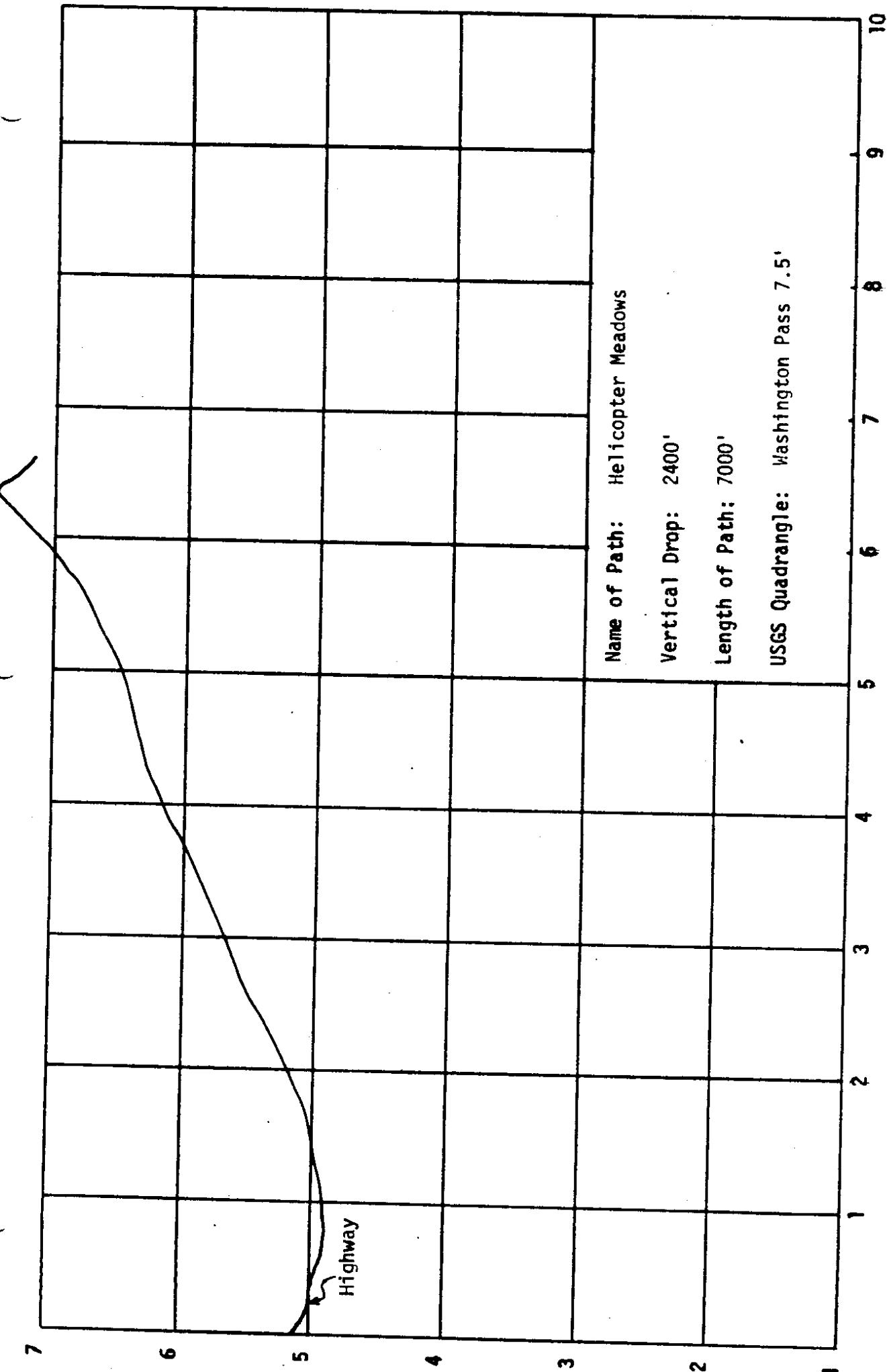
The Blue Lake avalanche originates in a basin on the WNW flank of Point 7509. Small avalanches in this basin are common. Infrequently a large avalanche can descend from the basin along a mapped stream channel to reach the North Cascade Highway. This descent has established a timber trimline over a wider front to the 5400' level, but only a narrow finger on the east extends all the way to the highway.

Expected Effect on Highway:

Infrequent deposit (probably not annually) of moderate amount of snow on the highway. In the event of unusually severe avalanching on this path, the broader front could be broken through timber below the 5400' level, in which case a large amount of timber debris could be deposited on the highway.

History:

An avalanche just reached the highway in the winter of 1971/72. None was reported in 1972/73 and in 1973/74.



Scale: 1" = 1000'

Name of Path: Helicopter Meadows

Vertical Drop: 2400'

Length of Path: 7000'

USGS Quadrangle: Washington Pass 7.5'

North Cascades Highway SR-20

Avalanche Summary Sheet

Name of Path: Helicopter Meadows (HM)

Hazard: Low

Map: Washington Pass 7.5'

Location: Station 192 UTM 5375650 N, 670770 E

Elevation of starting zone: 7400'

Vertical fall: 2400' Length: 7000'

Description:

This avalanche path lies above timberline except for the outrun to State Creek below about 5400'. Release zone is a large basin, rocky at top but covered with open meadows below. At least once in the past, a large avalanche has crossed State Creek and ascended the opposite slope 300' in elevation, crossing the present highway location. Small avalanches are common in the upper basin. Less frequent large avalanche run to timberline and occasionally to State Creek but do not normally affect the highway.

Expected Effect on Highway:

No hazard to highway in normal avalanche conditions, even with large amounts of snow. An unusually big dry snow avalanche with favorable sliding conditions can cross State Creek and travel as far as the highway. Such an avalanche would bring a large mount of timber debris from small trees. The wind blast from such an avalanche which fails to reach the highway is a more probably source of small debris on the highway and a limited source of hazard.

History:

Tree ring analysis suggests that the large avalanche which established the present timber trim line across the highway fell 40 to 60 years ago. Vegetation patterns indicate that avalanching big enough to reach State Creek is relatively frequent, though possible not annual.

Helicopter Meadows (HM)

Winter of 1971/72:

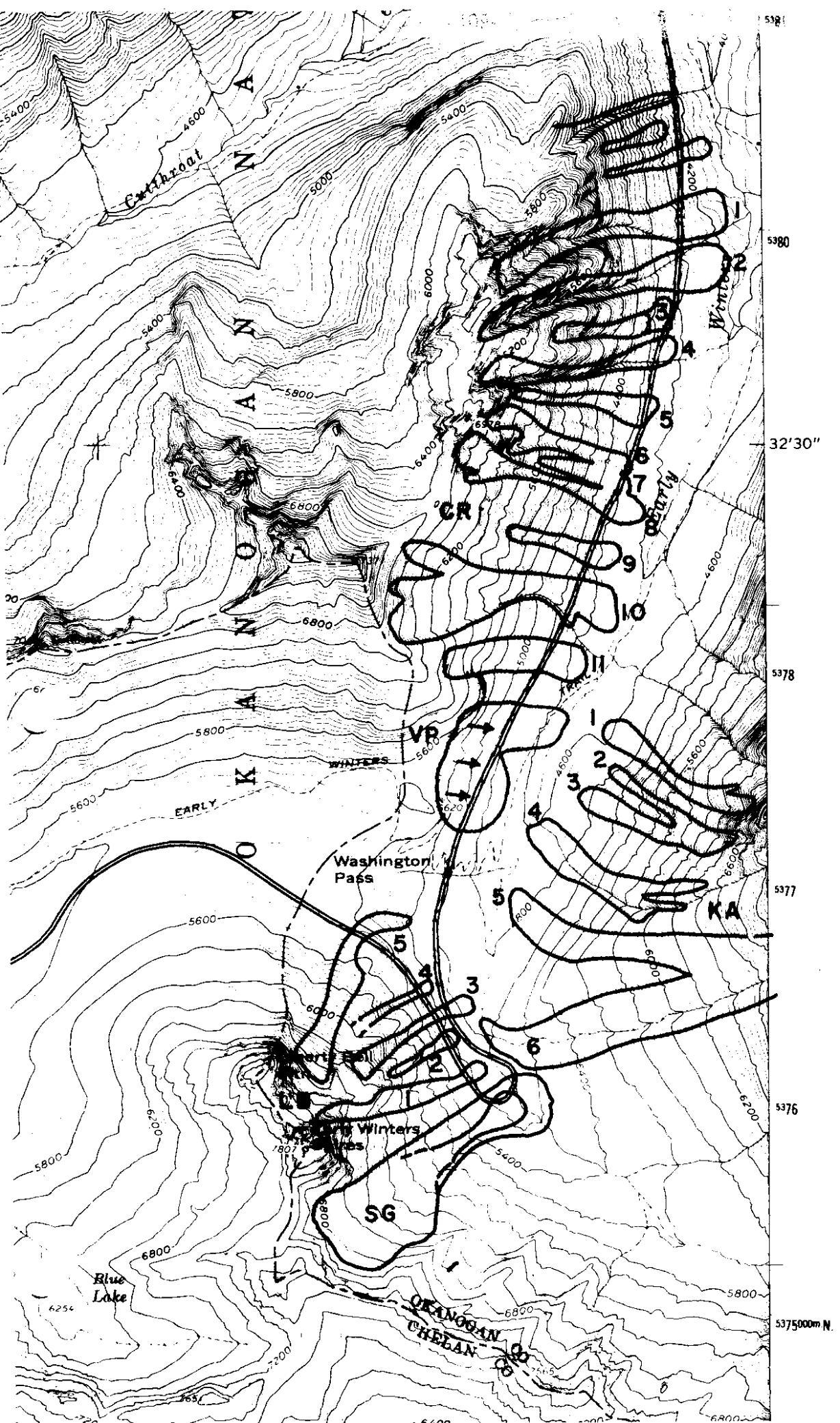
A major dry snow avalanche fell from the entire Helicopter Meadows release zone (basin S of Point 8050), crossed State Creek, ascended the opposite slope to about the 5260 ft. level, crossed the highway, and destroyed second-growth timber above the highway which had grown up since the last such major avalanche 40 to 60 years ago. The 1972 avalanche did not run as far as this previous avalanche. There was also considerable timber damage between State Creek and the highway. The avalanche extended beyond the mapped south boundary of the path in the run-out zone. The larger basin east of Point 8050 also discharged a major avalanche, possibly at the same time as the one from Helicopter Meadows, which joined the HM avalanche and may have contributed to its volume. Snow deposition on the highway was shallow but contained a large amount of small timber debris.

Winter of 1972/73:

Several avalanches in December from individual release zones ran to the lower run-out zone. There was no effect on the highway.

Winter of 1973/74:

In mid-winter a shallow dry snow avalanche ran down the middle of the path and just across State Creek. There was no effect on the highway. There were numerous small releases in the upper part of the path.





North Cascades Highway SR-20

Avalanche Summary Sheet

Name of Path: Liberty Bell No. 3 (LB-3)

Hazard: High

Map: Washington Pass 7.5'

Location: Station _____ UTM 5376300 N, 673810 E

Elevation of starting zone: 6400'

Vertical fall: 1400' Length: approximately 2300'

Description:

The release zone of LB-3 is a shallow basin consisting of rocky gulleys and scattered timber on the NE flank of Liberty Bell Mountain. Avalanches originating here rapidly funnel into a very narrow gully at the 5800' level. This gully turns into an extremely narrow, rock-bound chute just above the upper leg of the highway switchback. Shortly before reaching the highway it is joined by a shorter gully from the east. Snow moving out of the release zone is channelled into a high-velocity flow pattern by this steep gully. Avalanches strike the upper highway leg with large force, spill over the slope below and frequently cross the lower leg as well, running all the way to Early Winters Creek.

Expected Effect on Highway:

High and frequent hazard, with avalanches reaching highway up to several times each winter, in many cases crossing both legs of switchback. Hazard can be expected with most major storms. High-velocity impact of sliding snow can normally be expected. Debris content of avalanche deposits will generally be small.

History:

Terrain and vegetation indicate frequent avalanche activity. During the winter of 1970-71, at least three major avalanches fell across both legs of the highway.

Liberty Bell No. 3 (LB-3)

Winter of 1971/72:

A major accumulation of avalanche debris was deposited on both legs of the highway during the course of the winter. This apparently was the product of several different avalanches.

Winter of 1972/73:

(Early-season avalanches on this path fill the highway cut. Subsequent avalanches overrun the fill, adding some accretion to it each time. The larger avalanches also deposit snow on the lower leg of the highway switchback.)

Chronology of avalanches crossing the highway:

Dec. 16	Mar. 12 (to just above highway)
Dec. 26 (covered both legs)	Mar. 20 (small)
Jan. 8	Apr. 3 30 ft. wide, 3 ft. deep
Jan. 9	Apr. 9 Small to highway
Jan. 12	Apr. 11 25 ft. wide, 10 ft. deep
Jan. 13	Apr. 21 Small to highway
Jan. 14 (at this point debris on upper leg was 75 ft. wide and 35 ft. deep, that on lower leg 20 ft. wide and 6 ft. deep.)	Apr. 26 " May 2 " May 3 "
Jan. 26	May 11 " May 12 " May 13 "

Winter of 1973/74:

Chronology of avalanches crossing the highway:

Nov. 20 30 ft. wide, 4 ft. deep	Dec. 24 60 ft. wide, 2 ft. deep
Nov. 25 40 ft. wide, 10 ft. deep	80 ft. wide, 3 ft. deep upper and just to lower leg
Nov. 27 30 ft. wide, 3 ft. deep	Jan. 12 150 ft. wide, 3 ft. deep
Nov. 28 30 ft. wide, 7 ft. deep	Jan. 16 Crossed both legs (timber)
Dec. 7 50 ft. wide, 5 ft. deep	250 ft. wide, 20 ft. deep upper 400 ft. wide, 15 ft. deep lower
Dec. 12 Just to highway	Jan. 24 50 ft. wide, 4 ft. deep
Dec. 15 Crossed both legs	Jan. 29 Crossed both legs
50 ft. wide, 3 ft. deep upper 100 ft. wide, 3 ft. deep lower	250 ft. wide, 10 ft. deep upper 300 ft. wide, 3 ft. deep lower

Feb. 2 Into highway, small
Feb. 21 "
Feb. 25 "
Mar. 10 "
Mar. 16 200 ft. wide, 4 ft. deep
Mar. 18 Into highway, small

North Cascades Highway SR-20

Avalanche Summary Sheet

Name of Path: Liberty Bell No. 4 (LB-4)

Hazard: Moderately high

Map: Washington Pass 7.5'

Location: Station _____ UTM 5376430 N, 673750 E

Elevation of starting zone: 6000-6200'

Vertical fall: 800-1000' Length: approximately 1800-2000'

Description:

This path originates on an open scree slope adjacent to the release zone of LB-5. A shallow, open basin at this point is bounded on the east by a short section of cliff and on the west by a poorly-defined ridge in the scree slope. Sliding snow descends a shallow, open gulley and then across the steep cutbank onto the highway and the slope below.

Expected Effect on Highway:

Avalanches can be expected to reach the highway one or more times each winter, usually during prolonged winter storms. An exceptionally large avalanche from this path can also reach the lower leg of the switchback. Debris content of the snow will generally be small.

History:

Vegetation evidence indicates irregular occurrence of this avalanche. In winter of 1970-71, frequent avalanching occurred in upper path, but no significant amount of snow reached the highway.

North Cascades Highway SR-20

Avalanche Summary Sheet

Name of Path: Liberty Bell No. 5 (LB-5)

Hazard: Low

Map: Washington Pass 7.5'

Location: Station _____ UTM 5376700 N, 673480 E

Elevation of starting zone: 6500'

Vertical fall: 1300' Length: approximately 3000'

Description:

This slide originates at the foot of the vertical north face of Liberty Bell Mountain. The release zone is an open scree slope in the center of a shallow cirque. Avalanching is common here, triggered with almost every storm by snow falling off the Liberty Bell cliffs. Most avalanching is confined to the open scree slopes, with only the larger slides running to the upper of two clearly-defined benches at timberline. On rare occasions large avalanches can flow over the upper bench and descend over a second bench and a steep, timbered slope onto the highway. The release zone of LB-5 is distinguished from that of LB-4 only by a very shallow ridge in the scree slope. In many circumstances both paths will run at the same time, normally with only LB-4 reaching the highway.

Expected Effect on Highway:

The path will discharge snow onto the highway only in rare instances of exceptional avalanche activity. When it does, the debris is apt to be heavily laden with broken timber.

History:

Path at the highway level is plainly demarcated by a timber trimline. Younger conifers in the path have a uniform age of around 50 years, suggesting that the trimline was established by a large avalanche which fell 40 to 50 years ago. Stratigraphy of debris revealed by highway cut indicates two separate large avalanches have swept this path in the recent past.

Liberty Bell No. 4 and No. 5 (LB-4 and 5)

Winter of 1971/72:

No significant avalanching appeared to have reached the highway during this winter.

Winter of 1972/73:

Small avalanches--usually shallow softs slabs--were observed very frequently on the upper part of these paths. Such avalanching occurred on at least 11 occasions during the winter following the major storms, but only once did a small amount of snow reach the highway. This was from LB-4 on the evening of 25 December. No avalanches reached the highway from LB-5.

Winter of 1973/74:

Jan. 14 LB-4 crossed upper leg of highway, deposit was 40 ft. wide and 10 ft. deep.

Jan. 29 LB-4 crossed upper leg of highway and deposited snow 6 ft. deep on the lower leg.

There were no slides from LB-5 reaching the highway, although small slides in the upper part of the path were common.

Note: On March 5 an avalanche running from the cliffs a short distance above the highway between LB-4 and LB-3 crossed the upper leg of the switchback and deposited snow on the lower leg. Debris on the upper leg was 50 ft. wide and 3 ft. deep.

-114-



North Cascades Highway SR-20

Avalanche Summary Sheet

Name of Path: Liberty Bell No. 2 (LB-2)

Hazard: High

Map: Washington Pass 7.5'

Location: Station _____ UTM 5376190 N, 673890 E

Elevation of starting zone: 6200'

Vertical fall: 1100' Length: approximately 1500'

Description:

LB-2 is a smaller version of LB-3. It differs from the latter primarily in having a much smaller area in the release zone. Channelling through a narrow rock chute onto the highway is very similar to LB-3. Because LB-2 has a much smaller release zone, a smaller volume of snow is available to avalanche and consequently does not descend as far. Normally LB-2 runs only across the upper leg of the highway and quantity of snow available for accumulation on the highway grade is less.

Expected Effect on Highway:

Small to medium avalanches may reach the highway several times each winter, usually as a result of major storms. Debris content of the snow will be limited.

History:

Frequently avalanching each winter. Several small and medium avalanches fell here in 1970-71.

Liberty Bell No. 2 (LB-2)

Winter of 1971/72:

A number of avalanches during the winter produced a major accumulation of debris on the upper leg of the highway.

Winter of 1972/73:

Chronology of avalanches crossing the highway:

Nov. 26	50 ft. wide and 4 ft. deep	Feb. 16
Dec. 16		Mar. 12 To just above highway
Dec. 26		Mar. 20 Small (artillery)
Jan. 8		Mar. 30 Small to highway
Jan. 9		Apr. 11 "
Jan. 12		Apr. 21 "
Jan. 14	Now 50 ft. wide and 20 ft. deep	May 3 "
Jan. 26		

Winter of 1973/74:

Chronology of avalanches crossing the highway:

Nov. 23	30 ft. wide, 10 ft. deep	Jan. 24 Just into highway
Nov. 28	30 ft. wide, 7 ft. deep	Jan. 29 200 ft. wide, 15 ft. deep
Dec. 7	30 ft. wide, 5 ft. deep	Feb. 2 Just into highway
Dec. 11	40 ft. wide, 3 ft. deep	Feb. 25 "
Dec. 15	40 ft. wide, 5 ft. deep	Mar. 10 "
Dec. 24	30 ft. wide, 3 ft. deep	Mar. 16 200 ft. wide, 6 ft. deep
Jan. 16	Crossed both legs of highway with timber debris 150 ft. wide, 20 ft. deep upper 100 ft. wide, 30 ft. deep lower	Mar. 18 Just into highway Mar. 30 "

Note: Avalanche depths are cumulative. The early avalanches fill the highway and subsequent ones add to the depth. Maximum depth at center line may reach 30-40 ft. by end of winter. If each slide were plowed out, the next one would leave a much deeper deposit.

North Cascades Highway SR-20

Avalanche Summary Sheet

Name of Path: Liberty Bell No. 1 (LB-1)

Hazard: High

Map: Washington Pass 7.5'

Location: Station _____ UTM 5376040 N, 673990 E

Elevation of starting zone: 7200'

Vertical fall: 2100' Length: approximately 3500'

Description:

This avalanche path has a peculiar configuration with two separate release zones. The upper zone lies at the foot of the vertical cliffs of the northern Early Winter Spire. It is the open head of a steep, rocky gulley. The lower release zone at 6400' is an area of east-facing, steep rock slabs where this gulley widens before once more narrowing to a chute through rocky cliffs. Unlike the adjacent LB-2 and 3 paths, LB-1 fans out onto a talus fan before reaching the highway. The highway cutbank is deeply incised into this talus cone. Total volume of snow available for sliding is probably comparable to LB-3, but reaches the highway over a broader front with less velocity. There is no evidence of recent flow of this avalanche onto the lower leg of the switchback, which at this point is elevated on a fill.

Expected Effect on Highway:

Frequent high hazard from avalanches running up to several times each winter, usually with major storms. Debris content of the avalanche snow will generally be light. This path deposits snow on the highway over a broader front (up to 300' or more wide) than LB-2, 3 and 4, and consequently requires more work for snow removal.

History:

Avalanches several times each winter are the rule. At least three major avalanches fell on LB-1 in the winter of 1970-71.

Liberty Bell No. 1 (LB-1)

Winter of 1971/72:

A number of avalanches during the winter produced substantial accumulation of debris on the upper leg of the highway.

Winter of 1972/73:

Chronology of avalanches crossing the highway:

Nov. 23	Jan. 13
Nov. 29 75 ft. wide and 10 ft. deep	Jan. 14
Dec. 22 Just to highway	Feb. 16 To just above highway
Dec. 26	Mar. 1 "
Jan. 8	

Winter of 1973/74

Chronology of avalanches crossing the highway:

Nov. 28 60 ft. wide, 10 ft. deep	Jan. 29 300 ft. wide, 15 ft. deep
Dec. 11 60 ft. wide, 6 ft. deep 40 ft. wide, 3 ft. deep	Feb. 2 Just into highway
Dec. 15 100 ft. wide, 3 ft. deep	Feb. 16 "
Dec. 24 100 ft. wide, 5 ft. deep	Feb. 25 "
Jan. 16 300 ft. wide, 15 ft. deep	Mar. 16 200 ft. wide, 4 ft. deep
Jan. 24 Just into highway	Mar. 18 Just into highway
	Mar. 30 "

Note: Avalanche depths are cumulative. The early avalanches fill the highway and subsequent ones add to the depth. Maximum depth at centerline may reach 30-40 ft. by end of winter. If each slide were plowed out, the next one would leave a much deeper deposit.



North Cascades Highway SR-20

Avalanche Summary Sheet

Name of Path: Spire Gulch (SG) (also known as Sawtooth Basin)

Hazard: Moderately high

Map: Washington Pass 7.5'

Location: Station _____ UTM 5375960 N , 674220 E

Elevation of starting zone: 6900'

Vertical fall: 1800' Length: approximately 4800'

Description:

The release zone lies in a broad, rock-rimmed basin immediately SE of Early Winter Spires. The upper part of this basin consists of open scree slopes. Below about 6200' there are scattered rock outcrops and clumps of scrub timber. Avalanche fracture lines may occur at the upper rim of the basin or at various locations farther down. Normal avalanching snow is funnelled through a narrow slot in the rock cliffs at 5500'. Below this it spreads out on a talus fan, part of which is truncated by the highway fill at the switchback. There is also vegetation evidence of a large dry snow avalanche having fallen here at one time over a much broader front and leaving a clear trimline in the stand of timber encircled by the highway switchback. Smaller avalanches, especially damp or wet ones, are normally channeled through the rock slot. These can readily overrun part of the highway loop of the switchback.

Expected Effect on Highway:

Avalanches may reach the highway annually, but probably oftener than annually only in winters of extensive avalanche occurrence. Most avalanches will cover a limited part of the highway, up to 400-450' wide. On rare occasions a dry avalanche on a much broader front can cover up to 800-1000' of highway, inundating the entire loop of the switchback.

History:

Terrain and vegetation evidence suggest at least annual occurrence of avalanches reaching the valley floor and highway level. On occasions in the past this avalanche has crossed Early Winters Creek and ascended the opposite slope a short distance to form a trimline in the timber. Tree-ring evidence at this trimline indicates a major avalanche ran this far around 60 or 70 years ago. There is also some evidence to suggest another such avalanche may have occurred 30 or 40 years ago. Such avalanches presumably would have been dry snow ones falling over a broad front and not confined to the rock chute.

Spire Gulch (SG)

Winter of 1971/72:

A broad, shallow avalanche covered the upper half of the hairpin curve.

Winter of 1972/73:

Small avalanches in the upper path on December 17 were followed by a major avalanche on December 18 buried almost the entire hairpin curve in snow 2 to 4 ft. deep (800-1,000 ft. wide).

A narrow tongue of avalanche debris reached the highway on the right side of the path on Dec. 26.

Winter of 1973/74:

Dec. 15 A small avalanche ran just alongside the highway at the curve.

Jan. 29 A major avalanche covered the entire hairpin curve for 1000 ft. and up to 15 ft. deep.

Mar. 16 Avalanche snow covered the highway 60 ft. wide and 3 ft. deep.





North Cascades Highway SR-20

Avalanche Summary Sheet

Name of Path: Kangaroo No. 6 (KA-6)

Hazard: Low

Map: Washington Pass/Silver Star 7.5'

Location: Station _____ UTM 5376250 N, 674050 E

Elevation of starting zone: 8000'

Vertical fall: 3000' Length: approximately 7200'

Description:

The release zone of KA-6 is an open, rocky basin on the west side of Kangaroo Ridge. Avalancheing from the ridge crest into the basin above timberline is common, but is remote from the highway. On rare occasions a large avalanche has swept all the way from this basin to Early Winters Creek, cutting a broad swath through the timber and leaving a trimline. This avalanche falls on a broad front with little relation to a wandering stream cannel which follows the same route. There presently is a substantial amount of second growth timber in this path. The path intersects the highway fill just before it reaches Early Winters Creek, where the highway bends around on the lower side of the switchback loop.

Expected Effect on Highway:

The high fill at this site will probably protect the highway from surface avalanches by deflecting the flowing snow down-valley, although an exceptionally large avalanche could possibly run clear up onto the highway. In the case of a dry-snow avalanche with substantial wind blast, the highway on top of the fill would be directly exposed to the full force of the blast. There would probably be little direct effect on the highway, and only limited debris deposition in such a case, but any vehicles exposed to the blast could be blown off the highway.

History:

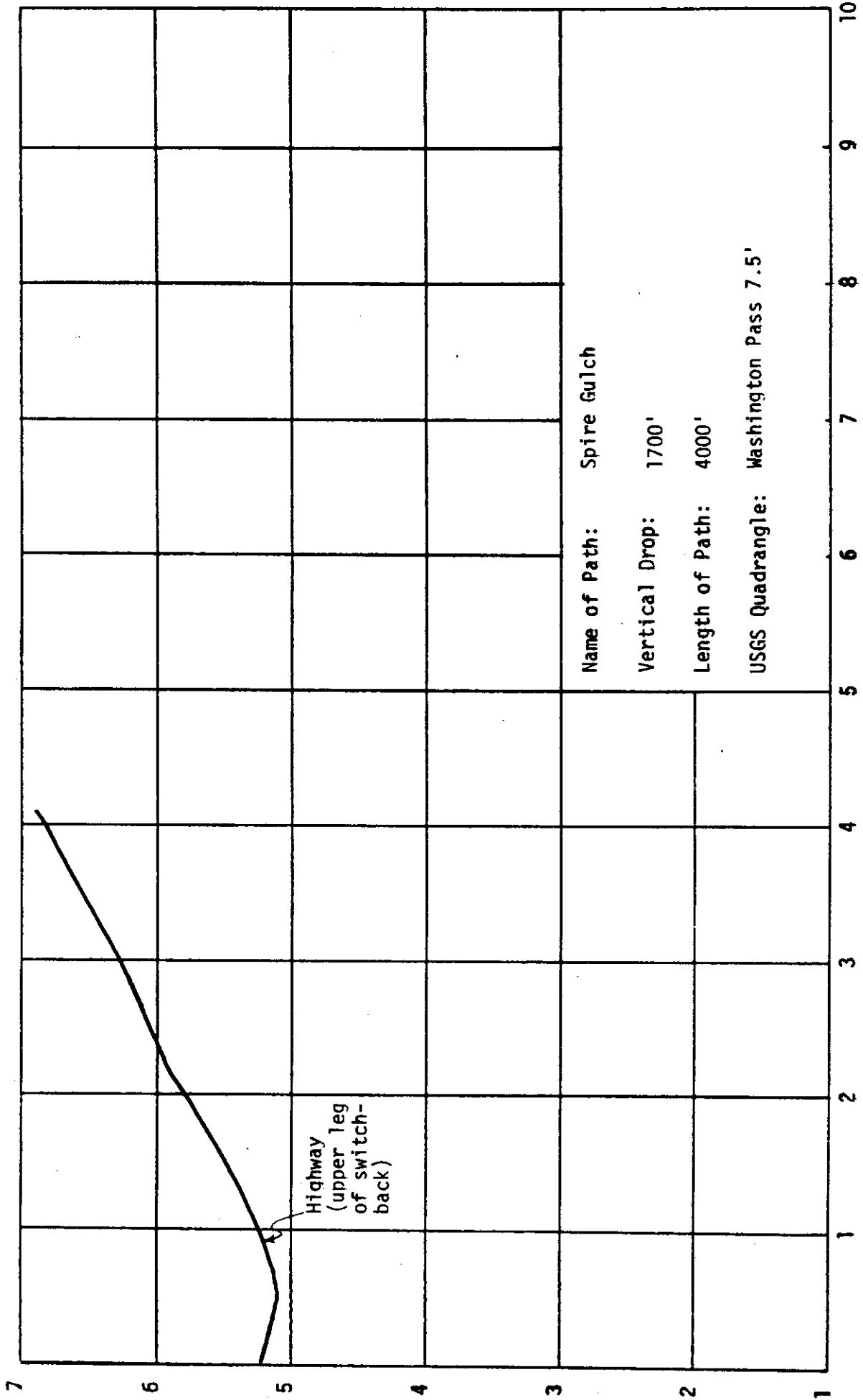
No recent evidence of avalanche snow reaching the valley floor. Tree-ring studies indicate that the last major avalanche which established the present timber trimline fell about 30 or 40 years ago. There may have been an earlier avalanche this big upwards of a century ago. The surrounding mature forest outside the trimline contains trees 300 to 400 years old.

Kangaroo Ridge No. 1 through No. 6 (KA-1 through KA-6)

General activity summary for three winters 1971-1974:

Small avalanches occur frequently on KA-1 through KA-5. Most of these, both wet and dry snow avalanches, run to mid-path or onto the transition zone below. Occasional larger avalanches run to the valley floor but these are few. Most avalanches from KA-5 originate at the bench part way down the path; few start from the upper release zone. One large avalanche from this upper zone was observed to fall in 1972/73.

KA-6, the only path of this group which affects the present highway, has shown little activity during the three years of record. In 1973/74, a narrow tongue of wet snow avalanche debris ran all the way to the highway embankment on the lower part of the hairpin turn. No snow reached the highway.



North Cascades Highway SR-20
Avalanche Summary Sheet

Name of Path: Viewpoint Slides (VP)

Hazard: Moderately high

Map: Washington Pass 7.5'

Location: Station _____ UTM 5377430 N , 674050 E

Elevation of starting zone: 5600'

Vertical fall: up to 1000' Length: 1200-1800'

Description:

A series of steep cliffs, rocky slopes and gulleys, partially timbered, fall to the highway below the Forest Service Visitors Center viewpoint site (Point 5620) and along the highway for some 2000' north of Point 5620. There is no single, clearly-defined avalanche path in this area, but many small avalanches run to the highway among the rocks and trees. Toward the north end of this zone the avalanches can reach large enough size to cross the highway and flow to the valley floor.

Expected Effect on Highway:

Frequent small avalanches will run onto the highway during heavy snowstorms. Following exceptionally heavy snowfalls or unusual avalanche conditions, much of the Viewpoint Slides area may run simultaneously. Little debris normally will be incorporated in the snow. During high hazard conditions, avalanches in this zone can readily be triggered by plowing operations.

History:

Apparently frequent small avalanches occur each winter. Formerly they ran farther toward the valley floor, but many are now caught by the highway. This area was extensively covered by avalanche snow in the winter of 1970-71.









North Cascades Highway SR-20

Avalanche Summary Sheet

Name of Path: Cutthroat Ridge (CR-1 through CR-11)

Hazard: High and frequent

Map: Washington Pass

Location: Station _____ UTM _____,

Elevation of starting zone: 5400-6800'

Vertical fall: highway lies at 4200-4800' Length: variable up to 4500'

Description:

(The Cutthroat Ridge avalanches are discussed collectively, for many of them have very similar characteristics. Some of the individual paths are briefly described at the end of this Cutthroat Ridge Summary.)

Cutthroat Ridge is a steep, rocky ridge running almost due north-south and reaching crest elevations of 6800-7300'. It divides the valley of Early Winters Creek from that of its tributary, Cutthroat Creek. The entire east face of Cutthroat Ridge above 4800-5000' consists of broken rock faces, cliffs and steep gullies. Below these elevations talus slopes run to the valley floor amidst timbered areas which have escaped avalanche destruction.

The North Cascades Highway traverses this east face of Cutthroat Ridge just below the steepest parts of the cliffs and gully, descending from 4800' on the south to 4200' on the north. For a distance of 1.7 miles (not including the Viewpoint Slides zone) it is almost continuously exposed to avalanching snow. The highway is located just at the beginning of the outrun and deposition zones for many of the avalanches and hence serves to trap many of the smaller slides which formerly spread out onto the talus slopes below. If a catchment terrace were to be placed along this ridge to reduce avalanching onto the lower slopes, it would be located close to the present highway grade.

The annotated map of this section of highway (p. 109 shows only the principal avalanche paths falling from Cutthroat Ridge. The annotated photographs (p. 124 through 127 show these same principal paths but also indicate the zones where avalanching is continuous along the highway with no demarcation from one path to another at

North Cascades Highway SR-20

Avalanche Summary Sheet

Name of Path: Cutthroat Ridge (CR-1 through CR-11), continued

Description continued:

the deposition level on the highway. This continuous avalanche area is mainly confined (on the basis of evidence to date) to the southern half of the 1.7 mile zone, embracing CR-6 through CR-11 and extending beyond to merge with the Viewpoint Slides zone.

There are two distinct types of avalanches which fall to the highway along Cutthroat Ridge. One type originates at or near the ridge crest and descends clearly-defined gullies. Examples are CR-1, 2, 4, 6, 8, and 10. The release zones of this first type are readily identifiable except for CR-10, which probably has multiple release zones. The other type embraces the avalanches which originate at lower elevations among the rocky flanks of the ridge. Examples are CR-5, 7, and 9. The release zones of this second type are often difficult to identify. In fact the boundaries of these paths are difficult to identify, for one blends into another along the southern half of the Cutthroat Ridge avalanche zone.

The type distinction for the paths is an important one, for the two types are apt to react differently to different storm and weather conditions, and will present different problems for road closures and safety of maintenance crews. The gully avalanches with release zones near the crest are subjected to loading from each storm with prevailing south or southwest winds. Even strong winds in the absence of snowfall can build up a hazard on these paths. They are also subject to triggering by cornice falls. (Cornice formation is extensive and heavy along Cutthroat Ridge.) The lower release zones characteristic of the second avalanche type are less susceptible to wind-loading. They are apt to produce avalanches as a result of prolonged or heavy snow storms.

The first type includes several paths which are reasonably amenable to control by artillery fire, for the target points can be clearly determined. The second type would require extensive consumption of ammunition to assure that all unstable pockets of snow had been released, except in very unstable snow conditions when everything slides with a few shots.

North Cascades Highway SR-20

Avalanche Summary Sheet

Name of Path: Cutthroat Ridge (CR-1 through CR-11), continued

Description continued:

The second type of path with lower release zones are especially dangerous for snow-plowing operations because there is a good chance that the mechanical disturbance of plowing could initiate fracturing which would propagate up into the release zones and initiate avalanching. This is much less likely to happen with the higher release zones.

Expected Effect on Highway:

Avalanches of some kind, from one or the other path types or both, can be expected to reach the highway with almost every snow storm. During winter storms these will largely be dry snow avalanches originating as soft slabs. Extensive wet snow avalanching can also be expected during spring thaws and following spring snowstorms which may not otherwise produce slide activity. During winters of deep snow and/or heavy avalanching, large amounts of snow would have to be repeatedly cleared from this section of highway to keep it open. No sooner than one set of slides was cleared out, it would be necessary to do it all over again after the next storm, for the highway will fill right up again with avalanche snow. Debris content of snow deposited on the highway will mostly be limited to twigs and branches.

The overall effect of this Cutthroat Ridge avalanche zone on the highway would be to require frequent closures for public safety, for maintenance crew safety, and simply to spend time clearing snow even after hazardous conditions abate.

History:

Terrain and vegetation evidence point to frequent avalanching all along Cutthroat Ridge. Reports of earlier experience in this area prior to highway construction (Jack Wilson, Mazama) mention that this area is known to slide with every storm. Fewer avalanches presently reach the lower slopes and valley floor because much of the sliding snow is caught by the highway.

Several of the larger paths left enough snow deposits on the highway to persist into late spring after the winter of 1969-70. Avalanching was more extensive in 1970-71. The highway was buried under avalanche snow approximately to the extent shown in the annotated photos. There were repeated avalanche cycles in both winter and spring conditions.

North Cascades Highway SR-20

Avalanche Summary Sheet

Name of Path: Cutthroat Ridge (CR-1 through CR-11), continued

Individual paths:

The following avalanche paths falling from Cutthroat Ridge have sufficiently individual character to merit separate discussion.

CR-1 Release zone is a bifurcated gully with steep rock walls originating at the ridge crest. Substantial amount of sliding snow is also contributed from steep rock walls part-way down the gully. Avalanches fall through a constricted part of the gully at 4800', then fan out onto a talus slope before reaching the highway. Avalanche triggering by cornice fall is highly probable at the head of the gully.

CR-2 Very similar to CR-1, but narrower with a smaller source area for sliding snow. Dry snow avalanching does not follow the diagonal stream channel in the talus fan, but jumps out of this channel and falls straight to the highway. Triggering by cornice fall is highly probable.

CR-4 The release zone lies in the wide head of a rocky gully which falls from the ridge crest. Below 5600' the gully becomes very narrow and turns toward the north. This turn directs flowing snow diagonally toward the highway as the normal path of fall. In some circumstances the avalanche can turn and descend more directly down the fall line after leaving the gully mouth at 4800'. Falling cornices are a highly likely trigger.

CR-6 The release zone is an open, rocky slope with scattered small trees at the foot of a vertical cliff terminating at 6200'. Snow avalanching off this cliff early in each storm will tend to trigger slides from the release zone before unstable snow has a chance to build up here to great depth, hence there is less probability of large avalanches from CR-6 than from the other paths discussed above.

CR-8 Release zone is similar in character to CR-6, but originates at the ridge crest where cornice falls are a more likely trigger. Larger avalanches are likely than from CR-6.

CR-10 This path appears to have several release zones spread over a wide area on the upper flanks of Point 7371. The south edge is clearly demarcated by a long, slanting gully. More than one avalanche from this path within a short interval is very probable during heavy storms, a characteristic which would make it especially dangerous for plowing operations on the highway below.

North Cascades Highway SR-20

Avalanche Summary Sheet

Name of Path: Cutthroat Ridge (CR-1 through CR-11), continued

Map coordinates:

CR-1 UTM	5380040 N, 674920 E
CR-2	5379810 N, 674920 E
CR-3	5379610 N, 674870 E
CR-4	5379410 N, 674820 E
CR-5	5379140 N, 674750 E
CR-6	5378890 N, 674670 E
CR-7	5378820 N, 674650 E
CR-8	5378710 N, 674600 E
CR-9	5378480 N, 674530 E
CR-10	5378270 N, 674430 E
CR-11	5378000 N, 674310 E

Cutthroat Ridge No. 1 through No. 11 (CR-1 through CR-11)

Viewpoint (VP)

These series of slides behave in a very similar fashion and their occurrence history for 1971-1974 is reported collectively. For 1971/72, reports stem from occasional winter reconnaissance and can only summarize the accumulated effect on the highway. Detailed observations are available from 1972/73 and 1973/74, when an observer resided at Washington Pass.

Winter of 1971/72:

Frequent avalanching occurred during the winter, leading to more or less continuous deposition on the highway from CR-5 to CR-11 and deposition from most of the other paths as well. Deposition from VP was substantial but not entirely continuous.

Winter of 1972/73:

Date	Path	Type	Effect on highway & remarks	maximum at centerline	
				Depth	Width
Dec 16	VP	L-N-1	Just reached edge of highway		
17	CR-10 & 11	SS-N-2	Crossed--similar activity on other paths	3 ft.	15 ft.
18	CR-10 & 11	SS-N-3	Crossed-similar activity on other paths	6 ft.	20 ft.
26	CR-10	SS-N-4	Crossed the highway	20 ft.	50 ft.
26	CR-11	SS-N-2	Into the highway at 7 places Similar activity other CR slides	3 ft.	10 ft.
Jan 12	CR-11	L-N-2	Crossed the highway in 2 places	5 ft.	15 ft.
14	CR-11	SS-N-2	Into the highway at several places, crossed highway 4 places	10 ft.	20 ft.
14	CR-10	SS-N-3	Crossed highway to the right of old debris. Soft slab activity occurred on all other CR slides	20 ft.	50 ft.
26	CR-11	L-N-2	Crossed the highway	2 ft.	
Feb 16	CR-1 thru 5	SS-N-2	Slid to bottom of gully		
16	CR-6	SS-N-3	Crossed the highway	15 ft.	35 ft.
16	CR-7-8	SS-N-2	Slid to bench above road cut		

Winter of 1972/73 (cont.)

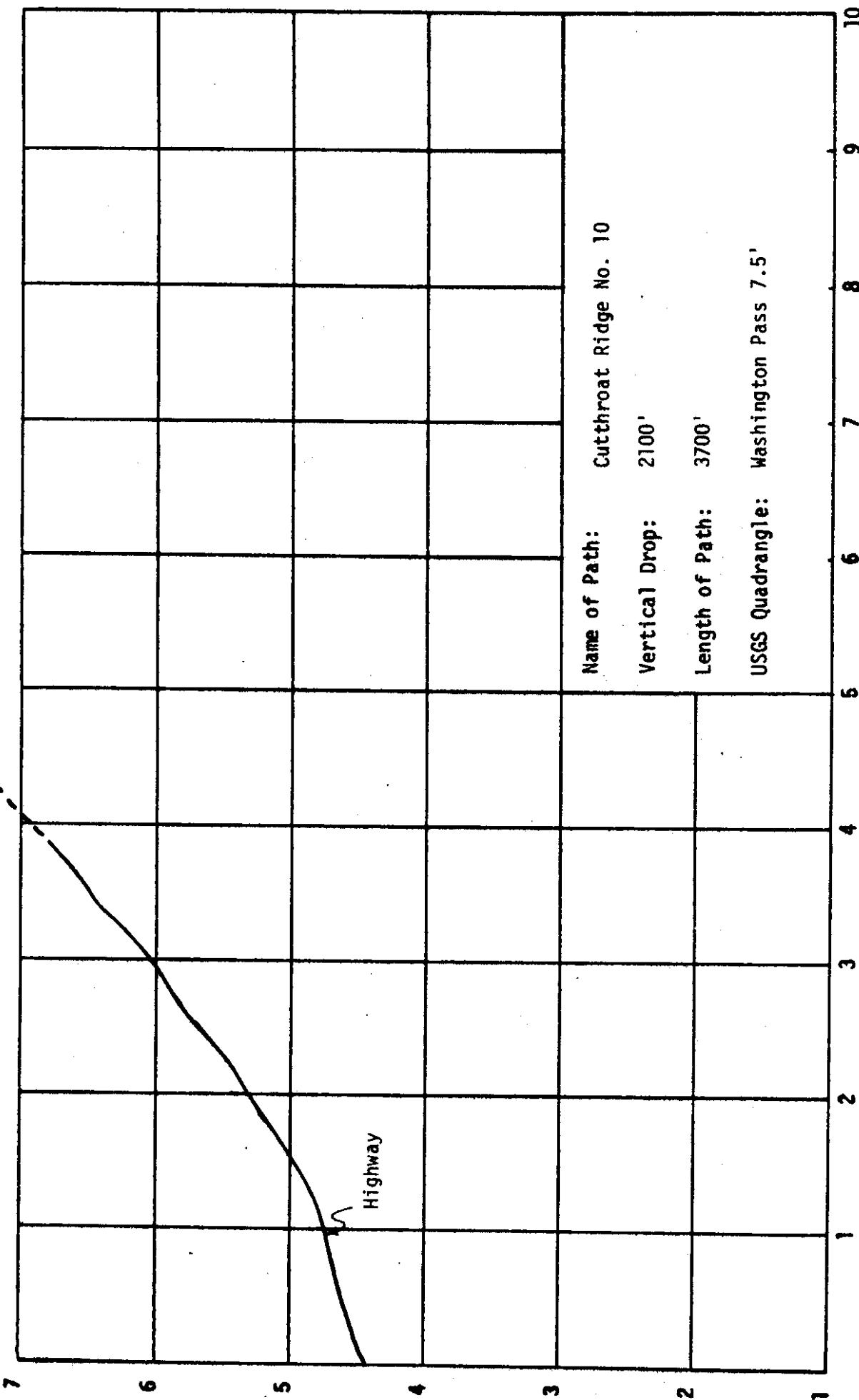
Date	Path	Type	Effect on highway & remarks	maximum at centerline	
				Depth	Width
Feb 16	CR-9	SS-N-2	Just reached the edge of highway		
16	CR-10	SS-N-2	To edge of road over a wide area		
16	CR-11	SS-N-2	Into the road at two places		
22	CR-11	WL-N-1	Bank sluff to the edge of road	4 ft.	30 ft.
Mar 1	CR-11	WL-N-1	Bank sluff to shoulder		50 ft.
12	CR-11	L-N-1	Sluffing in all CR upper release zones		
30	CR-11	WL-N-2	Into road	3 ft.	30 ft.
Winter of 1973/74:					
Nov 28	CR-6	SS-N-2	Crossed	3 ft.	30 ft.
28	CR-7	SS-N-2	"	3 ft.	30 ft.
28	CR-10	SS-N-2	"	5 ft.	50 ft.
Dec 15	CR-10	SS-N-3	"	10 ft.	100 ft.
15	CR-11	SS-N-2	"	6 ft.	40 ft.
15	VP	SS-N-2	Crossed at two places	6 ft.	40 ft.
24	CR-1	SS-N-3	Crossed	8 ft.	50 ft.
24	CR-2	SS-N-3	"	8 ft.	50 ft.
24	CR-4	SS-N-3	"	10 ft.	80 ft.
24	CR-5	SS-N-3	"	8 ft.	70 ft.
24	CR-6	SS-N-3	"	8 ft.	70 ft.
24	CR-7	SS-N-3	"	8 ft.	70 ft.
24	CR-8	SS-N-3	"	8 ft.	70 ft.
24	CR-9	SS-N-3	"	10 ft.	50 ft.
24	CR-10	SS-N-3	"	15 ft.	200 ft.
24	CR-11	SS-N-3	"	20 ft.	80 ft.
24	VP	SS-N-3	"	8 ft.	30 ft.

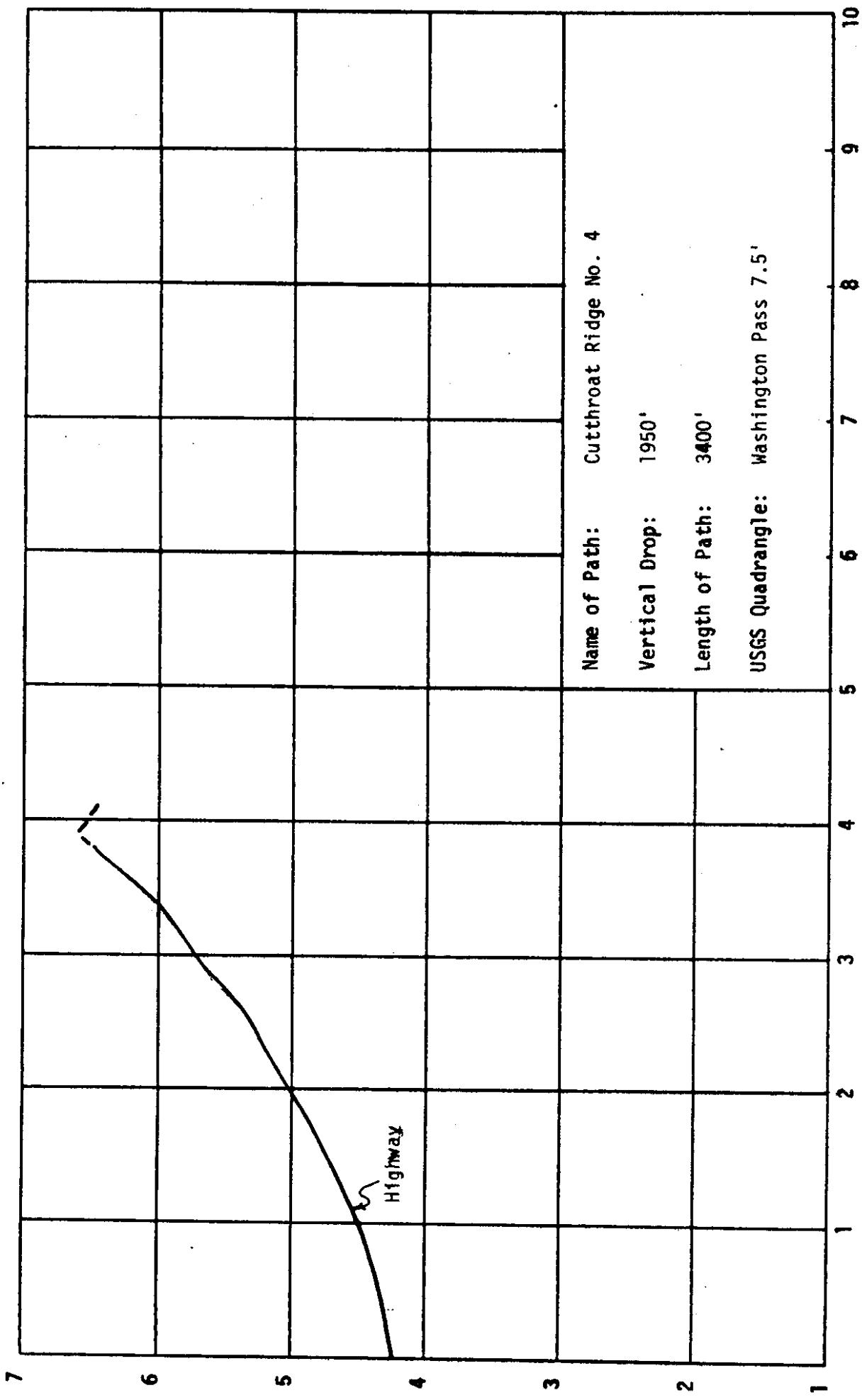
Winter of 1973/74 (cont.):

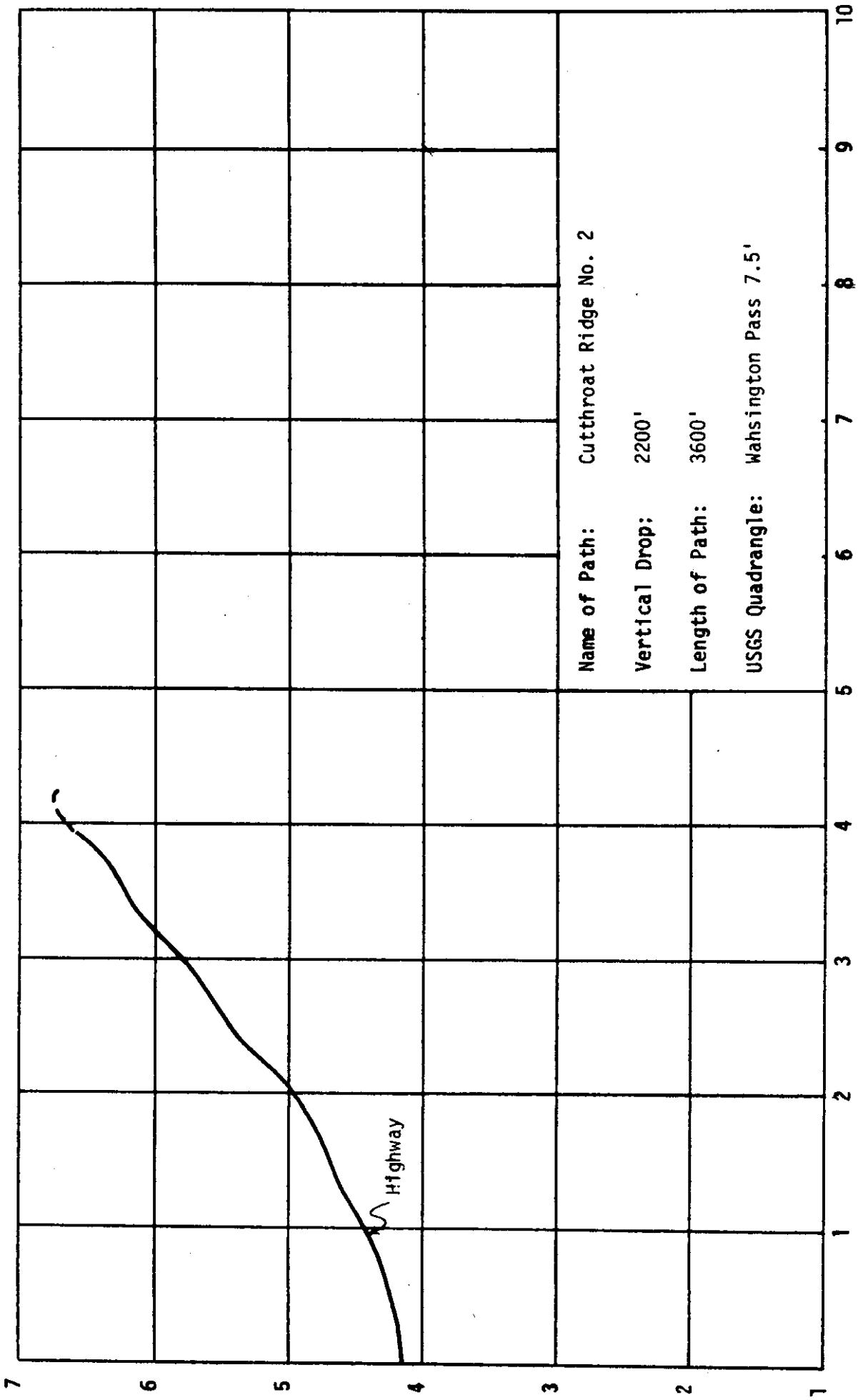
Date	Path	Type	Effect on highway & remarks	maximum at centerline	
				Depth	Width
Jan 14	CR-10	SS-N-3	Crossed	20 ft.	200 ft.
	CR-11	SS-N-3	Crossed, timber		15 ft.
	CR-4	SS-N-3	Crossed		15 ft.
	CR-5	SS-N-3	"		15 ft.
	CR-6-8	SS-N-3	Crossed, continuous deposition		300 ft.
	CR-9	SS-N-3	Crossed		50 ft.
	VP	SS-N-3	Crossed at several places		500 ft.
	All CR paths	SS-N-3	Crossed		Cont. dep. above CR-5
Feb 1	VP	SS-N-3	Crossed, Continuous deposition	7 - 15'	1000 ft.
	CR-10	SS-N-3	Crossed	10 ft.	75 ft.
	CR-11	SS-N-2	Into highway	Small amt. of snow	
	CR-10	SS-N-3	Crossed		200 ft.
	CR-11	L-N-2	Into highway	Small amt. of snow	
	CR-11	L-N-2	"		"
Mar 7	CR-11	L-N-2	"		"
	VP	L-N-2	"	5 ft.	
	CR-9	SS-N-3	Crossed		50 ft.
	CR-11	SS-N-3	"	5 ft.	50 ft.
	VP	SS-N-3	"	5 ft.	50 ft.
16	CR-10	SS-N-3	"	6 ft.	200 ft.
	CR-1	SS-N-3	"	3 ft.	100 ft.
	CR-2	SS-N-3	"	3 ft.	70 ft.
	CR-4	SS-N-3	"	3 ft.	50 ft.
	CR-5	SS-N-3	"	3 ft.	50 ft.
	CR-6-7-8	SS-N-3	Crossed, continuous deposition	3 ft.	500 ft.

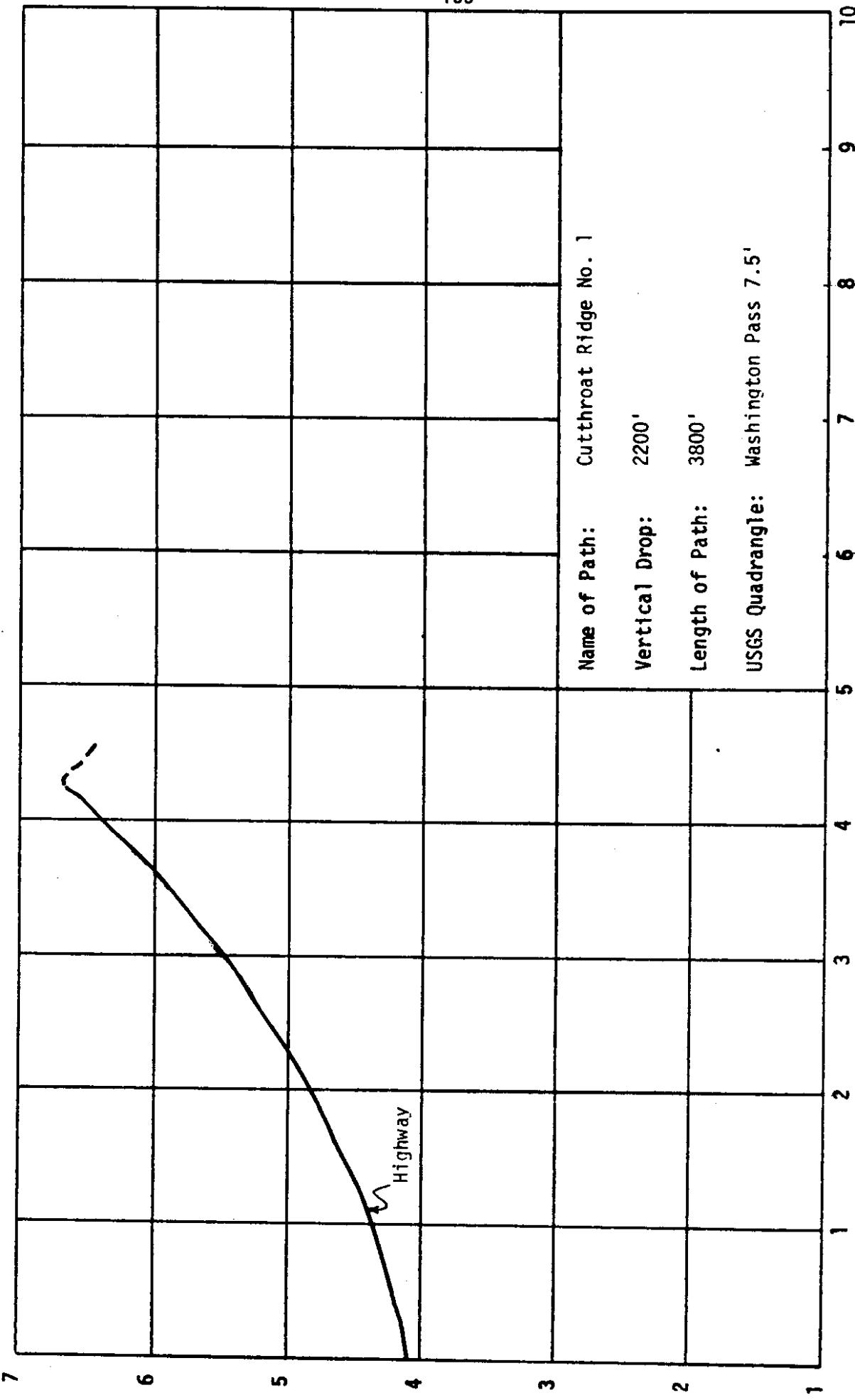
Winter of 1973/74 (cont.):

Date	Path	Type	Effect on highway & remarks	<u>maximum at centerline</u>	
				Depth	Width
Mar 16	CR-9	SS-N-3	Crossed	3 ft.	75 ft.
16	CR-11	SS-N-3	"	3 ft.	200 ft.
16	VP	SS-N-3	"	3 ft.	600 ft.
18	CR-8	L-N-2	Into highway	Small amt. of snow	
18	CR-10	L-N-2	"	"	
18	CR-11	L-N-2	"	"	
27	CR-8	SS-N-2	Crossed	3 ft.	100 ft.
27	CR-9	SS-N-2	"	3 ft.	70 ft.
27	CR-11	SS-N-2	"	3 ft.	100 ft.
27	VP	SS-N-2	"	3 ft.	50 ft.
30	CR-5	SS-N-3	Crossed, timber	5 ft.	50 ft.

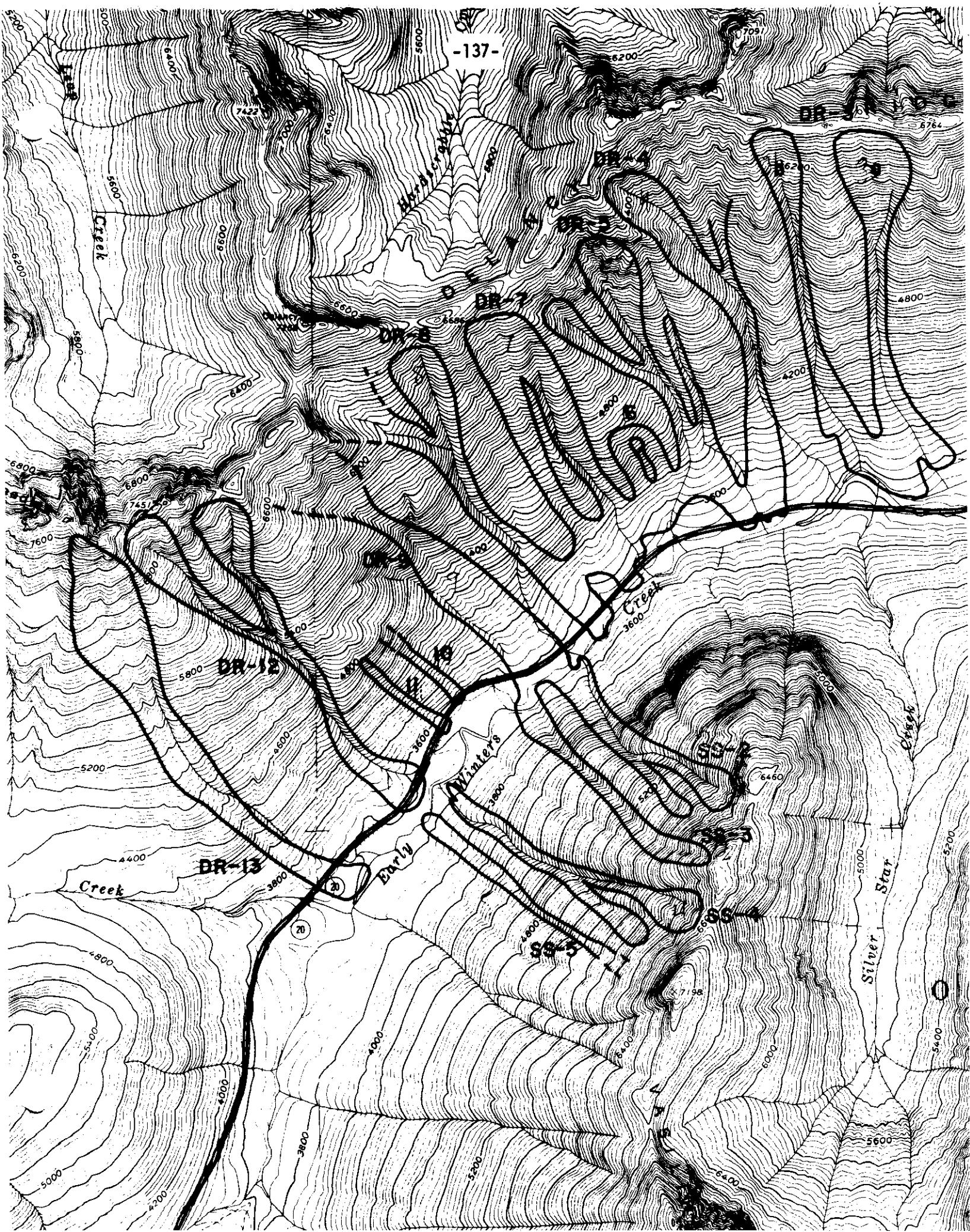








Scale: 1" = 1000'



North Cascades Highway SR-20

Avalanche Summary Sheet

General Remarks on Delancy Ridge Avalanches

These thirteen avalanche paths, except DR-6, 10 and 11, have a generally similar character and behavior. All originate at the 6-7000' level near the crest of Delancy Ridge and the Needles, mostly on south or southeast-facing slopes. All fall directly to the valley floor and for the most part reach Early Winters Creek.

These paths experience repeated avalanching each winter with both wet and dry snow avalanches. Wet avalanches reaching to at least the 3800' level are a consequence of spring thaw almost every year. The dry snow avalanching is more variable, depending on character of the winter and amount of snowfall.

The highway crosses the lower ends of these paths close to the valley floor and close to their maximum extent. Only the large avalanches will reach the highway or deposit much snow on it. While forecasting procedures should be able to anticipate periods of avalanche danger from these paths, it will be difficult to determine just how big the avalanches are going to be in any given instance. Hence, it will probably be prudent to close the highway during hazard periods rather more frequently than in fact might be necessary, at least until several years of experience can be developed with the behavior of these paths.

Most of these paths are amenable to artificial avalanche release by artillery fire. Such a procedure, especially blind firing during storms, would substantially improve the management of avalanche hazard in this area.

East of DR-3 there are numerous avalanche paths falling from Delancy Ridge in between DR-3, 2 and 1. These have not been entered separately on the maps and photographs because they are not deemed large enough to cross Early Winters Creek and ascend the opposite slope to the highway in any but the most extreme avalanche conditions. One possible exception would be the large path immediately west of DR-2, and just as large as DR-2. Because the highway is farther from the valley floor at this point than opposite DR-3 and 2, it is judged to be only minimally exposed to hazard from this path.

Delancy Ridge No. 1 through No. 13 (DR-1 through DR-13)

Observations for the period 1971-1974 have confirmed the general appraisal of these slide paths given on pages 138-139. Avalanching is frequent to the transition slopes and run-out zones around 3800 ft., but large avalanches reaching the highway are infrequent. Overall, the hazard to the highway is rather low except in winters of unusual avalanche activity on these slopes.

Winter of 1971/72:

Jan. 13 DR-5 across highway
DR-7 across highway
Jan. 23 DR-13 into highway
Feb. 5 DR-7 into highway
Mar. 6 DR-7 into highway, 250 ft. wide and 8 ft. deep
DR-13 just to edge of highway

Winter of 1972/73:

No reported avalanches reached the highway.

Winter of 1973/74:

DR-7 crossed the highway to full mapped width (west leg)
DR-13 just reached the highway
No dates are available for these slides.

Avalanching, especially in wet snow, was common on the upper parts of the DR paths in all three winters.

-140-





North Cascades Highway SR-20

Avalanche Summary Sheet

Name of Path: Delancy Ridge No. 13 (Lone Fir) (DR-13)

Hazard: Moderately low

Map: Washington Pass/Silver Star 7.5'

Location: Station _____ UTM 5383400 N, 675230 E

Elevation of starting zone: 7600'

Vertical fall: 3950' Length: 8600'

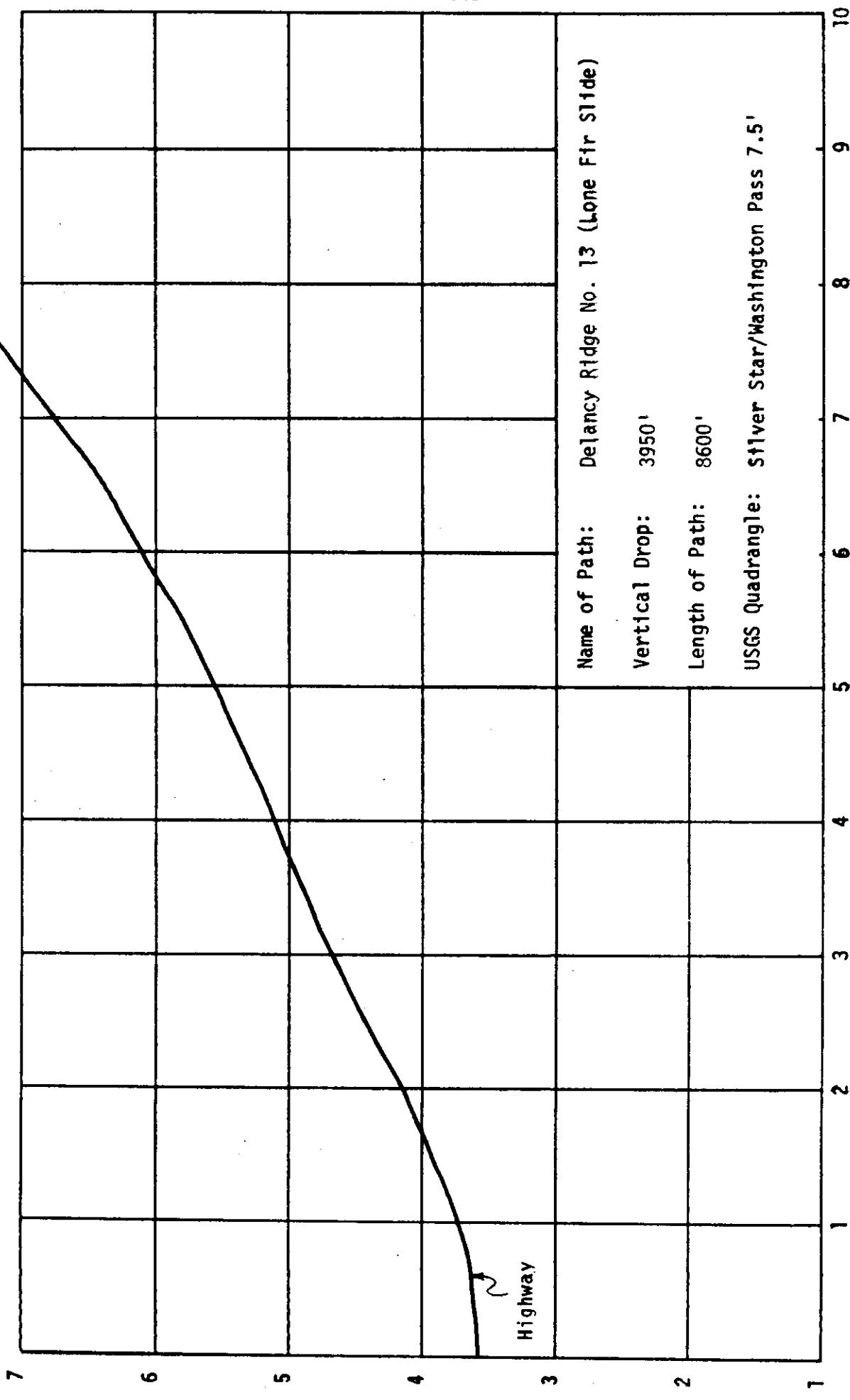
Description:

The release zone is high on the southern flanks of the rocky ridge known as The Needles. Flowing snow descends two separate shallow gulleys to a bench area at 4400-4800', then plunges over steeper slopes to the valley floor and highway by a path separate from the principal stream channel. For major avalanches, outrun on the valley floor sweeps across the Forest Service campground. The "lone fir" is a huge fir tree estimated to be 300 years old, located in the middle of the campground. This tree apparently is the sole survivor of some earlier avalanches. Above the highway a clearly defined trimline marks the maximum recent extent of avalanching.

Expected Effect on Highway:

A persistent threat due to possibility of large avalanches each winter, but sliding snow is not expected to reach the highway as often as annually. A major avalanche to the valley floor will deposit large amounts of timber debris on the highway over a distance up to 600'.

History: Tree ring counts in the second growth timber in the campground and adjacent to the highway indicate that the last major avalanche prior to the growth of these trees occurred at least 30 to 40 years ago. In January 1971 a large, dry snow avalanche fell just to the highway. Major snow deposition stopped above the highway but a small amount of snow reached the roadbed, along with scattered timber debris which in part was carried down by wind blast.



Scale: 1" = 1000'

North Cascades Highway SR-20

Avalanche Summary Sheet

Name of Path: Delancy Ridge No. 12 (DR-12)

Hazard: Moderately low

Map: Washington Pass/Silver Star 7.5'

Location: Station _____ UTM 5383870 N, 675690 E

Elevation of starting zone: 7200'

Vertical fall: 3600' Length: 7800'

Description:

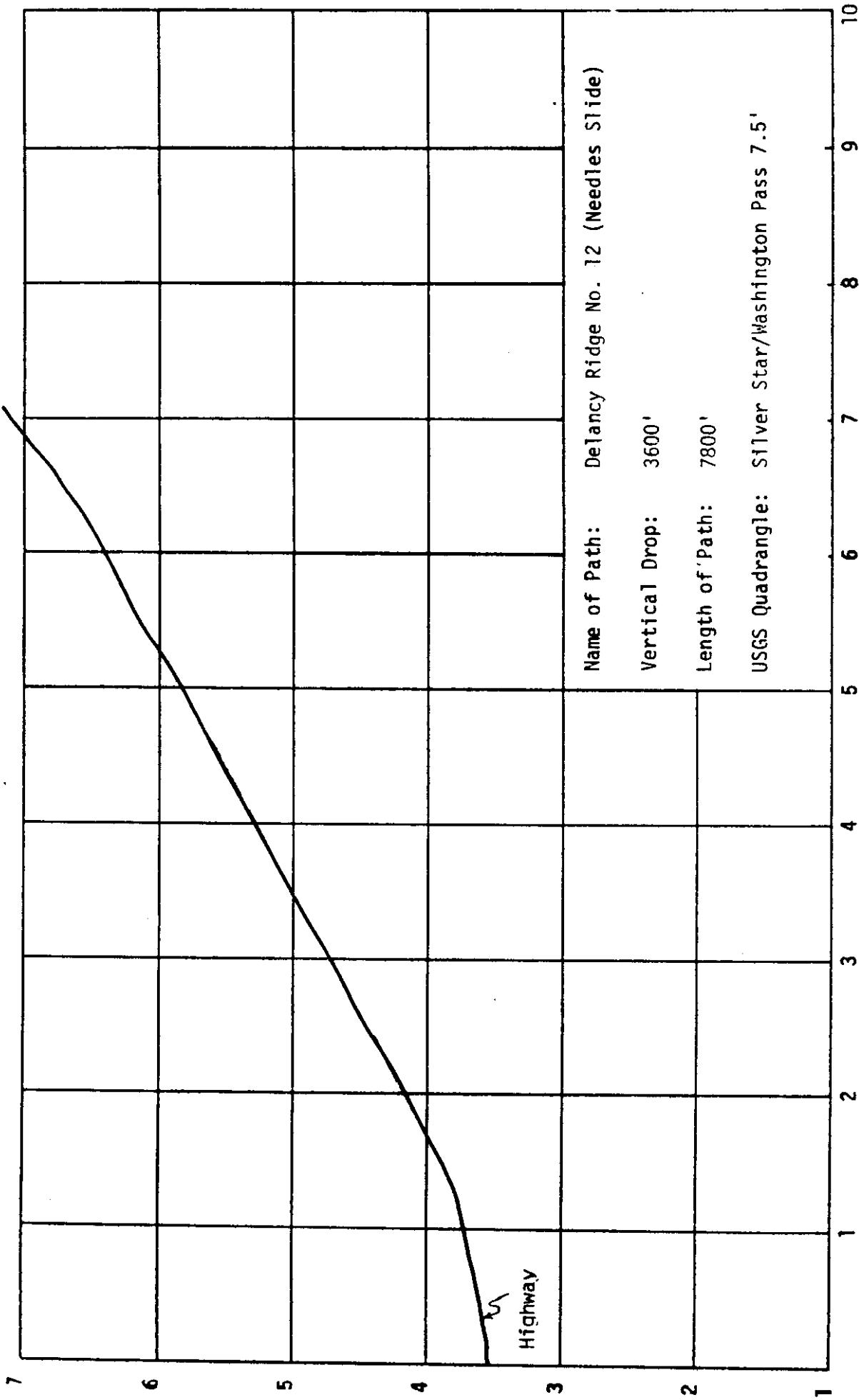
There are two separate release zones located in adjacent shallow basins. The outflow channels from these basins join at 5400'; from this point avalanching snow descends a gully scattered with small timber. Transition to a talus cone and the deposition zone takes place at 3800', from where the avalanche path spreads out rapidly to the valley floor. The highway runs across the bottom end of the presently-defined deposition zone for a distance of 800'.

Expected Effect on Highway:

Only the largest avalanches falling on this path are apt to reach the highway. Such avalanches probably occur less often than annually. Major avalanches on the highway may be laden with timber debris. The divided release zone raises the possibility of more than one large avalanche running within a short time.

History:

Tree ring record in the deposition zone is not clear, but suggests a return interval of around 30 years for avalanches with major timber destruction. In the winter of 1970-71 an avalanche ran to the full extent of this path, covering the highway for a distance of 800'.



North Cascades Highway SR-20

Avalanche Summary Sheet

Name of Path: Delancy Ridge No. 10 and 11 (DR-10 and DR-11)

Hazard: Low

Map: Silver Star 7.5' 5384390 N (10) 675920 E

Location: Station _____ UTM 5384220 N (11), 675830 E

Elevation of starting zone: 4800'

Vertical fall: 1200' Length: 2100'

Description:

These are two almost identical avalanche paths. Both have diffuse release zones located among cliff outcrops and scattered trees and both fall along straight but rather poorly defined boundaries to the highway level. No. 10 is wider than No. 11, owing largely to a wider release zone. Both show little evidence of penetration much beyond the highway. Both dry and wet snow activity can be expected, with the former mostly likely when large amounts of new snow have fallen at lower elevations along Early Winters Creek.

Expected Effect on Highway:

Winter avalanching from these paths is probably limited to years of deep snow cover and extra avalanche activity. Volumes of snow reaching the highway are not apt to be large. Damp or wet snow avalanches accompanying spring thaw are the most likely form of activity.

History:

Because of their small size, these paths have left only a limited amount of evidence in the form of timber destruction. Occurrence frequency will have to be established by experience.

North Cascades Highway SR-20

Avalanche Summary Sheet

Name of Path: Delancy Ridge No. 9 (DR-9)

Hazard: Moderate

Map: Silver Star 7.5'

Location: Station _____ UTM 5384550 N, 676360 E

Elevation of starting zone: 6600'

Vertical fall: 3000' Length: 6600'

Description:

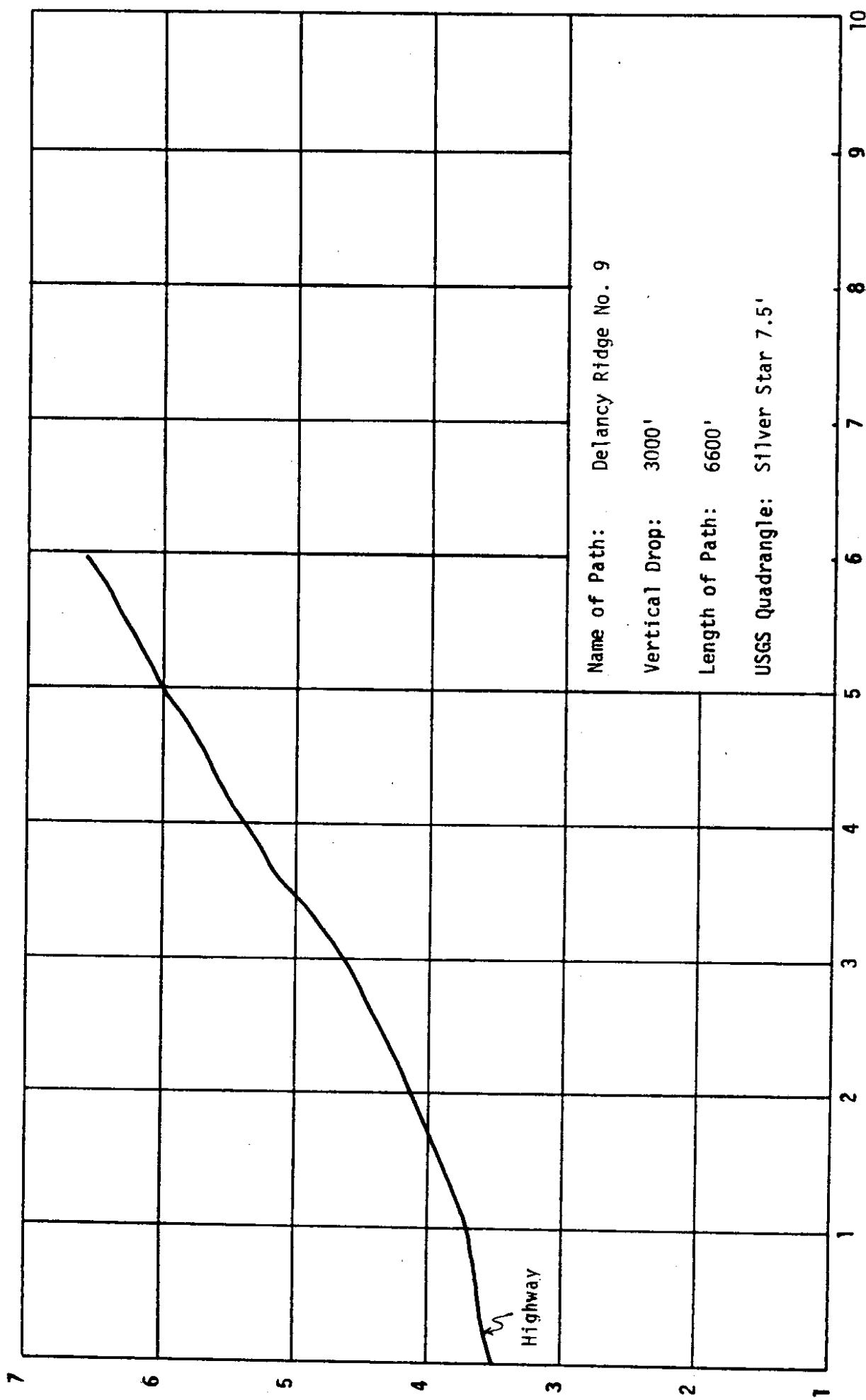
Release zone lies in a large, open basin which funnels into a narrow gulley at the 5200' level. Below this gulley opens again and the falling snow descends over a wide front in the lower half of the path. The path runs all the way to Early Winters Creek, where it joins two other paths, Silver Star No. 2 and No. 3, falling opposite from the northern end of Vasilik Ridge. The lower part of DR-9, on the transition slopes below 4200', shows vegetation patterns characteristic of repeated avalanching. Large wet snow avalanches undoubtedly run to the upper part of the deposition zone every spring. Dry snow avalanches are less frequent but are more apt to reach the highway.

Expected Effect on Highway:

There is a good probability of dry snow avalanches reaching the highway as often as annually. Highway is exposed to present path for a distance of 1100'. Snow deposited on the highway is apt to contain a substantial amount of small timber debris.

History:

Terrain and vegetation indicate repeated occurrence of major avalanches. Major avalanches probably occur every 10 to 15 years, those large enough to reach the highway as often as annually. An avalanche stopped just short of the highway in January 1970 (Miller). A year later the maximum penetration was to the 4000' level.



Scale: 1" = 1000'

Name of Path: Delancy Ridge No. 9

Vertical Drop: 3000'

Length of Path: 6600'

USGS Quadrangle: Silver Star 7.5'





North Cascades Highway SR-20

Avalanche Summary Sheet

Name of Path: Delancy Ridge No. 8 (DR-8)

Hazard: Moderate

Map: Silver Star 7.5'

Location: Station _____ UTM 5384840 N , 676640 E

Elevation of starting zone: 6400'

Vertical fall: 2850' Length: 6700'

Description:

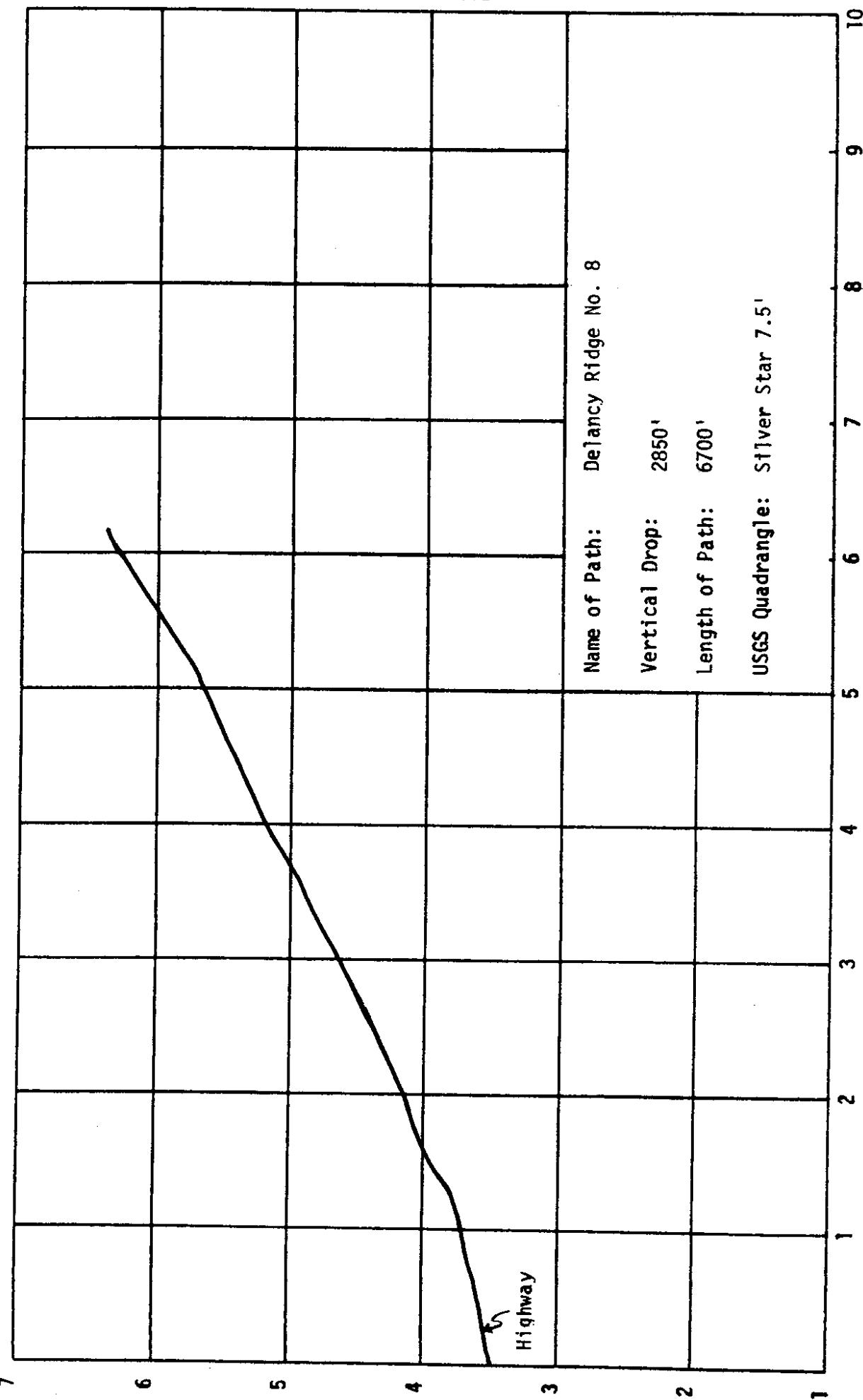
Annotated map and photograph for this path show two separate release zones. The eastern zone, a shallow, broad gully reaching to the ridge crest, is believed to be the main source of avalanching. The west release zone is a deep basin with relatively flat floor. Avalanching is probably common here each winter, but only in exceptional circumstances will snow flow out of this basin and descend DR-8. The lower path has a well-defined trimline which is 600' wide where it crosses the highway. It is possible for avalanches to spill sideways in both directions on the outrun, encroaching on adjacent paths DR-9 and DR-7. This is especially true for wet snow avalanches following the streambed toward DR-9.

Expected Effect on Highway:

Recurring possibility of both wet and dry snow avalanches reaching the highway, with the latter type more probable. Annual avalanching to deposition zone, but not always to highway. Entrained timber debris in avalanche snow is apt to be small in size.

History:

Vegetation pattern indicates both wet and dry snow avalanching annually or oftener to 3700-3800' level. Trimline between highway and Early Winters Creek shows less frequent intrusion of avalanche snow beyond the highway, possibly with a return interval of 20-30 years. A dry snow avalanche with both release zones active reached just to the highway in the winter of 1970-71. Deposition on the highway was 300' wide.



Scale: 1" = 1000'

North Cascades Highway SR-20

Avalanche Summary Sheet

Name of Path: Delancy Ridge No. 7 (DR-7)

Hazard: Moderate

Map: Silver Star 7.5'

Location: Station _____ UTM 5385060 N, 676820 E

Elevation of starting zone: 6400'

Vertical fall: 2850' Length: 6100'

Description:

The release zone is a broad face of Delancy Ridge intersected by several small gullies. Multiple releases in this zone are highly probable, especially for wet snow avalanches. Descending snow is split into two separate streams by a shallow ridge at the 5400' level. The west path descends across the highway for 500' and on to Early Winters Creek. The east path does not show evidence of having recently reached the highway, but an overrun of the existing path could readily occur here.

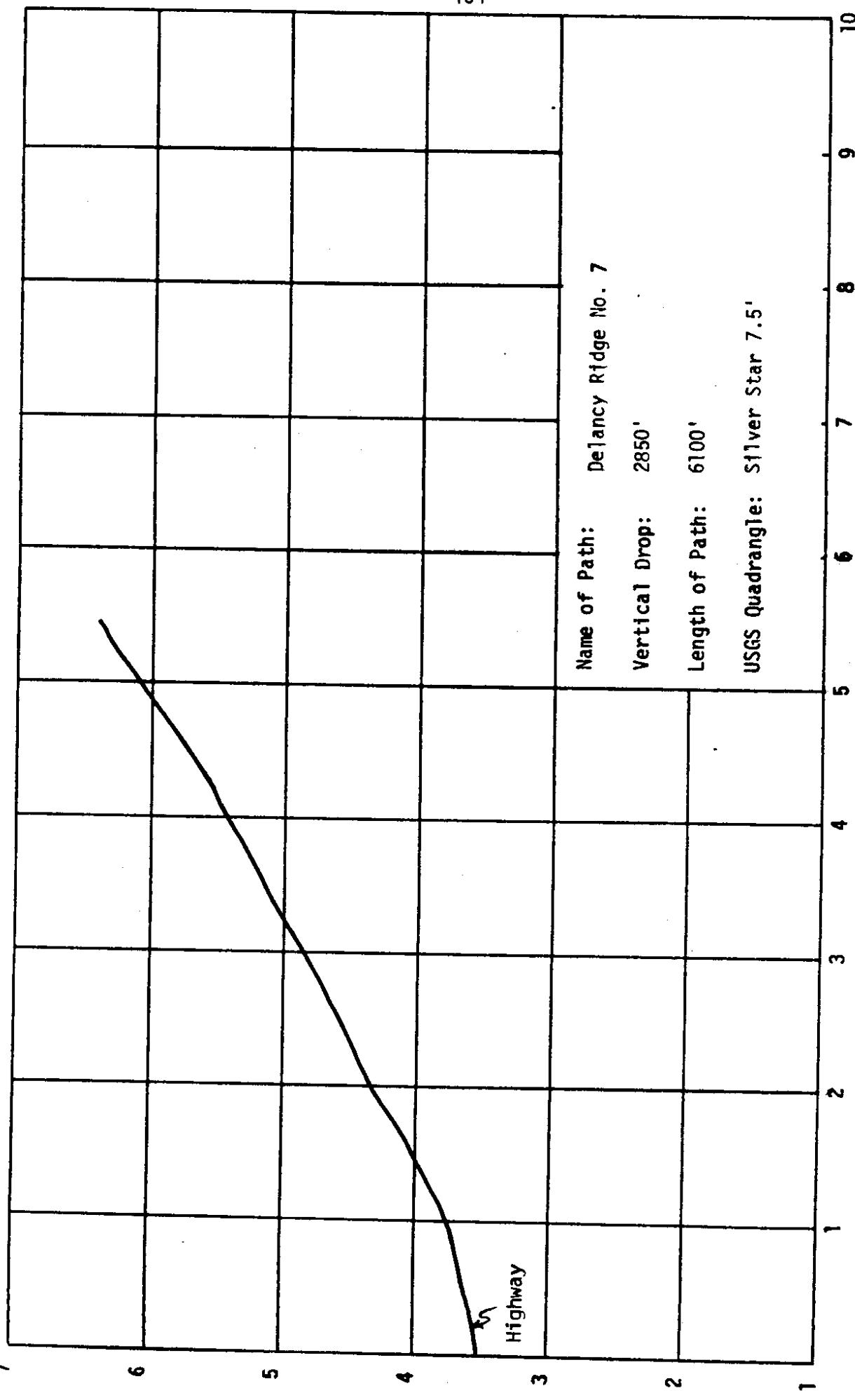
Expected Effect on Highway:

Avalanching on the west leg reaches the deposition zone each year and can in many cases reach the highway. If the east leg experiences an overrun from an unusually large avalanche, it will bring a large amount of timber debris onto the highway.

History:

Annual avalanching to at least upper part of deposition zone. Probably more frequent avalanches crossing the highway than for the adjacent DR-8. Maximum penetration in 1970-71 was to 3600' level (east leg).

Scale: 1" = 1000'



North Cascades Highway SR-20

Avalanche Summary Sheet

Name of Path: Delancy Ridge No. 6 (DR-6)

Hazard: Low

Map: Silver Star 7.5'

Location: Station _____ UTM 5385290 N, 677000 E

Elevation of starting zone: 4600'

Vertical fall: 1100' Length: approximately 2200'

Description:

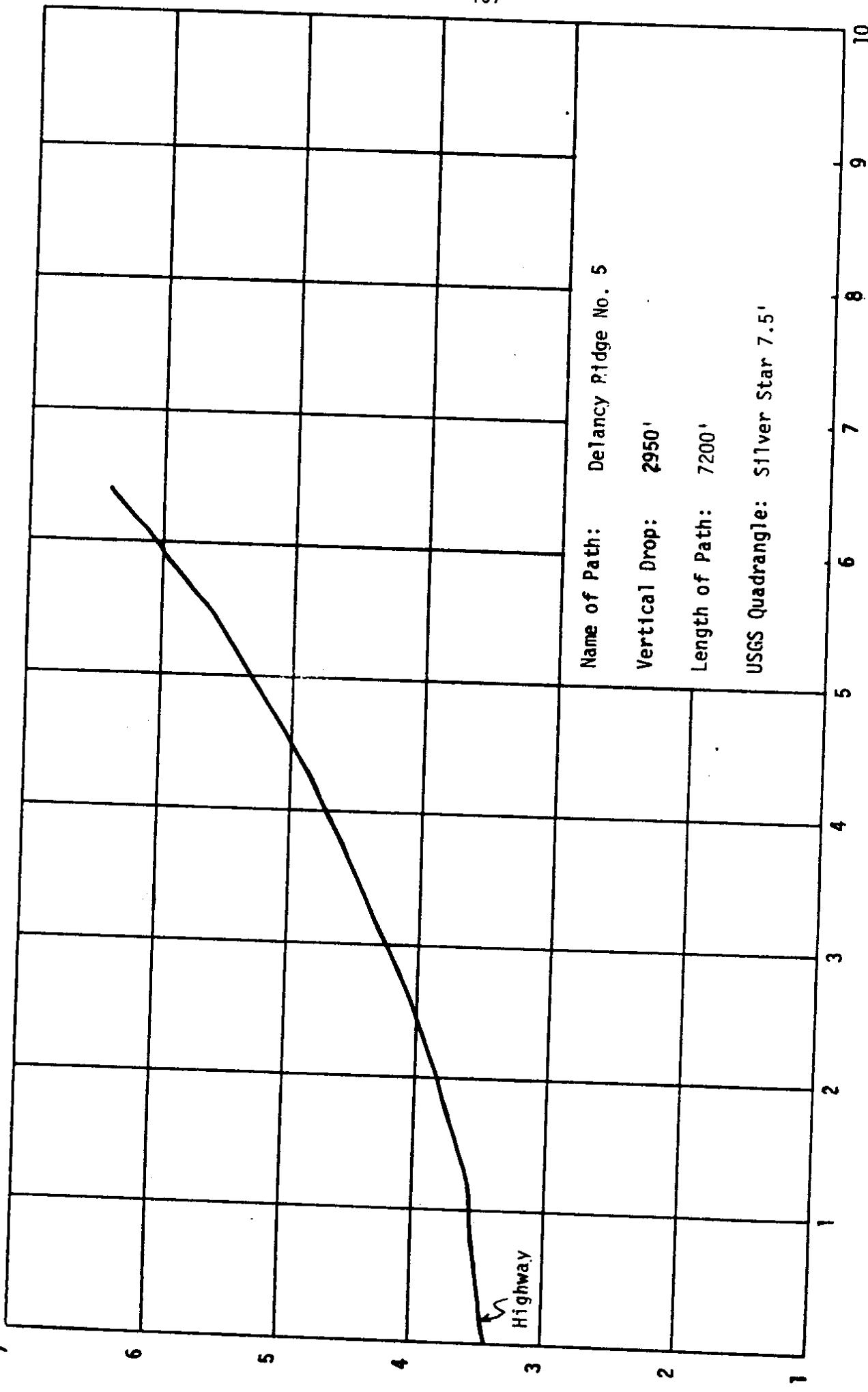
This is a low-level avalanche falling from an ill-defined release zone among rocks and trees. The outrun is divided by an island of timber at the 4100' level. Wet snow avalanching in spring is probably common here on a small scale. Dry snow avalanches are more limited. There is no evidence of recent avalanching as far as the highway and a substantial timber screen exists at the foot of this path.

Expected Effect on Highway:

None except in exceptional dry snow avalanche conditions with very deep snow at lower elevations, when there is a possibility of an avalanche large enough to reach the highway. Such an avalanche would bear a large amount of timber debris with it.

History:

Frequent small avalanches but no major ones reaching below 3500' in recent years.



Scale: 1" = 1000'

North Cascades Highway SR-20

Avalanche Summary Sheet

Name of Path: Delancy Ridge No. 4 (DR-4)

Hazard: Moderate

Map: Silver Star 7.5'

Location: Station _____ UTM 5385400 N, 677550 E

Elevation of starting zone: 6500'

Vertical fall: 3250' Length: 7200'

Description:

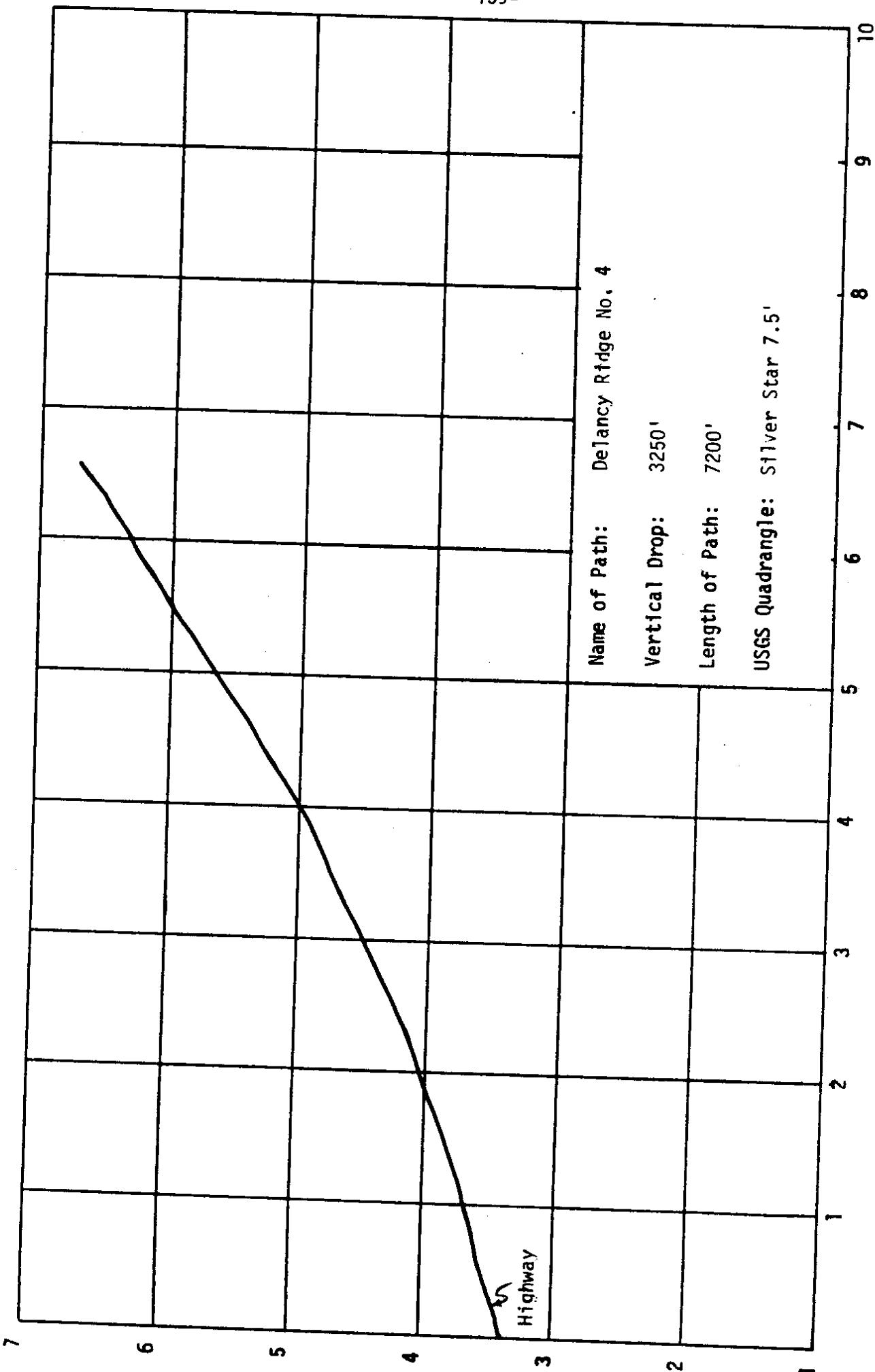
The primary release zone is an open basin near the ridge crest which faces east to east-southeast. The path descends a long gulley on a sweeping curve which brings the deposition area at the highway to a nearly north-south alignment. An area of scattered trees and rocky gulleys to the northeast of the primary release zone is also a potential source of avalanching. Flowing snow from this area joins the main gulley at 5200'. The highway lies at the very tip of this path, which has not overrun this level to reach Early Winters Creek for many years. There is a long deposition zone of gentle gradient which collects most of the avalanche snow.

Expected Effect on Highway:

Occasional penetration of avalanching snow to the highway, but probably not annually. Danger to the highway is most likely to occur with dry snow avalanche conditions.

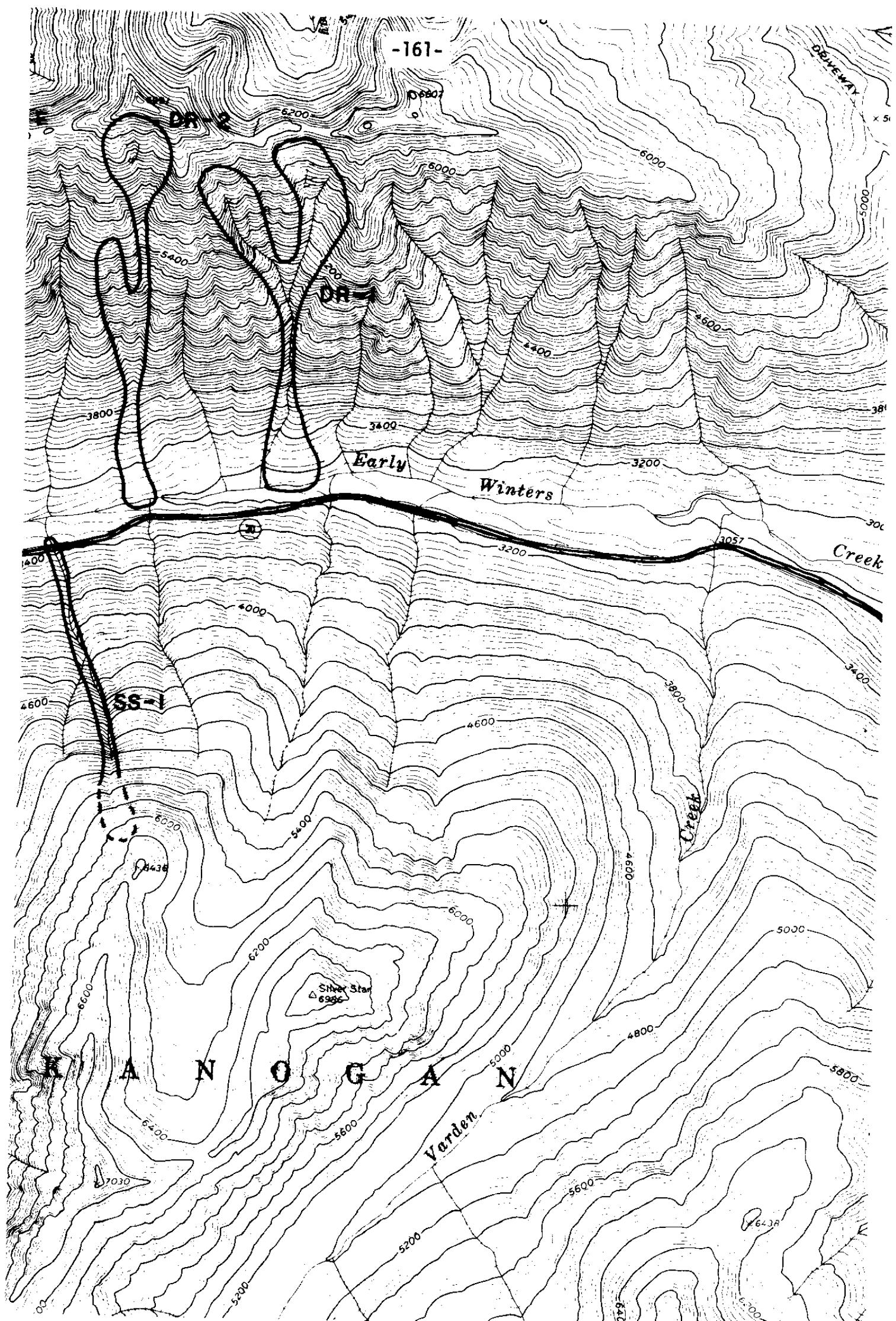
History:

Avalanches run annually to the upper part of the deposition zone, especially wet snow avalanches in the spring. Vegetation patterns indicate frequent avalanching over most of the deposition zone. Maximum penetration of avalanche snow in 1970-71 was to the 3800' level.



Scale: 1" = 1000'







DH-2

North Cascades Highway SR-20

Avalanche Summary Sheet

Name of Path: Delancy Ridge No. 3 (DR-3)

Hazard: Low

Map: Silver Star 7.5'

Location: Station _____ UTM 5385500 N, 678360 E

Elevation of starting zone: 6600'

Vertical fall: 3300' Length: approximately 7500'

Description:

DR-3 consists of two separate avalanche paths which run onto a common deposition zone below the 3600' level. These two paths (a-west, b-east) are almost identical, with steep shallow basins near the ridge crest as release zones and long, steep gulleys as the middle part of the paths. Sliding snow commonly runs all the way to Early Winters Creek. Vigorous avalanche activity from both wet and dry snow is the norm.
NOTE: Between DR-4 and DR-3, the highway crosses Early Winters Creek. Downstream from this crossing it lies on the opposite side of the valley from Delancy Ridge.

Expected Effect on Highway:

Normally little effect. The avalanche would have to cross the Creek and ascend the opposite slope a short distance to the highway. Terrain is such that this is entirely possible in the event of an exceptionally large avalanche. Such an avalanche would carry a large amount of timber debris onto the highway. There is also a possibility of a much smaller amount of debris being deposited on the highway from wind blast accompanying an avalanche which did not reach past Early Winters Creek.

History:

Frequent avalanching to the 3500' level, both dry and wet snow. No recent penetration to the highway position. In 1970-71 an unusually large avalanche from DR-3b overran the entire deposition zone and crossed the Creek for a short distance, but did not ascend to the highway.

North Cascades Highway SR-20
Avalanche Summary Sheet

Name of Path: Delancy Ridge No. 2 (DR-2)

Hazard: Low

Map: Silver Star 7.5'

Location: Station _____ UTM 5385720 N, 679170 E

Elevation of starting zone: 6800'

Vertical fall: 3400' Length: approximately 7000'

Description:

Release zone consists of a series of shallow gullies on the south face of Point 6991. The main path makes a twist to the west at 4800', where a lower, subsidiary release zone also contributes snow. Sliding snow descends over a wider front from 6000' to 4800' than is shown on the map and photograph, according to results of the 1970-71 survey. This path reaches Early Winters Creek at a point where it is only a short distance from the highway on the opposite side of the valley.

Expected Effect on Highway:

Little effect in normal winters. Abnormally large avalanches could easily cross the Creek and ascend to the highway. There is a good chance of wind blast reaching the highway from dry snow avalanches.

History:

Frequent dry and wet snow avalanches to Early Winters Creek. No evidence of recent extension of this path to the highway position. Avalancheing snow reached the Creek in 1970-71.

North Cascades Highway SR-20

Avalanche Summary Sheet

Name of Path: Delancy Ridge No. 1 (DR-1)

Hazard: Low

Map: Silver Star 7.5'

Location: Station _____ UTM 5385840 N, 679890 E

Elevation of starting zone: 6200'

Vertical fall: 3000' Length: approximately 6500'

Description:

The annotated map shows two separate release zones. Experience in the winter of 1970-71 shows that these two zones actually merge into one for major avalanches. They probably remain as separate zones for smaller avalanches, especially those in wet snow. Sliding snow emerges from a narrow gully at 3600' to fan out onto a broad deposition zone. Because of the relatively large area of the release zone, this path is capable of producing a large amount of avalanche snow.

Expected Effect on Highway:

Little effect in normal winters. An exceptionally large avalanche could cross Early Winters Creek in sufficient volume to reach the highway a short distance up the opposite slope. Wind blast at the highway is possible from dry snow avalanches.

History:

Frequent avalanching to the deposition zone, both wet and dry snow. In 1970-71 an unusually large avalanche fell on DR-1, slightly enlarged the trimline by destroying some timber, and crossed the Creek for a short distance.

SS-4

North Cascades Highway SR-20
Avalanche Summary Sheet

Name of Path: Silver Star No. 5 (SS-5)

Hazard: Low

Map: Silver Star 7.5'

Location: Station _____ UTM 5383740 N, 675630 E

Elevation of starting zone: around 6000'

Vertical fall: around 2400' Length: approximately 4600'

Description:

A narrow path with an ill-defined release zone on steep, timbered slopes. The relatively small area of this release zone limits the volume of snow which can descend this path.

Expected Effect on Highway:

Little effect except in unusual circumstances of an abnormally large avalanche, which could cross Early Winters Creek and reach the highway opposite the outrun of DR-12.

History:

Frequent small avalanches, but seldom any big enough to reach or cross Early Winters Creek.

North Cascades Highway SR-20

Avalanche Summary Sheet

Name of Path: Silver Star No. 4 (SS-4)

Hazard: Low

Map: Silver Star 7.5'

Location: Station _____ UTM 5383870 N, 675880 E

Elevation of starting zone: 6400'

Vertical fall: 2800' Length: approximately 5800'

Description:

Release zone is a broad basin on the NW flank of Vasiliki Ridge, just north of Point 7198. This path is less steep than SS-2 and 3; normally avalanching barely reaches to Early Winters Creek and there is no trimline evidence of sliding snow having crossed the creek in the recent past.

Expected Effect on Highway:

Very little effect under normal conditions. There is a limited possibility of wind blast reaching the highway. An exceptionally large avalanche could cross the creek and travel the short distance to the highway. In such an event, the snow would be heavily laden with large timber debris from the intervening timber stand between the creek and the highway.

History:

Frequent avalanching but not likely to cross Early Winters Creek except at long intervals. In 1970-71 this path discharged a large avalanche which did cross the creek and slightly extended the trimline beyond the position shown on the map.



North Cascades Highway SR-20

Avalanche Summary Sheet

Name of Path: Silver Star No. 3 (SS-3)

Hazard: Low

Map: Silver Star 7.5'

Location: Station _____ UTM 5384390 N, 676290 E

Elevation of starting zone: 6400'

Vertical fall: 2850' Length: approximately 4800'

Description:

This path originates from an ill-defined release zone in a shallow basin near the crest of Vasiliki Ridge. It is similar to SS-2 in general characteristics in behavior. Like SS-2, it also crosses Early Winters Creek to join the deposition zone of DR-9.

Expected Effect on Highway:

Little effect in normal conditions except for possible exposure of highway to wind blast from dry snow avalanches. In exceptional conditions SS-3 can cross the Creek and ascend a short distance to the highway.

History:

Frequent avalanching, but seldom crossing Early Winters Creek in any significant volume. In 1970-71, two smaller avalanches just reached to the creek and one wider one crossed it for a short distance.

North Cascades Highway SR-20
Avalanche Summary Sheet

Name of Path: Silver Star No. 2 (SS-2)

Hazard: Low

Map: Silver Star 7.5'

Location: Station _____ UTM 5384530 N, 676480 E

Elevation of starting zone: 6000'

Vertical fall: 2450' Length: approximately 4200'

Description:

The release zone is an area of steep slopes and broken cliffs with quite a bit of large timber. A subsidiary release zone originating among some vertical cliffs joins the main path 4800'. The outrun of this path meets that of DR-9 coming from the opposite side of the valley at Early Winters Creek. The northwest exposure of the release zone will lead to a different pattern of avalanching than is found on the Delancy Ridge paths. Dry snow avalanching with major winter storms probably is common.

Expected Effect on Highway:

Little effect in normal conditions, although even moderate-size avalanche running to the valley floor in dry snow can produce wind blast reaching the highway. Exceptionally large avalanches can cross the Creek as they travel the short distance to the highway up the toe of the nearly tree-free deposition zone of DR-9.

History:

Frequent avalanching but seldom crossing Early Winters Creek in any significant volume. Is thought to have reached the highway location in the past from debris evidence (Wilson). In 1970-71 this path ran in full volume to the Creek.



North Cascades Highway SR-20
Avalanche Summary Sheet

Name of Path: Silver Star No. 1 (SS-1)

Hazard: Low

Map: Silver Star 7.5'

Location: Station _____ UTM 5385510 N, 678770 E

Elevation of starting zone: about 6000'

Vertical fall: 2600' Length: 5000'

Description:

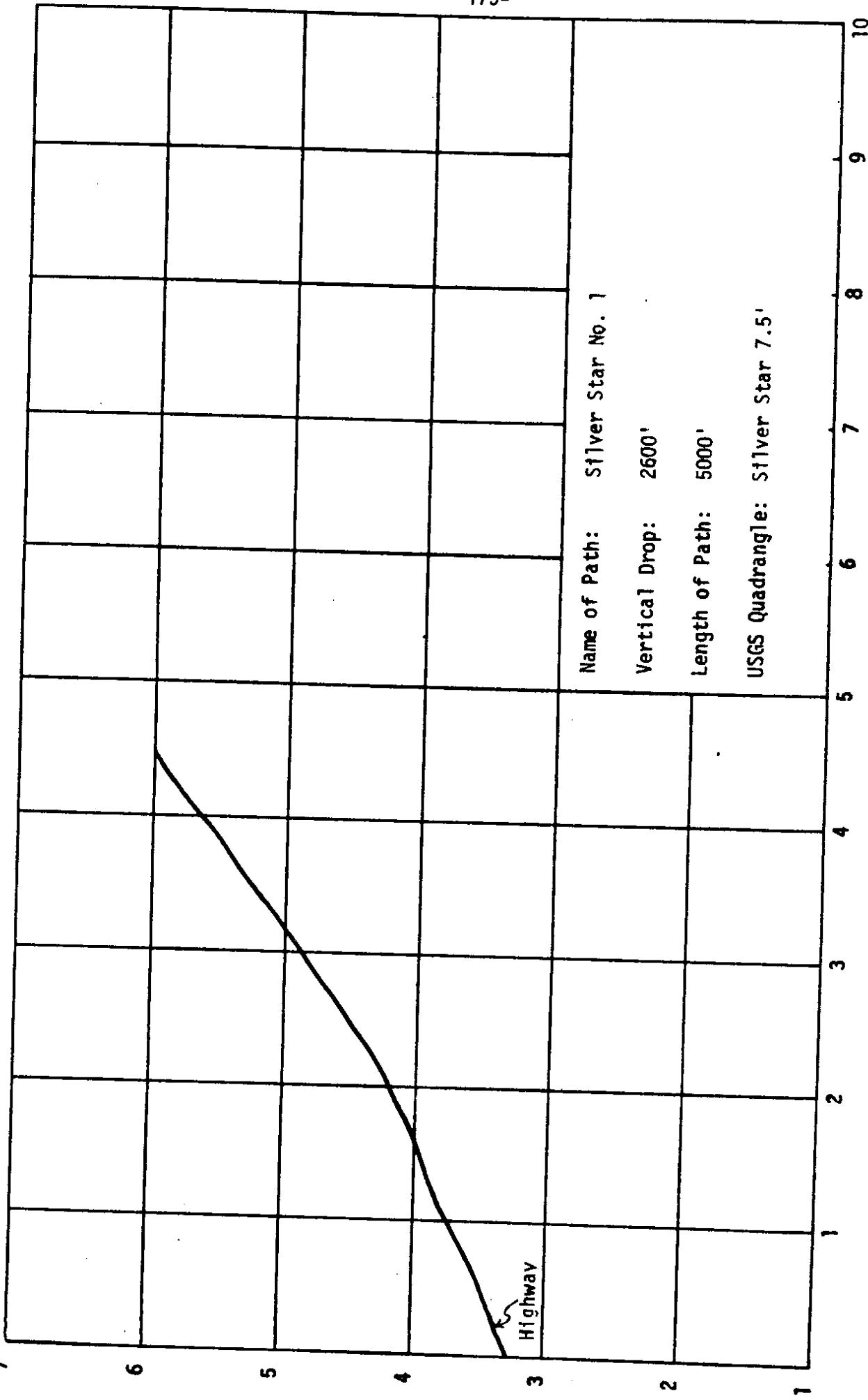
This is a straight, narrow avalanche path falling along a stream channel from a small, ill-defined release zone amongst moderately thick timber. Except for the presence of a very clear timber trimline, there is little reason to expect an avalanche at this site. It may well have fallen only once in the recent past to create the trimline. Hazard conditions on this path may be difficult to predict. They most likely would follow from extensive accumulation of new snow at lower elevations in the valley of Early Winters Creek.

Expected Effect on Highway:

Little effect likely except in unusual snow conditions when a narrow tongue of snow may be deposited on the highway.

History:

Little evidence of recent activity except for the existence of the trimline itself. No avalanche has been observed on this path in recent years (Wilson).



Scale: 1" = 1000'