Chapter VIII

ARTILLERY CONTROL

Control of avalanches by systematic firing of military and commercial artillery has become a standard practice in the United States and Canada. As early as 1945 this method was used by the Swiss, mostly with the employment of mortars.

In 1946 Monty Atwater, the snow ranger in Little Cottonwood Canyon, Utah, learned of the use of artillery in Europe, and decided to pursue its use here in the United States. He was able to reach an agreement with the U.S. Army to fire on the slopes overhanging the highway and town of Alta. Immediately following severe storms he would call upon the Army to assist in shelling potential avalanche areas. Realizing that this was somewhat inefficient, the next year he arranged to have the gun left up the canyon, leaving only the gun crew to be called out for the drive and subsequent shooting. By the third year Atwater was doing the firing. Thus was born Forest Service involvement in artillery avalanche control. (Cottonwood Canyons Highway Safety Plan, 1979).

Since that time the Forest Service has focused on artillery use for public safety by means of a cooperative agreement with the U.S. Army for procurement of artillery supplies. This has made these supplies available to permittees of the Forest Service for controlling avalanches, primarily in ski areas, but also in some locations on highways. In some areas the use of military artillery has become a prerequisite for the safe movement of large numbers of people.

Federal law presently dictates that military weapons be fired by federal employees or state employees who have a cooperative agreement with the U.S. Army. Several states, including Alaska, have pursued agreements on their own to procure equipment for highway control programs. State employees are then allowed to fire weapons after intensive training.

According to the latest information artillery control is now being used in 18 ski areas and 6 state highway departments in the U.S. to provide for safe travel in mountainous terrain. Approximately 13,300 rounds are fired per year nationwide. This is causing some depletion of surplus reserves; and, in some cases, parts have had to be remanufactured in order to use existing hardware (Anderson, 1975).

In 1975, as a result of an investigation into usage and supply by the National Ski Areas Association, Congress made $300,000 available to the Forest Service for purchase of ammunition, guns, and parts through a revolving account. This prepurchase procedure tied up a considerable number of rounds and all remaining surplus weaponry deemed suitable for avalanche control. It was found at the time that breeches and vent rings for 75mm and 105mm recoilless rifles were in short supply or non-existent. Money was appropriated from the revolving account for remanufacture of vent rings and breeches to match the supply of barrels and ammunition. Users of this supply are expected to pay the fund actual costs of procurement, thereby insuring a continuing flow of money for the purchase of equipment. This system could go on for years so long as supplies are available (Anderson, 1975).

It is possible that there will be other weapons systems made available in the future. Improved communications between the U.S. Army's Rock Island procurement division, the U.S. Forest Service, and interested state agencies would result in a more comprehensive view of the artillery hardware available for avalanche control. Of particular interest to this study would be the possibility of obtaining a 105mm Howitzer for Gun Position No. 2.

Artillery control has proven itself to be the most reliable and cost-effective method of controlling remote slopes. In spite of this, there are some drawbacks to artillery use. Safety is of

primary interest. A single fatal accident would, in all probability, result in the abatement of all artillery avalanche control.

Recoilless rifles are based upon the principle of half the blast propelling the projectile out the front and half the blast being vented out the back to balance the forces. There is a large area adjacent to the rear of the gun that could cause a fatality should a round go off while a person is exposed. Two close calls with rounds that overshot their targets and landed near populated areas have occurred in Wyoming and Utah. Hearing losses occur regularly to gunners. Handling ammunition has a long-term possibility of accident exposure. Care must be taken and proper procedures set and practiced to avoid a serious accident.

There is not a commercial substitute for military artillery that can reliably fire long distances in high winds without visibility. A compressed air cannon called the avalancher has been developed but is severely restricted in range and adversely affected by winds because of its slow, lobbing trajectory. Helicopter bombing is limited to clear weather with little wind - a rare occurrence in coastal Alaska. Military artillery continues to be the only delivery system of explosives to remote locations that combines speed, safety, and cost-effectiveness.

Weapons Available and Characteristics

Weapons	Maximum Range	Useful Life (#rounds)	
75mm Recoilless	2,700 yards	500/breech	2,000/barrel
105mm Recoilless	3,500 yards	500/breech	2,000/barrel
75mm Howitzer	5,000 yards	20,000	
105mm Howitzer	8,000 yards	20,000	

The above are maximums used in existing control programs and might disagree with official estimates of maximum range.

EXPLOSIVES FOR AVALANCHE CONTROL

Inventory of Weapons and Ammunition for Avalanche Control

Weapon Type	Weapons in Storage	x Tube Life =	Potential Rounds	÷ Vent Assembly Life =	Vent Assembly Needs	/ Vent Assemblies in Storage x	Vent Assembly Life =	Adjusted Potential Rounds	/ Rounds in Storage HE	HEP	Total
75 mm Howitzer	5	20,000	100,000	N/A	N/A	N/A	N/A	100,000	20,800	----- =	20,800
75 mm Recoilless Rifle	31	2,000	62,000	500	124	61	500	30,500	27,500	55,000 =	82,500
105 mm Recoilless Rifel	18	2,000	36,000	500	72	28	500	14,000	30,500	35,000 =	65,500

Corrected figure of useable rounds based on available weapons, available vent assemblies, tube life and available ammunition.

75mm Howitzer - 20,800
75mm Recoilless Rifle - 30,500
105mm Recoilless Rifle - 14,000

Unserviceable Weapons
75mm Howitzer - 8
75mm Recoilless Rifle - 251
105mm Recoilless Rifle - 249

Plans call for re-vamping of unserviceable weapons to replace weapons that become inoperative due to expiration of tube life or malfunction after inventories on this chart are exhausted.

Figures - U.S. Army and U.S.F.S. 10/79

There are considerable differences in several letters obtained concerning quantities of ammunition. It is entirely possible that there is considerably more ammunition than indicated in the 1979 report. This is an area where further communications with the Army will help to obtain accurate reports. In recent communications with various people it seems there is a good possibility that the amount of 75mm Howitzer ammunition has been understated. A 1975 report showed considerably fewer 75 howitzer rounds than the 1979 report. There seems to be an absence of records reflecting the availability of 105mm Howitzers and ammunition.

Gunners' Qualifications and Training

Standards for the training and certification of gunners vary somewhat according to geographical location. It is not clear whether the U.S. Army requires a particular course of training.

There is an excellent publication by Region 6 of the U.S. Forest Service that can be used as a basis for training which is included in the related letters section of this report, an unpublished collection of information.

There are some guidelines that can be generalized as standards. All gunners should receive a formal training course (20 to 40 hours) every two years and refresher courses should occur every year (8 hours). There is a natural progression of involvement beginning with occasional exposure to artillery, then assuming the role of assistant gunner and eventually becoming a gunner. Normally this process takes two years or more, however, if this progression is intensified by virtue of considerable expenditure of ammunition, this familiarization period could be made shorter.

Of primary importance in the use of artillery is the application of common sense and caution. These weapons can be extremely dangerous if used in a casual manner. Diligence, adherence to strict procedure, and alertness in every firing mission should preclude the possibility of an accident.

Storage, Handling, and Transport

All of these operations must be done in adherence to federal and military rules and regulations. It is beyond the scope of this plan to outline all of these, as manuals are available, but several aspects of these procedures should be noted.

Storage requirements presently dictate that all recoilless rifle rounds be stored in separate compartments with a minimum of 4-1/2 inches of sand separating each round. In addition, the walls of the storage facility must be 12-inch reinforced concrete or cinder block poured with concrete, the roof 12-inch reinforced concrete, and the door 1/2-inch steel plate with a 2-inch hardwood backing. Doors must be double locked with safety shields to prohibit the locks from being cut off with a hack saw.

All handling and transportation should take place at a distance from public areas with vehicles in good repair and equipped with explosives warning signs. Care should be taken in handling and transport to avoid sudden stops or jarring of the ammunition.

Response Time

During critical periods of the winter avalanche conditions can develop in a very short period of time, particularly with the advent of wind increase. Most active control programs can respond to changing conditions with control work in an hour or less. At present, conditions here may not allow for such rapid response, but efforts should be made to reach this guideline in the future. There should be no problem with establishing a maximum two-hour response time for this coming season. Forecasting ahead of the hazard will be necessary considering this time requirement. A method of alerting the gun crews to standby status will help reduce response time. This might require some extra funds but will greatly increase the efficiency of the operation. Another consideration in terms of response time is the fact that instability can rectify itself almost as quickly as it occurs, therefore, timing of artillery control is very important to achieve the best results possible.

Continuity

Every effort should be made to utilize the same gun crews year after year. Many hours will be spent by each crew in initially identifying all of the target points from each gun position and becoming familiar enough with the terrain so that confusion over targets is eliminated. Thorough training in artillery pro-

cedure also takes considerable time. The combination of these factors makes continuity of the gun crew an important prerequisite to a smoothly functioning control program.

Helicopter Bombing

This method of avalanche control has been successfully used in many areas of the country. Since 1975 it has been used occasionally by the DOT/PF to control avalanches on the Seward Highway. It has been proven to be an accurate and cost-effective method, but there are certain limitations. Clear and calm weather is an important prerequisite. This means that helicopter bombing can be done only a few times each year. The use of a large helicopter can extend these weather limitations somewhat. There are considerable target points on the highway. Because the price of helicopter time is much greater than extra explosives, it could be considered more effective to carry a large number of bombs on each individual run. The helicopter bombing done during the avalanche cycle of March, 1979, could have used in excess of 100 charges had they been on board at that time. The number of charges necessary is another justification for using a large ship such as the Bell 212.

Safety of the crews is a difficult proposition when using two such potentially dangerous elements as helicopters and explosives. The use of a twin turbine Bell 212 will somewhat reduce the hazard presented by the helicopter. Adherence to strict procedures in handling the explosives while airborne will reduce the possibility of an accident from the powder. Nevertheless, there is always the possibility that the ship could go down with explosives on board, therefore the powder must always be contained in a wood box, enabling jettisoning the load should a mechanical problem develop.

The design of the avalanche control system is such that there is no necessity for helicopter bombing. This technique can be valuable at times, but must be used with much discretion.

Gun Positions

An inventory of gun positions is given below. Positions for visual fire are not given as they can remain flexible. Some of the gun positions listed were established in years past, and some were installed this year (fall, 1979) to provide a reasonable degree of control coverage until the full program comes on line. Related com ments are provided.

* is an existing mount

\# is the recommended mounts for this control design

Gun Position	Target Points	Total no. of Targets	Type Weapon	Type Mount	Milepost	Comments
*1A	103-108	9	105RR	Fixed	99.2	Avalanche safe, protection shots to allow gun crew to 1B and 1.
1B	101-116		105RR	Mobile	98.15	Low probability of inundation.
#1	102-116	32	105RR	Fixed	97.1	Avalanche safe.
*2A	All P west of 201		105RR	Mobile	95.7	Protection shots for 2B.
*2B	201-208		105RR	Fixed	95.3	High probability of inundation.
*2C	209-219		105RR	Fixed	94.3	Low probability of inundation.

Chart (continued)

Gun Position	Target Points	Total no. of Targets	Type Weapon	Type Mount	Milepost	Comments
#2	201-219	50	75/105 Howitz.	Turntable	Bird Point	Avalanche safe if located properly. Could combine S.H.A. Forecast Office.
#3	301-313	26	105RR	Fixed	92.74	Low probability of inundation Earthworks defense required.
*3A	305-313,401-404		105RR	Fixed	92.05	Low probability of inundation High probability of skipped round into Girdwood.
#*4	401-409	21	105RR	Fixed	90.7	Avalanche safe, eliminates skipped round potential.
#5	501-510	10	105RR	Fixed	44	Avalanche safe.
#6	601-614	14	105RR	Fixed	37	Avalanche safe.
#*	701-708	8	105RR	Fixed	22.6	Avalanche safe, long range to shots 707 and 708.
#*8	801-811	14	105RR	Fixed	20.5	Avalanche safe.

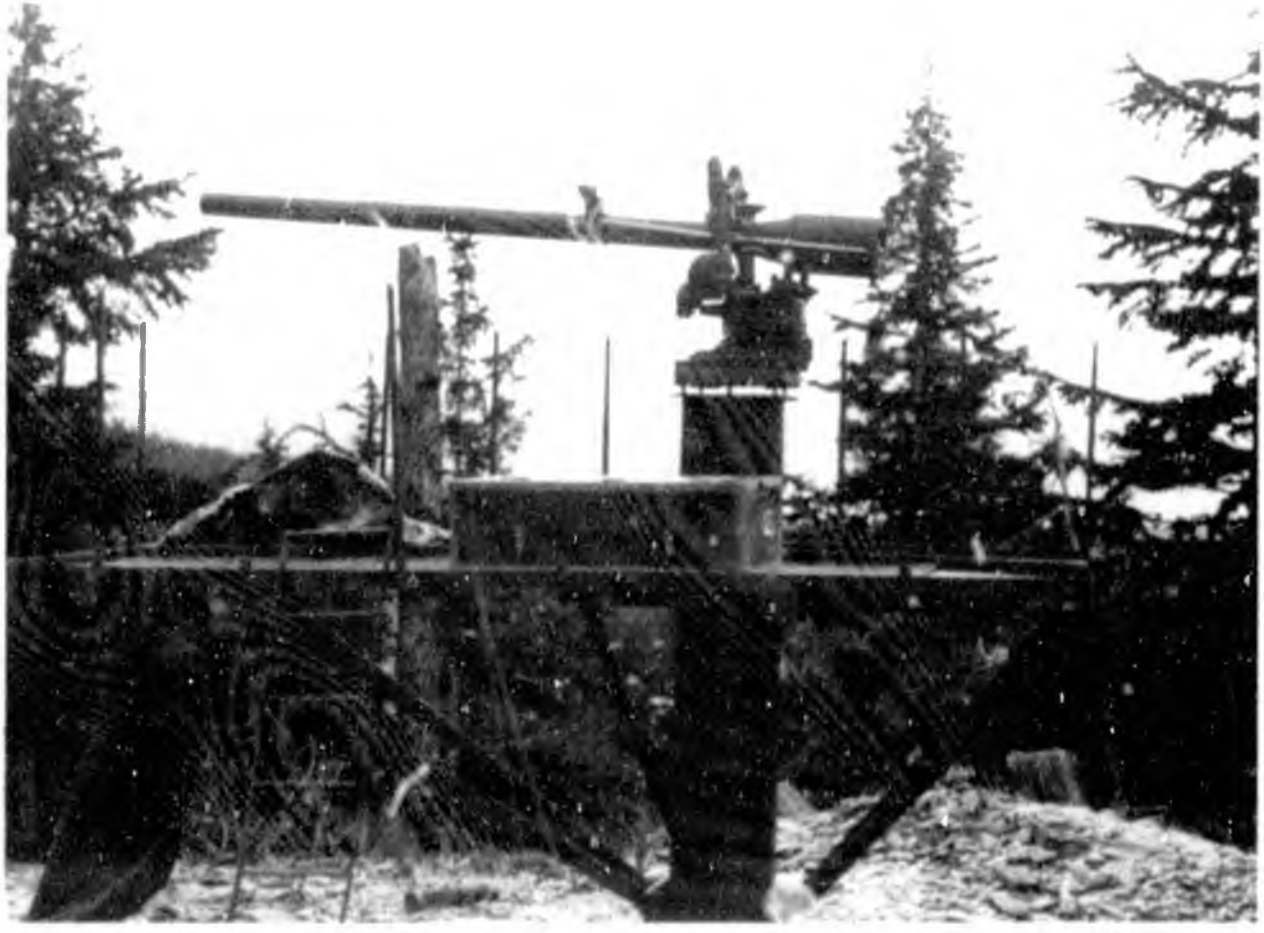


FIGURE 8-1

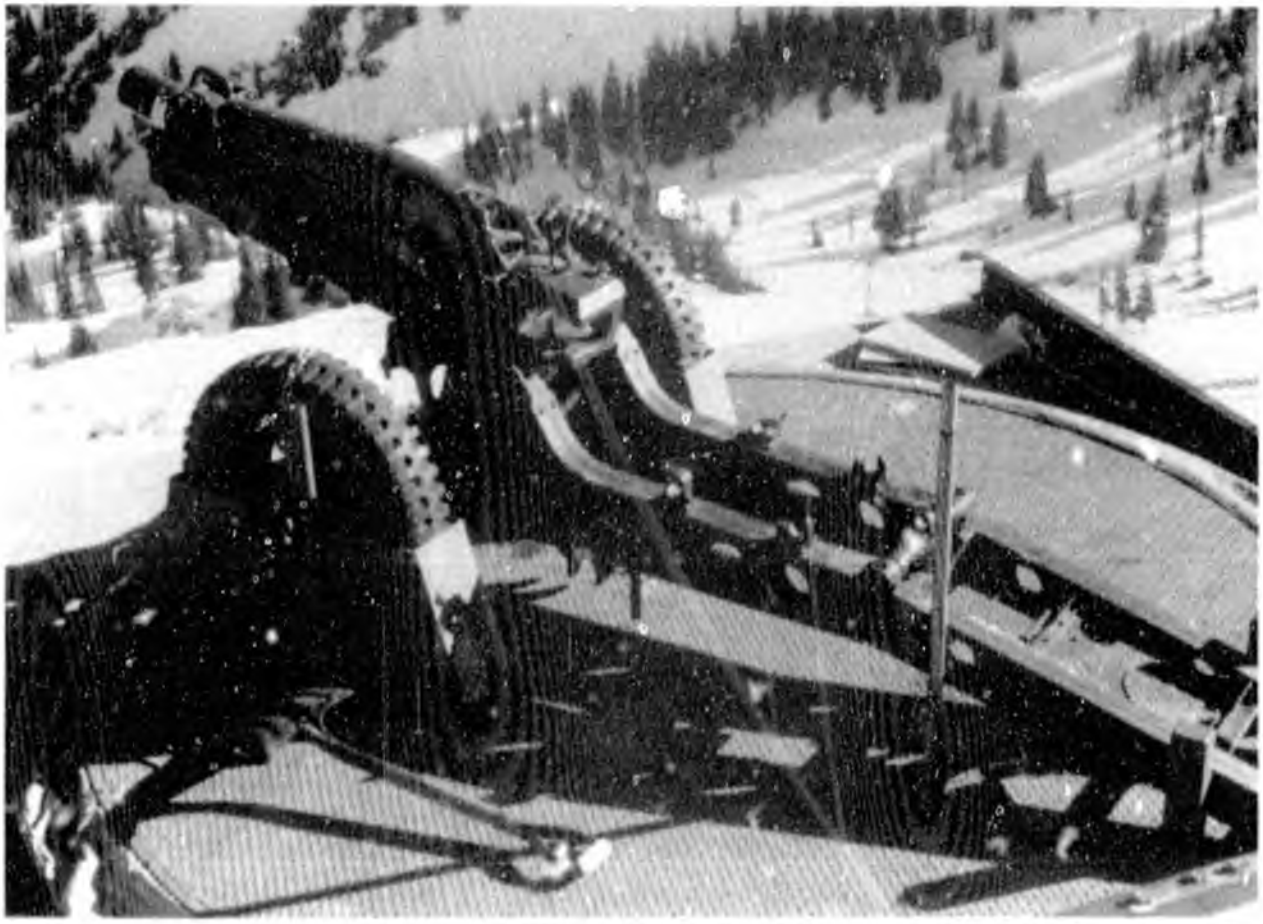


FIGURE 8-2

FIGURE 8-3

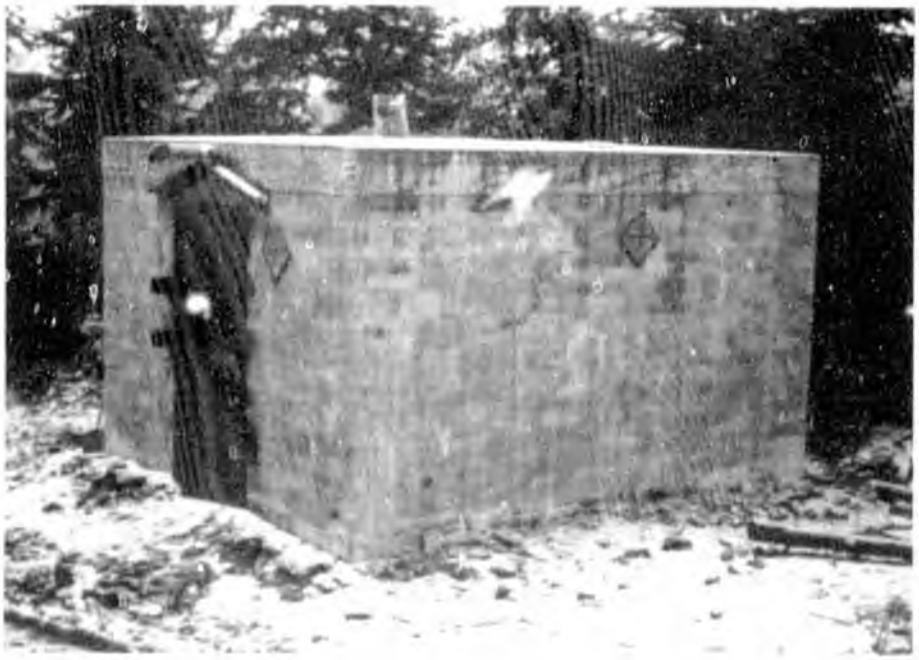


FIGURE 8-4

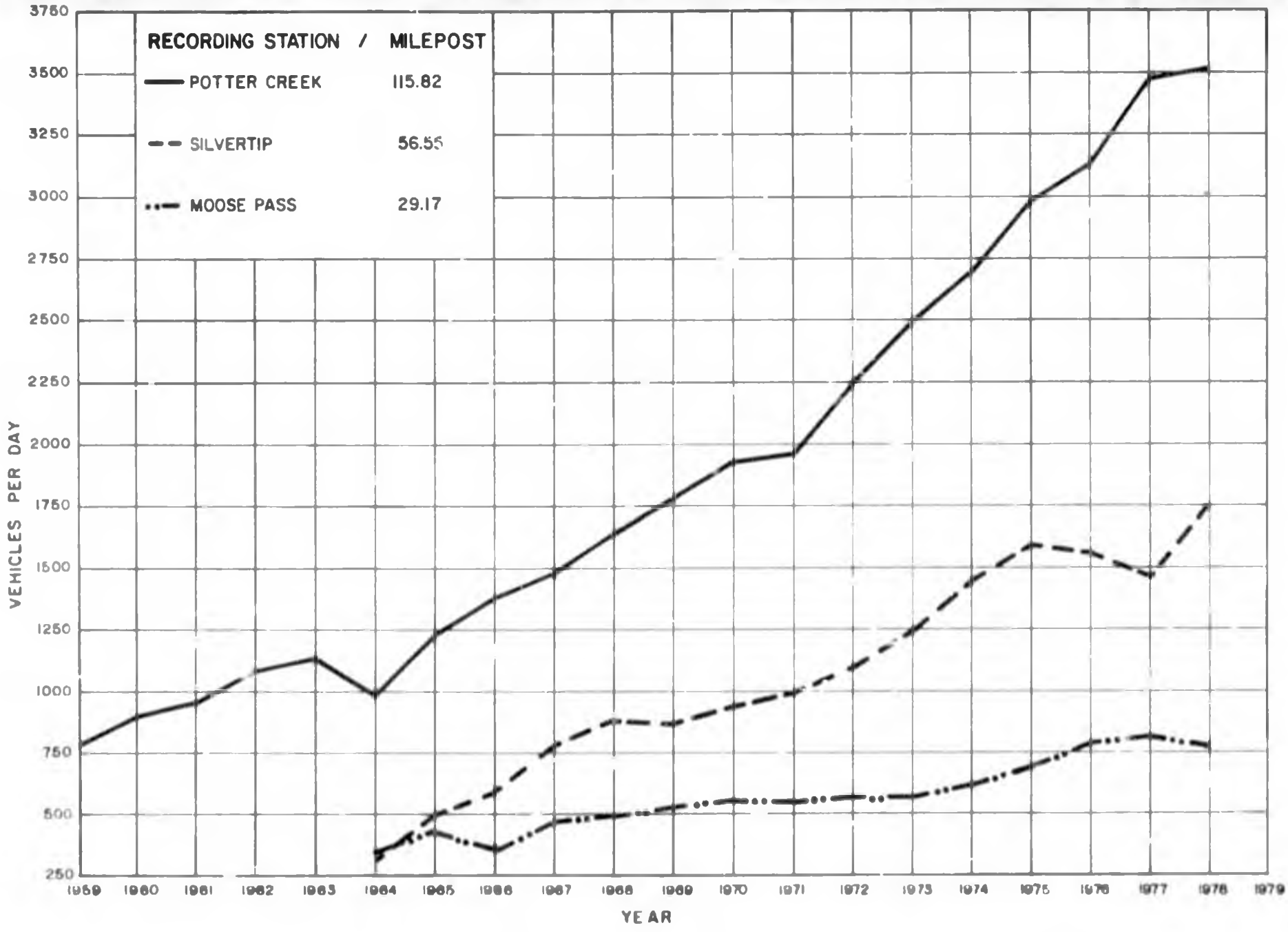
FIGURE 8-5

FIGURE 8-6

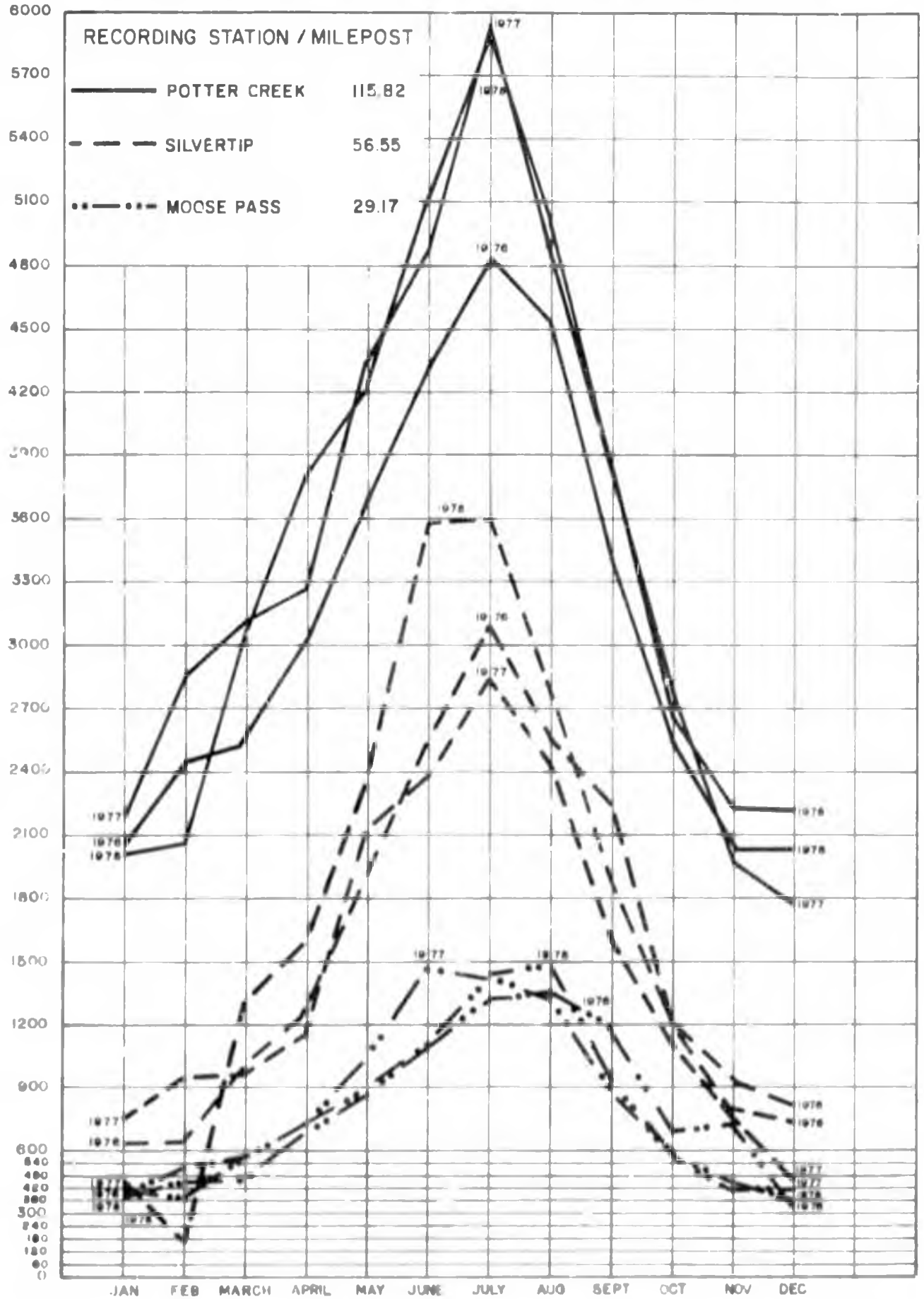
FIGURE 8-7

APPENDICES

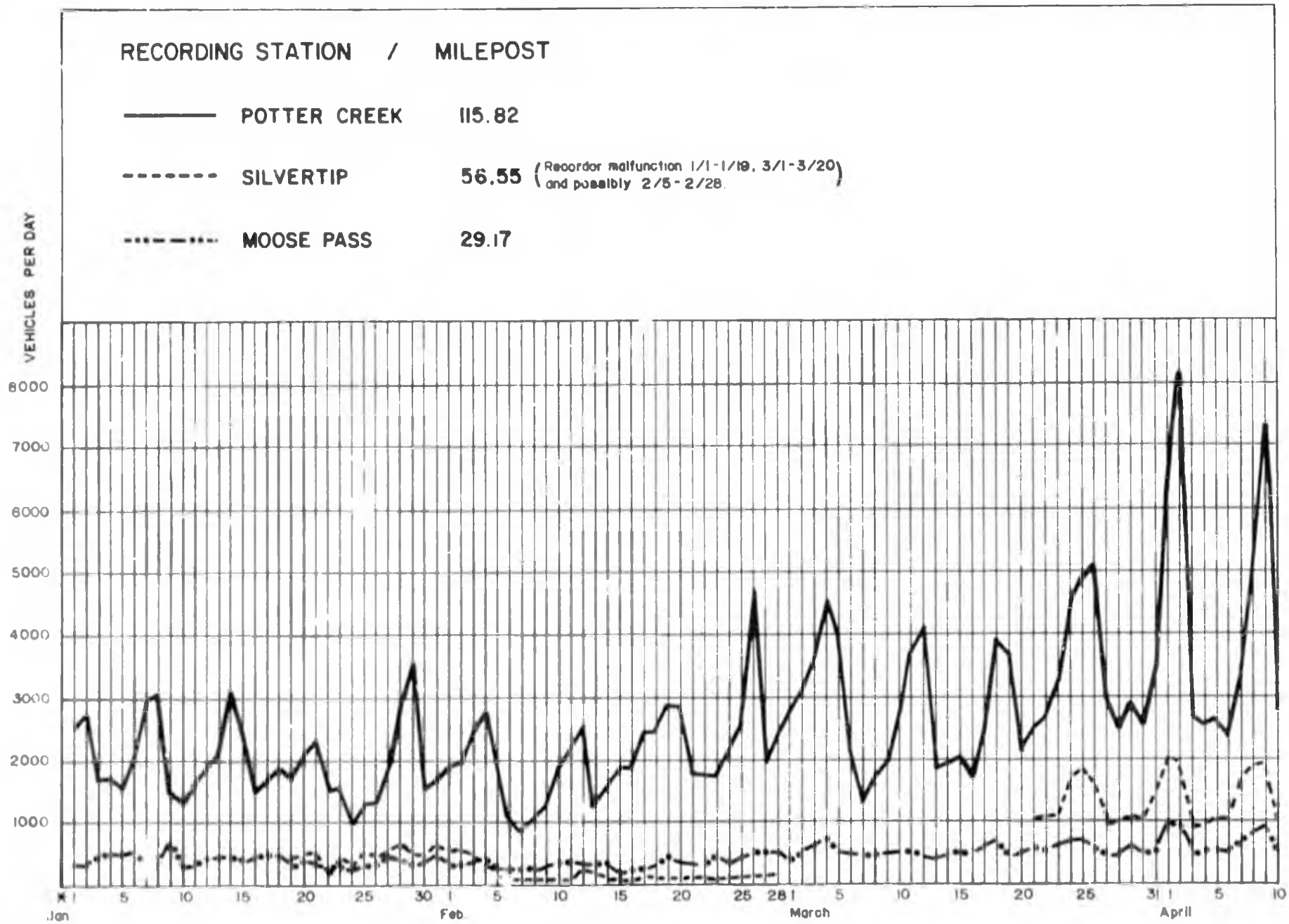
AVERAGE ANNUAL DAILY TRAFFIC



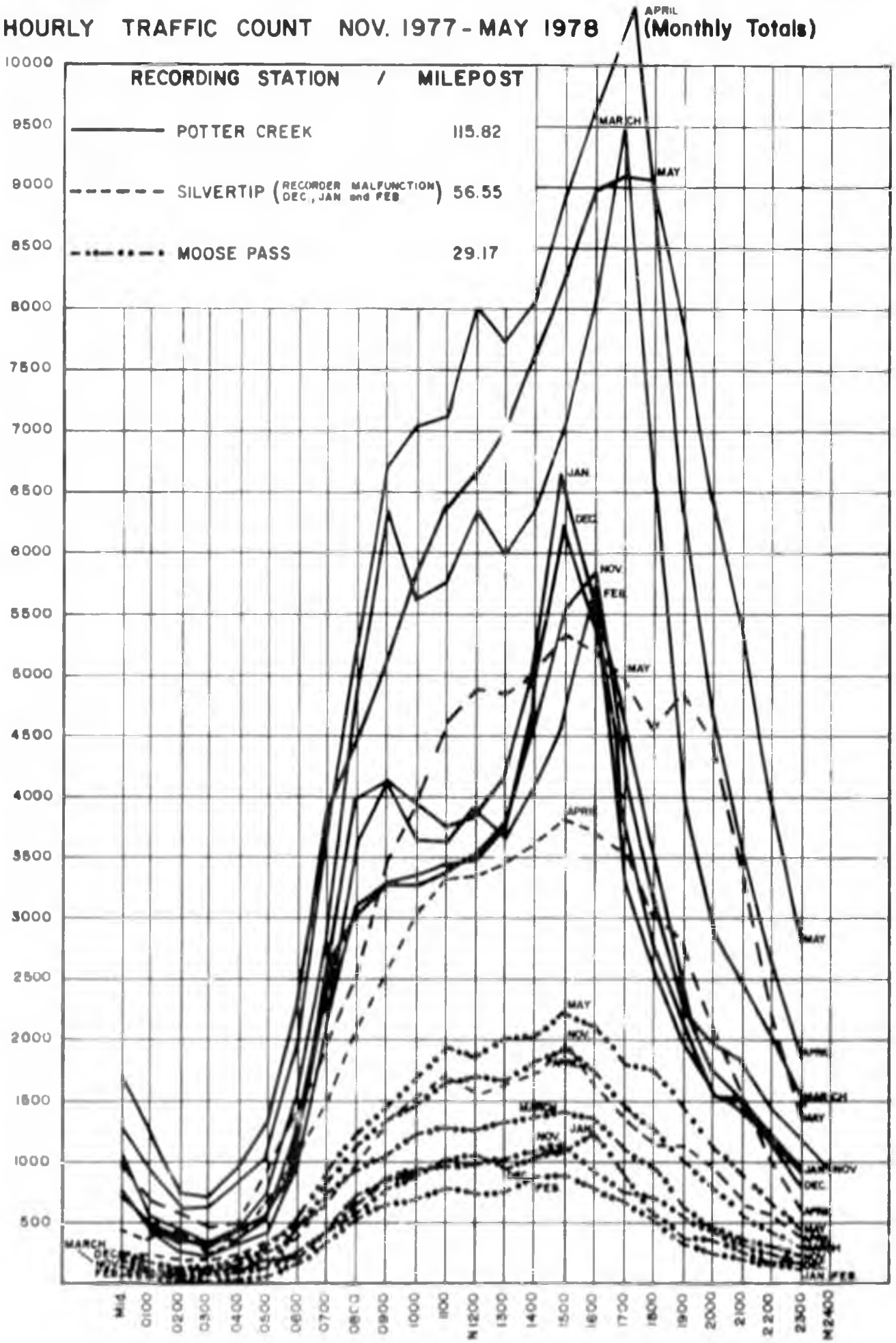
MONTHLY AVERAGE DAILY TRAFFIC 1976-1977-1978



DAILY TRAFFIC VOLUMES JAN. 1, 1978 - APRIL 9, 1978



HOURLY TRAFFIC COUNT NOV. 1977 - MAY 1978 (Monthly Totals)



Appendix II

HISTORICAL AVALANCHE ACTIVITY ON THE SEWARD HIGHWAY

This record was largely compiled from DOT/PF records. There are several intermediate years between 1968 and 1979 for which no avalanche activity reached the higway so these years have been deleted from the survey.

Slide Path #	68/69	70/71	74/75	75/76	76/77	77/78	78/79	Avg/Yrs
1					2	1		1/4
2						2	4	1/2
3				1		2	2	5/12
4				1	1	1	1	1/3
5						1	4	5/12
6						1	1	1/6
7						1	2	1/4
8						1	1	1/6
9						1	1	1/6
10						2	4	1/2
11			1	1		2	3	7/12
12	1					2	3	1/2
13						2	2	1/3
14				1		4	3	1/1-1/2
15						2	1	1/4
16	1				1	2	2	1/2
17						2	2	1/3
18						3	2	5/12
19	1			1		2	2	1/2
20						1	2	1/4
22						1	1	1/6
23						1		1/12

Chart (Continued)

HISTORICAL AVALANCHE ACTIVITY ON THE SEWARD HIGHWAY

Slide Path #	68/69	70/71	74/75	75/76	76/77	77/78	78/79	Avg/Yrs
24		1				1	1	1/4
25		1				1		1/6
26	1	1	1			2		5/12
27		1			1	1		1/4
28	1							1/12
41			1					1/12
42			1					1/12
43			1					1/12
45	1							1/12
49						1		1/12
50						1		1/12
51			1			1		1/6
52			1			1		1/6
53						1		1/12
70							1	1/12
73							2	1/6
74			1					1/12
75						1	3	1/3
76							3	1/4
77							3	1/4
78							2	1/6
79							2	1/6
92						1		1/12

H STORICAL AVALANCHE ACTIVITY ON THE SEWARD HIGHWAY

Slide Path #	Years	Avg/Yrs
92	Nov. 11, 1976	1/12
93	May 11, 1974, 1978	1/6
94	1974, 1978	1/6

There has been a considerable number of avalanches reported the last two years, either as the result of unusually heavy winters or better reporting. While this section does give a good indication of the relative frequency of each path it was not used exclusively in establishing a frequency rating for these locations. It is possible that unreported or recorded avalanches did occur. The overall record spans too short a time to be used reliably in establishing frequency ratings. As a consequence the frequency ratings given in Appendix V are based loosely on historical information. Primary input was provided by field personnel that have been working with these avalanche paths for a number of years.

Appendix III

SUPPLEMENTAL WEATHER INFORMATION

The collection of weather data is essential to the formation of an avalanche hazard forecast. Recording all previous weather and avalanche occurrence data will take a considerable amount of time. This appendix is therefore limited to graphing two storm periods that induced large scale avalanching. Good records exist for these periods and were used to compile the graphed data.

For purposes of graphing the information was split into two geographical sections - north and south of Silvertip Maintenance Station. Seward weather observations were used for the section south and Mt. Alyeska for the northern section. Temperature graphs had to be adjusted to the wind graph for each location.

These graphs can be reproduced on a daily basis by the forecasting office for use as an aid to stability evaluations. Operationally, the graph works such that when the wind speed, increasing downward, crosses the minimum temperature line a favorable wind speed/temperature for instability exists. When the precipitation rate crosses into the wind speed it can be presumed that leeslope loading is reaching a critical level.

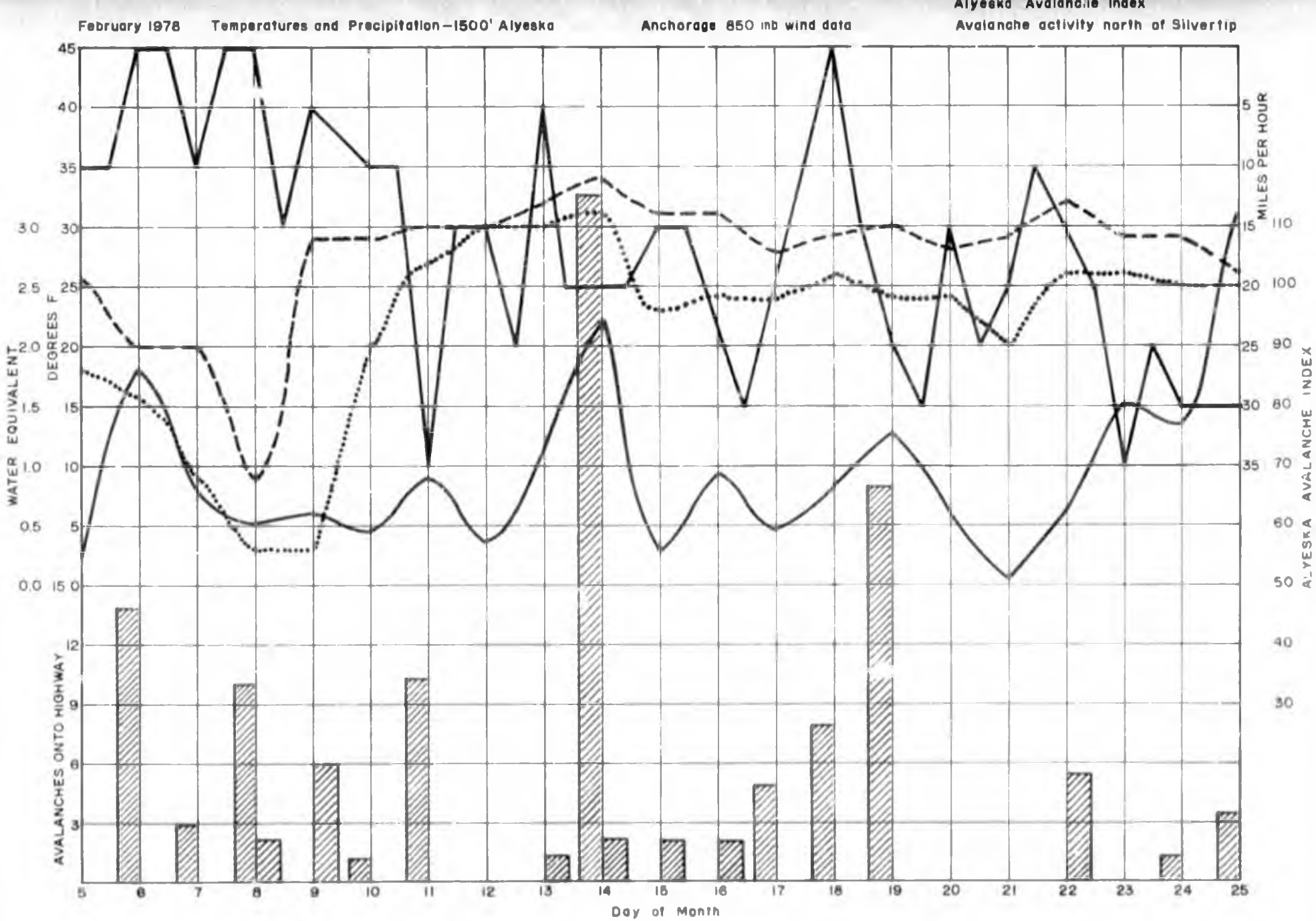
On the north section graphs it is interesting to compare avalanche activity at Alyeska to the Seward Highway. The difference is largely due to control being done during storms at Alyeska, and after storms on the highway.

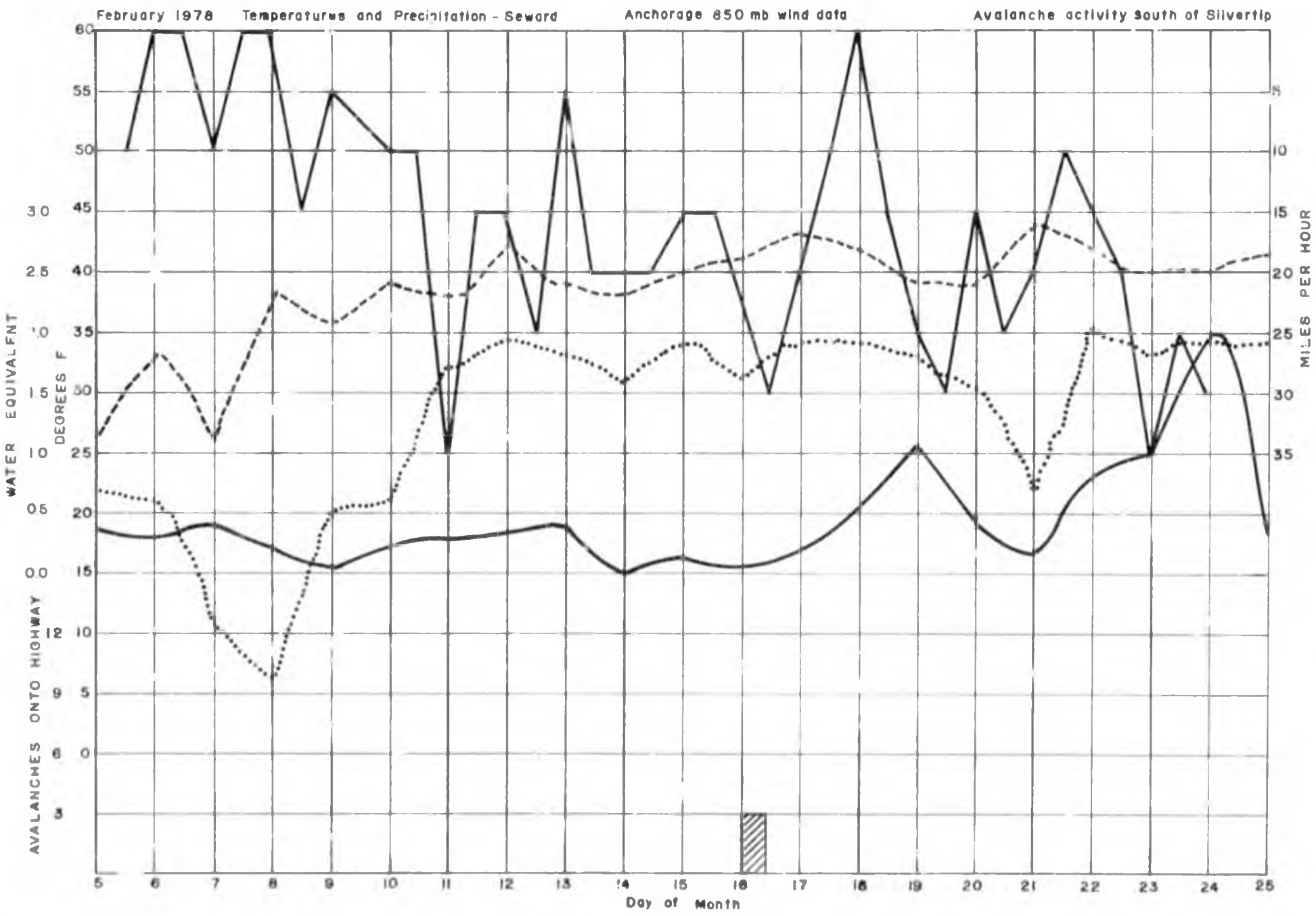
The Alyeska Avalanche Index (AAI) was derived by multiplying the number of avalanches times a magnitude scale. The magnitude scale was derived on the basis of Class #2 and #3 avalanche runouts being on the perimeter of the area, Class #4 avalanches running well into the area, and Class #5 going completely through the area. Because of the hazard level to people a proportionately higher scale had to be applied to Class #4 and #5. A value of 6 was applied to Class #4 and

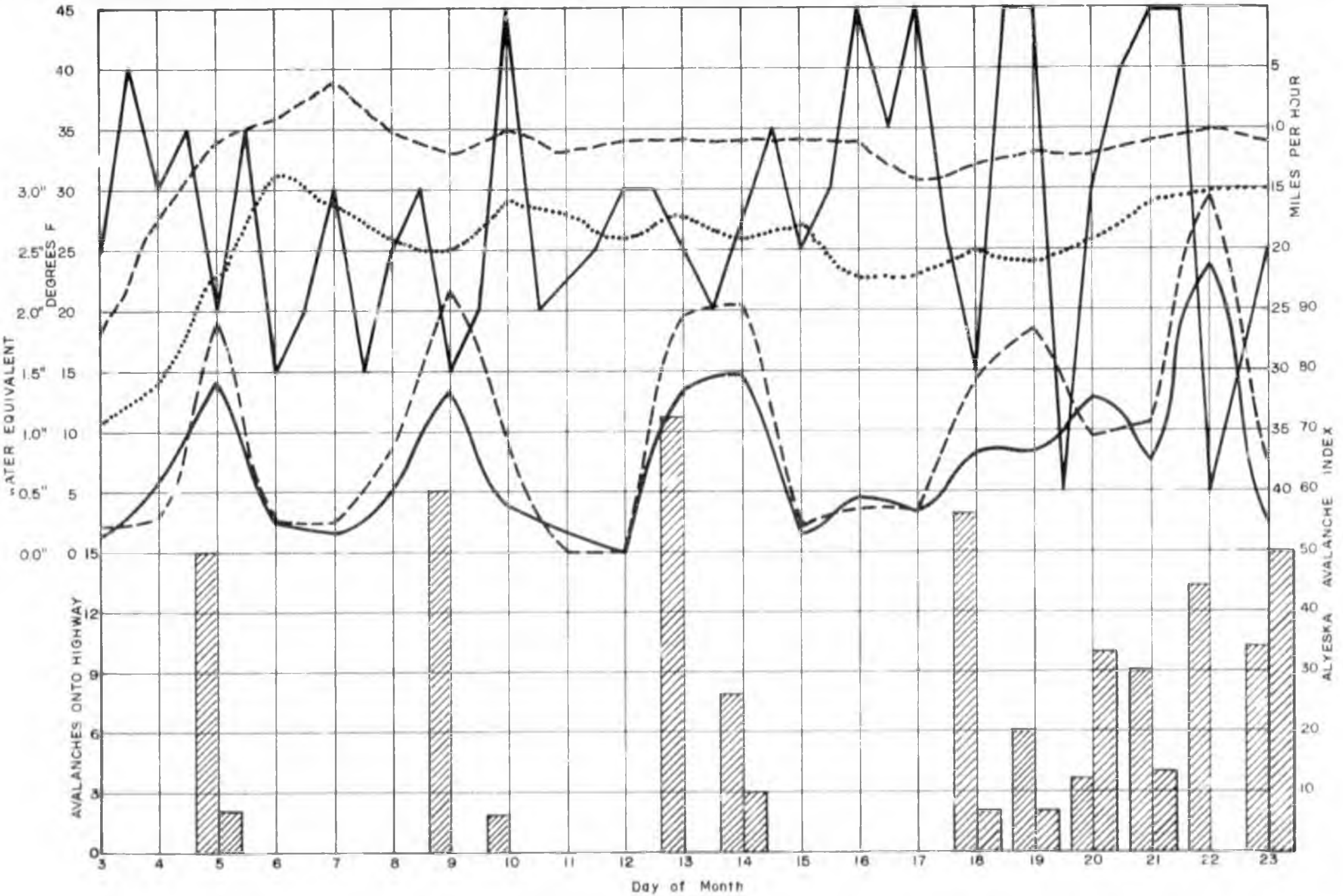
10 applied to Class #5. For a day that had 3 class #3, 1 Class #4, and 1 Class #5, the magnitude factor would be (3x3)+(1x6)+(1x10) = 25 ÷ 5 = 5 magnitude factor x 5 avalanches = 25 AAI.

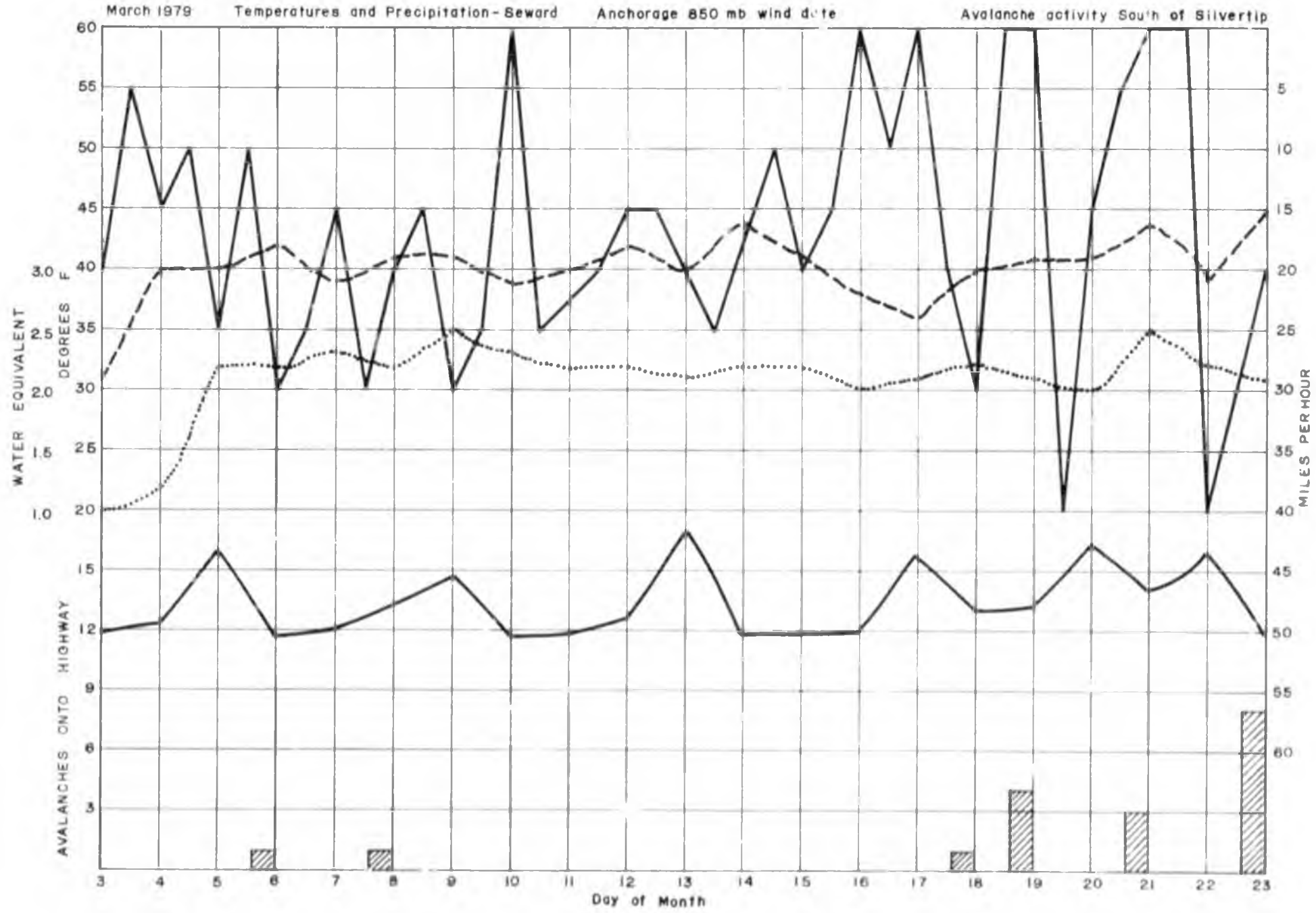
4 Class #3 and 1 Class #4 would produce a scale of (4x3)+(1x6) = 18 ÷ 5 = 3.6 magnitude factor x 5 avalanches = 18 AAI.

The final part of this appendix is a collection of 850 mb. wind flow patterns that produced differential precipitation between Seward and Alyeska. More work needs to be done on this phenomenon, however, it was possible during this report to isolate these cases to find if there was a similarity in flow patterns. Type 1 storms produced heavier precipitation in Girdwood, and Type 2 produced heavier precipitation in Seward. These are certainly limited examples but a cursory study does show a good correlation in pattern.


February 1978 Temperatures and Precipitation—1500' Alyeska
Anchorage 850 mb wind data
Alyeska Avalanche Index
Avalanche activity north of Silvertip
WATER EQUIVALENT
DEGREES F
MILES PER HOUR
ALYESKA AVALANCHE INDEX
AVALANCHES ONTO HIGHWAY
Day of Month


February 1978 Temperatures and Precipitation - Seward
Anchorage 850 mb wind data
Avalanche activity South of Silvertip
WATER EQUIVALENT
DEGREES F
AVALANCHES ONTO HIGHWAY
MILES PER HOUR
Day of Month

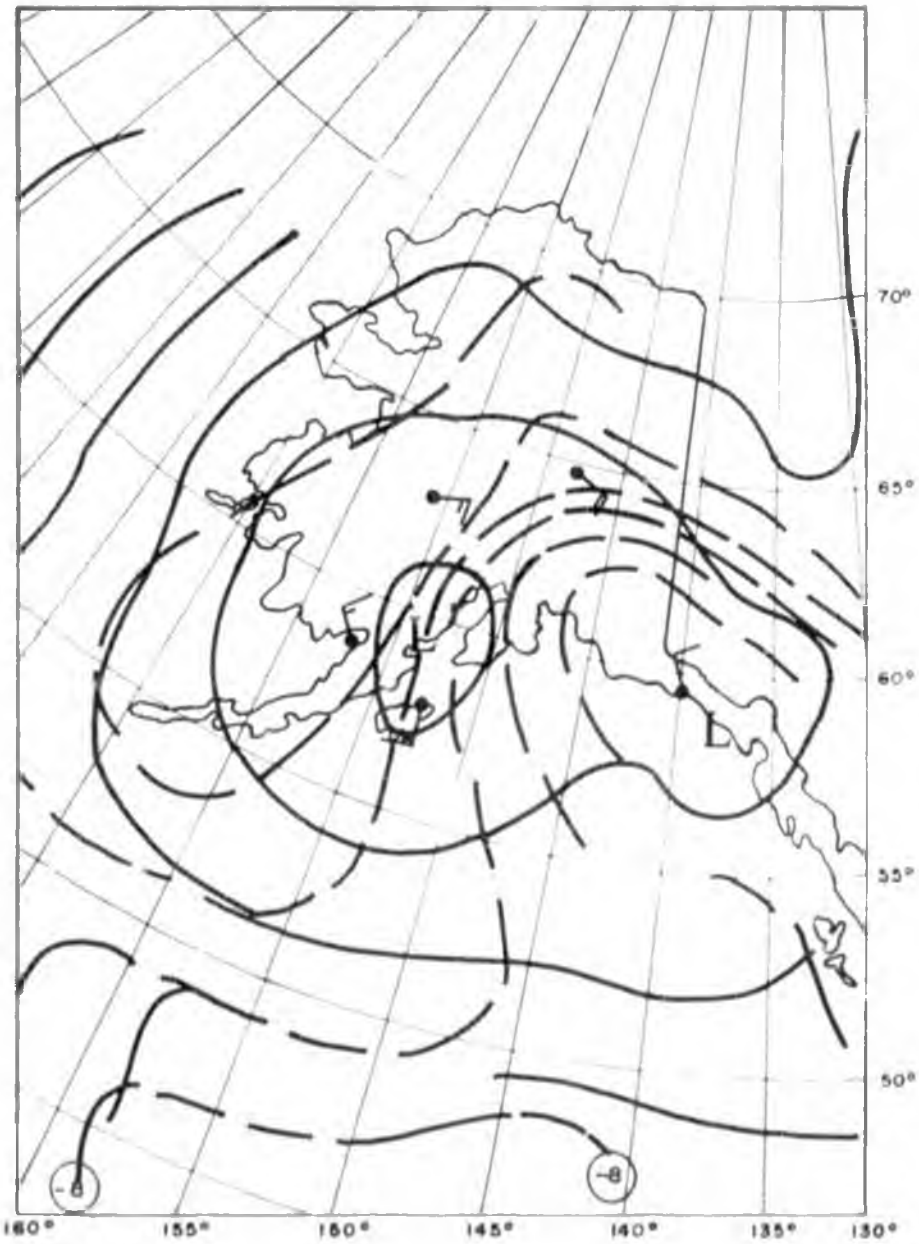

March 1979
Temperature-1500' Alyeska
Precipitation-1500' to 3000' Alyeska
Anchorage 850 mb wind data
Alyeska Avalanche Index
Avalanche activity north of Silvertip Maintenance Station
WATER EQUIVALENT
DEGREES F
MILES PER HOUR
AVALANCHES ONTO HIGHWAY
ALYESKA AVALANCHE INDEX
Day of Month


March 1979 Temperatures and Precipitation - Seward
Anchorage 850 mb wind data
Avalanche activity South of Silvertip
WATER EQUIVALENT
DEGREES F
MILES PER HOUR
AVALANCHES ONTO HIGHWAY
Day of Month
60
55
50
45
40
35
30
25
20
3.0
2.5
2.0
1.5
1.0
5
10
15
20
25
30
35
40
45
50
55
60
15
12
9
6
3
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23

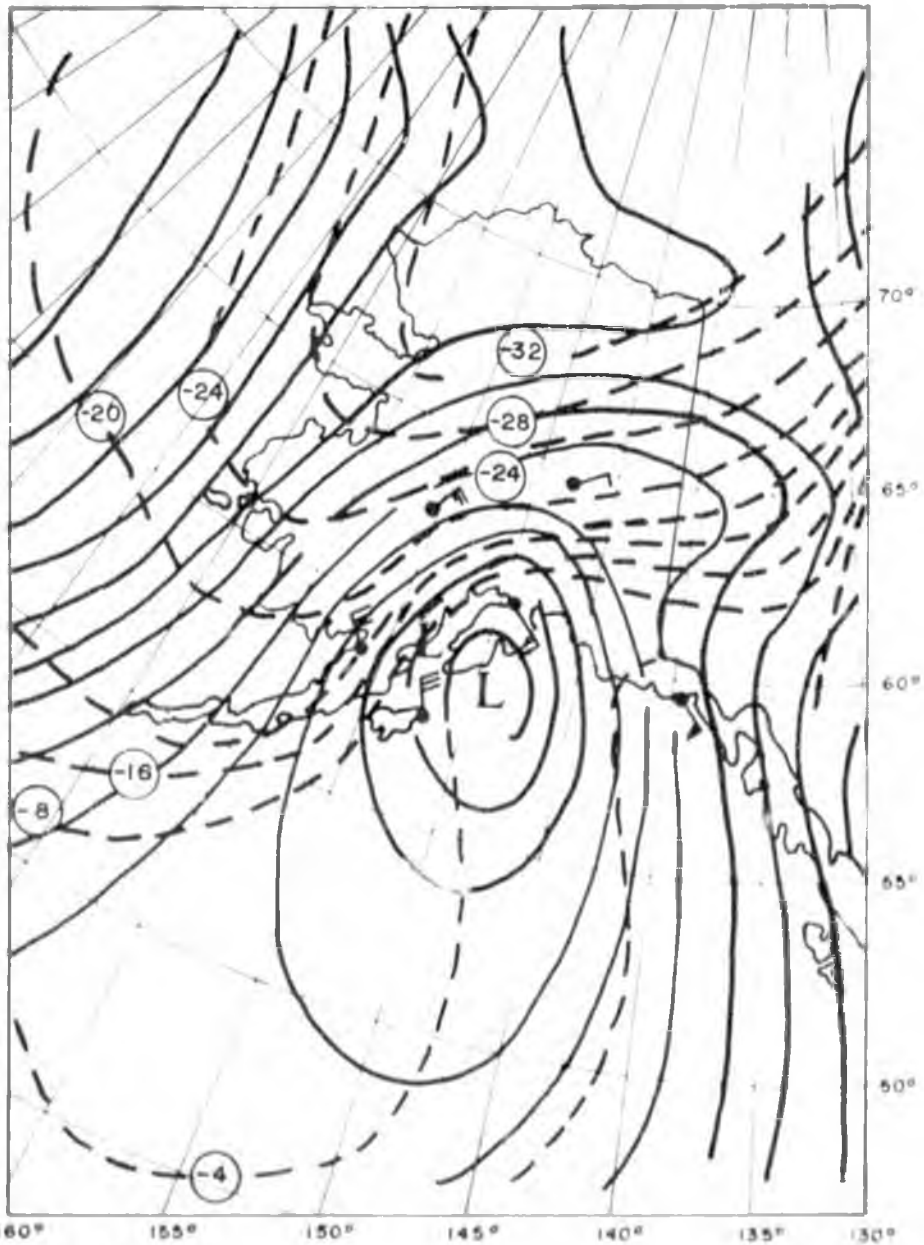
7 Mar 78
Type 1
160°
155°
150°
145°
140°
135°
130°
50°
55°
60°
65°
70°
L
-18
-20
-22
-27
-24
-16
-14
-12
-10
-8
-6
-4
-2
+6
+8
+38

10 Mar 78
Type 1
160°
155°
150°
145°
140°
135°
130°
60°
65°
70°
L
-20
-24
-16
-12
-8
+4
+0

24 Feb 78
Type I
3 Mar 79
Type I

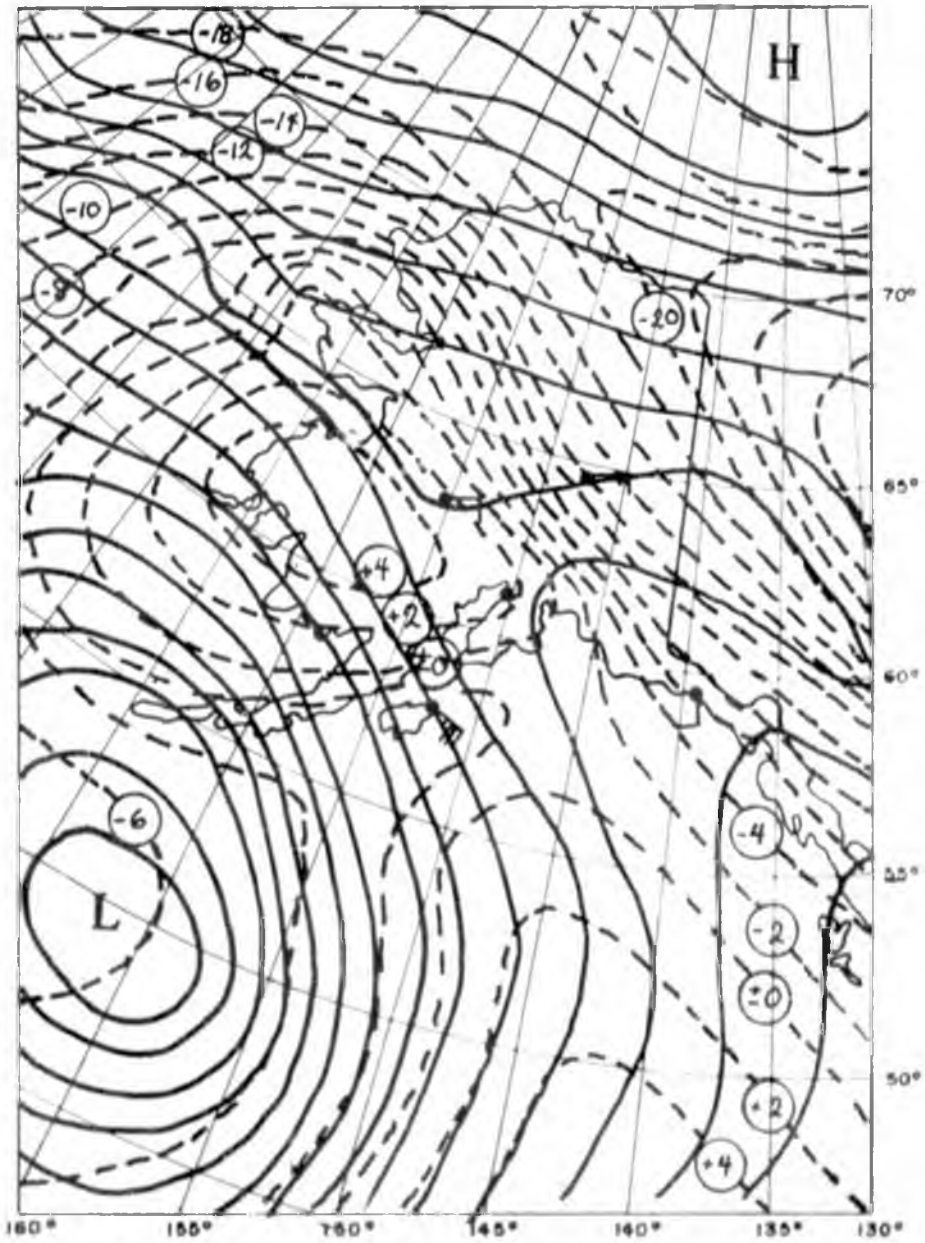


19 Mar 76 Type I

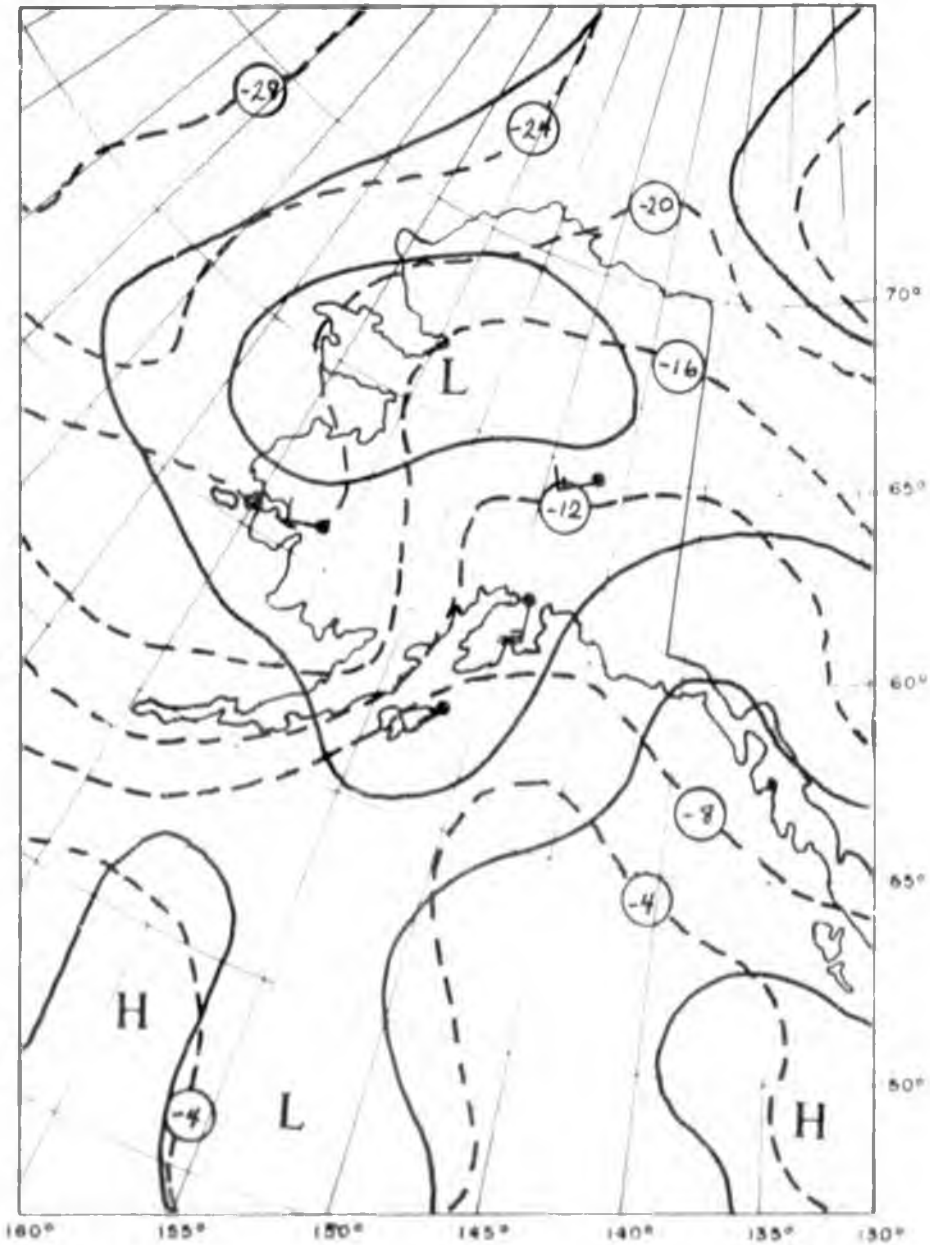


6 Feb 78 Type I

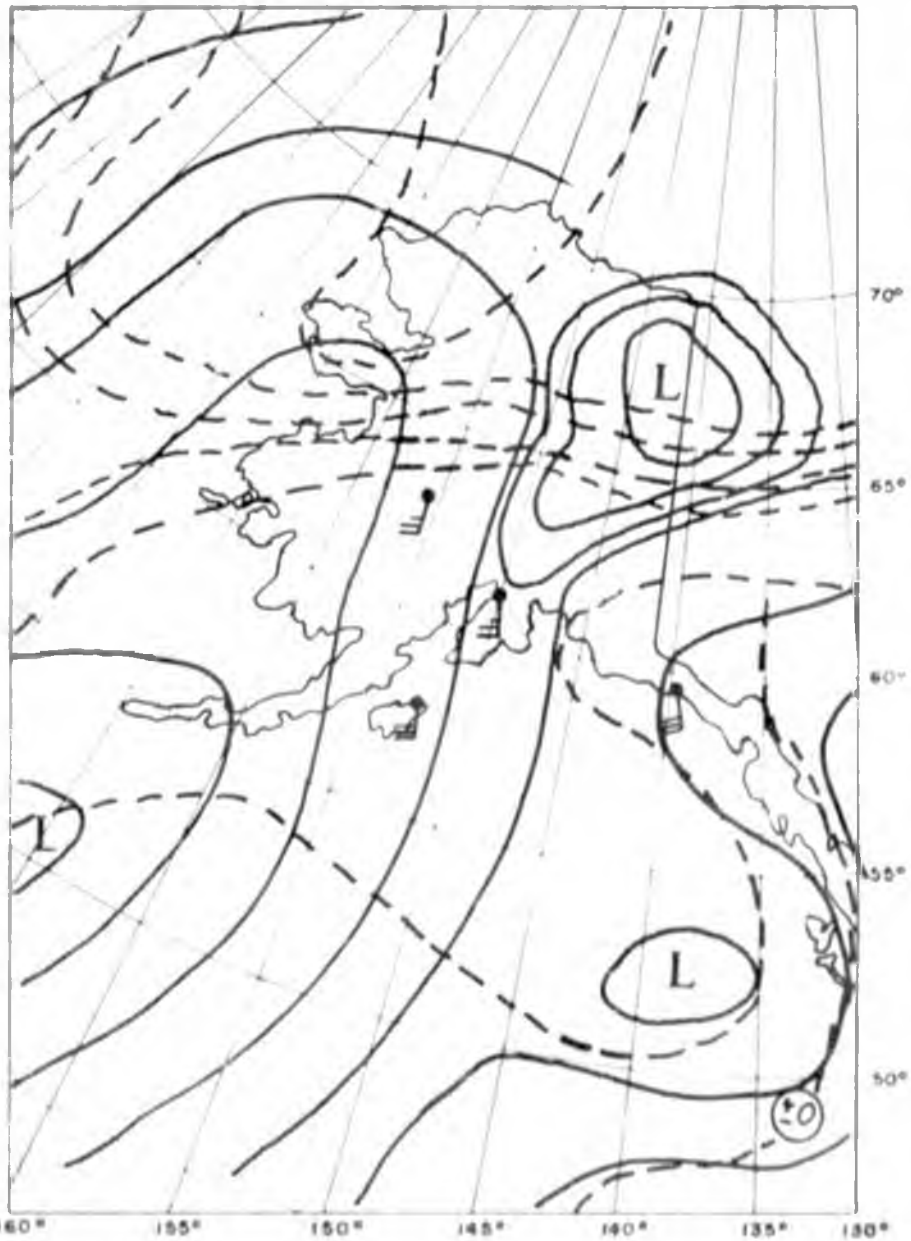
6 Mar 76
Type 2
160°
155°
150°
145°
140°
135°
130°
50°
55°
60°
65°
70°
H
L
-10
-4
-12
-16
-10
3 Jan 77
Type 2
H
L
+4
+2
+0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-22



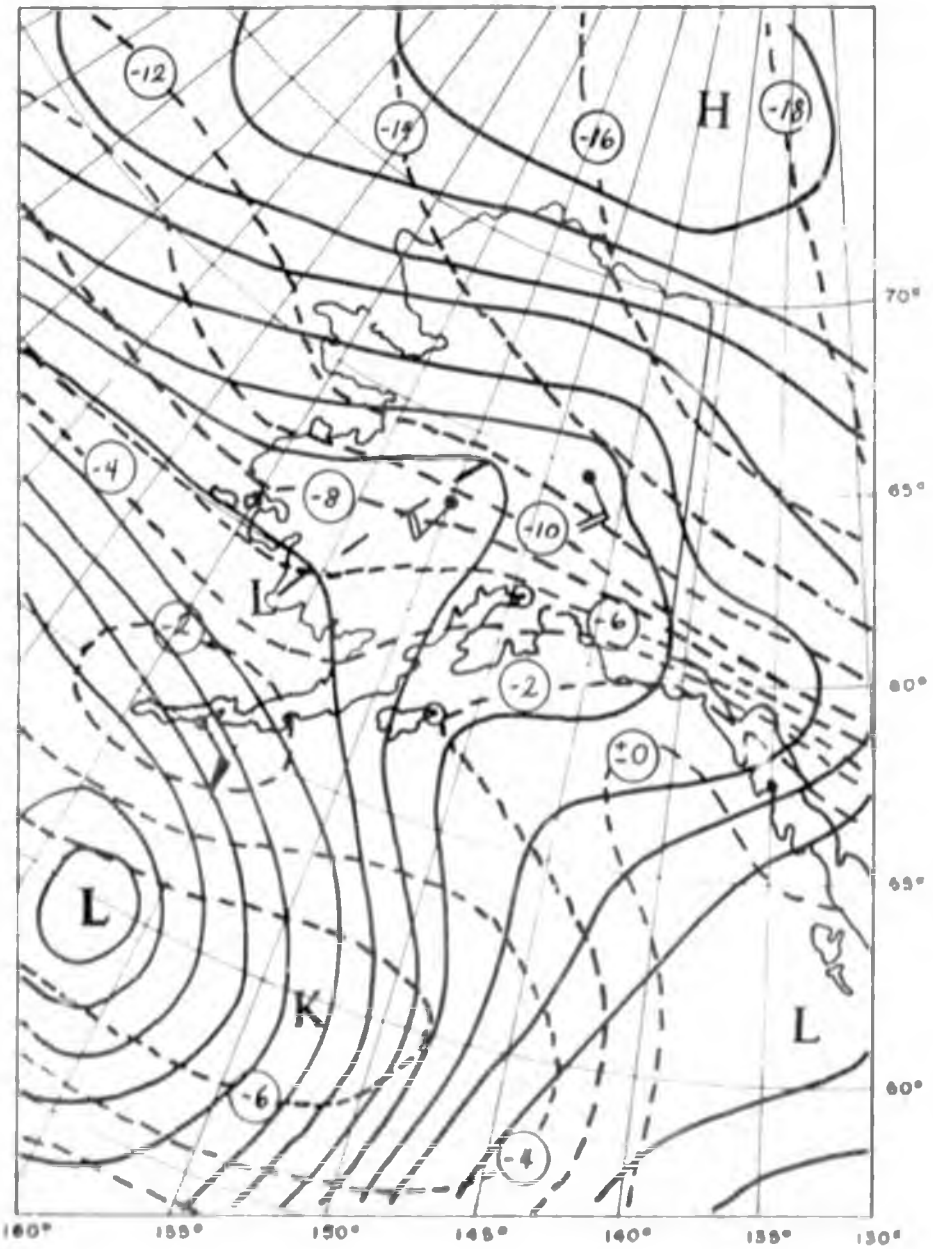
13 Jan 77 Type 2



13 Mar 78 Type 2



28 Jan 76 Type 2



28 Nov 78 Type 2

Appendix IV

AVALANCHE PATH INVENTORY

Slide Path #	Width(ft)	Vertical(ft)	Frequency	Hazard Class	Milepost
1A	200	3800	Infreq.	High	104.9
1	520	3000	Infreq.	Low	98.8
2A	800	4300	Infreq.	Low	98.3-98.5
2B	720	4300	Freq.	High	98.2-98.3
3	850	3900	Freq.	High	97.9-98.1
4	480	4000	Freq.	Low	97.8-97.9
5	1050	4100	Infreq.	High	97.4-97.7
6	690	4100	Infreq.	Low	97.3-97.4
7	660	3800	Infreq.	High	95.1-95.2
8	600	3800	Infreq.	High	95.0-95.1
9	580	3500	Infreq.	High	94.9-95.0
10	575	3500	Infreq.	High	94.8-94.9
11	2000	3200	Freq.	High	94.3-94.8
12	2600	2900	Freq.	High	93.8-94.3
13	550	3400	Infreq.	High	93.6-93.8
14	800	3300	Freq.	High	93.4-93.6
15	825	3300	Infreq.	Low	92.8-93.0
15A	200	3300	Infreq.	Low	92.7
16	1080	3300	Infreq.	High	92.3-92.6
17	730	3500	Freq.	High	92.1-92.3
18A	860	3200	Infreq.	High	91.8-92.0
18B	1800	3200	Freq.	High	91.5-91.8
19	1580	3000	Freq.	High	91.3-91.5
20	1370	2700	Freq.	High	90.9-91.3
21	750	3300	Infreq.	Low	87.0-87.1
22	850	3200	Infreq.	Low	86.8-87.0
23	700	3200	Infreq.	Low	85.5-85.6
24	700	3800	Infreq.	Low	83.8-83.9
25	730	3800	Infreq.	Low	83.7-83.8
26	800	3800	Infreq.	Low	83.5-83.7
27	800	3800	Infreq.	Low	83.4-83.5
40	150	1600	Infreq.	Low	71.6
41	300	1600	Infreq.	Low	71.4
42	200	1600	Infreq.	Low	71.2
43	1700	2600	Infreq.	Low	66.5-66.8
44	400	2800	Infreq.	Low	66.2
45	200	2900	Infreq.	Low	65.9
46	200	2300	Infreq.	Low	65.2
47	200	3400	Infreq.	Low	62.5
51	300	3200	Infreq.	Low	59.7
52	250	3200	Infreq.	High	59.5
53	400	3200	Infreq.	High	59.1
54	350	2800	Infreq.	Low	49.3
55	560	2800	Infreq.	Low	49.1-49.2
56	1300	1600	Infreq.	Low	48.5-48.8
58	300	3500	Infreq.	Low	47
70	4040	2100	Freq.	High	44.7-45.5
71	1220	2400	Freq.	High	44.4-44.7
72	840	2500	Freq.	High	44.2-44.4

Chart (Continued)

AVALANCHE PATH INVENTORY

Slide Path #	Width(ft)	Vertical(ft)	Frequency	Hazard Class	Milepost
73	360	2700	Infreq.	Low	44.1-44.2
74	2300	2800	Infreq.	High	37.6-38.1
75A	300	2900	Infreq.	Low	37.4
75	550	2800	Freq.	Low	37.1-37.2
76	1300	2800	Infreq.	Low	36.8-37.1
77	1370	3400	Infreq.	Low	36.2-36.5
78	200	3400	Infreq.	Low	35.7
79	500	3400	Infreq.	Low	35.1-35.2
80	2600	3700	Infreq.	Low	34.0-34.5
82	200	4200	Infreq.	Low	31.7
83	200	4200	Infreq.	Low	30.6
90	200	3800	Infreq.	Low	22.4
91	1150	3800	Infreq.	High	22.0-22.2
92	1950	3800	Infreq.	High	21.6-21.9
93	770	4900	Freq.	High	20.9-21.1
94	1100	4400	Infreq.	High	20.7-20.9
95	570	4000	Infreq.	Low	18.5-18.7
96	470	4000	Infreq.	Low	18.3-18.4
97	700	4000	Infreq.	Low	18.1-18.3

In addition to these well recognized paths there are several areas that show evidence of damage to vegetation, probably as a result of large, infrequent avalanches. This study does not document all such areas, but several bear mention. These have been indicated in Chapter VI, Avalanche Mapping, with the use of a slide path marker, but not in this inventory.

LAWS

PASSED AT THE
SECOND REGULAR SESSION
OF THE

FORTY-NINTH GENERAL ASSEMBLY OF THE
STATE OF COLORADO
CONVENED AT DENVER
AT 10 O'CLOCK A.M.
WEDNESDAY, JANUARY 2, A.D. 1974
AND ADJOURNED SINE DIE ON
WEDNESDAY, MAY 22, 1974

Published by authority of
TED L. STRICKLAND
Acting President of the Senate
JOHN D. FUHR
Speaker of the House of Representatives

Legislation pertaining to "natural hazard areas" and snow avalanches.
RSG 5/1/79

Bradford Printing Co.
Denver, Colorado
1974

CHAPTER 80

PLANNING COMMISSIONS — STATE AND COUNTY

AREAS AND ACTIVITIES OF STATE INTEREST

HOUSE BILL NO. 1041, BY REPRESENTATIVES Dittemore, Buechner, Herzberger, Miller, Petrie, Faker, Echelberry, Friedman, Gustafson, Hamlin, Koster, O'Brian, Ross, Sack, Sonnenberg, and Tempest; also SENATORS Allshouse, Darby, Johnson, Plock, H. Brown, DeBerard, L. Fowler, Garnsey, Jackson, Klein, McCormick, Schieffelin, Stockton, and Strickland.

AN ACT

CONCERNING LAND USE, AND PROVIDING FOR IDENTIFICATION, DESIGNATION, AND ADMINISTRATION OF AREAS AND ACTIVITIES OF STATE INTEREST, AND ASSIGNING ADDITIONAL DUTIES TO THE COLORADO LAND USE COMMISSION AND THE DEPARTMENT OF LOCAL AFFAIRS, AND MAKING APPROPRIATIONS THEREFOR.

Be it enacted by the General Assembly of the State of Colorado:

Section 1. Chapter 106, Colorado Revised Statutes 1963, as amended, is amended BY THE ADDITION OF A NEW ARTICLE to read:

ARTICLE 7

Areas and Activities of State Interest

PART 1

GENERAL PROVISIONS

106-7-101. Legislative declaration. (1) In addition to the legislative declaration contained in section 106-4-1 (1), the general assembly further finds and declares that:

(a) The protection of the utility, value, and future of all lands within the state, including the public domain as well as privately owned land, is a matter of the public interest;

(b) Adequate information on land use and systematic methods of definition, classification, and utilization thereof are either lacking or not readily available to land use decision makers;

(c) It is the intent of the general assembly that land use, land use planning, and quality of development are matters in which the state has responsibility for the health, welfare, and safety of the people of the state and for the protection of the environment of the state.

(2) It is the purpose of this article that:

(a) The general assembly shall describe areas which may be of state interest

Capital letters indicate new material added to existing statutes; dashes through words indicate deletions from existing statutes and such material not part of act.

Includes "natural hazard areas" and controls re. occupancy of snow avalanche paths

RF 5/19

and activities which may be of state interest and establish criteria for the administration of such areas and activities;

(b) Local governments shall be encouraged to designate areas and activities of state interest and, after such designation, shall administer such areas and activities of state interest and promulgate guidelines for the administration thereof; and

(c) Appropriate state agencies shall assist local governments to identify, designate, and adopt guidelines for administration of matters of state interest.

106-7-102. General definitions. As used in this article, unless the context otherwise requires:

(1) "Development" means any construction or activity which changes the basic character or the use of the land on which the construction or activity occurs.

(2) "Local government" means a municipality or county.

(3) "Local permit authority" means the governing body of a local government with which an application for development in an area of state interest or for conduct of an activity of state interest must be filed or the designee thereof.

(4) "Matter of state interest" means an area of state interest or an activity of state interest or both.

(5) "Municipality" means a home rule or statutory city, town, or city and county or a territorial charter city.

(6) "Person" means any individual, partnership, corporation, association, company, or other public or corporate body, including the federal government, and includes any political subdivision, agency, instrumentality, or corporation of the state.

106-7-103. Definitions pertaining to natural hazards. As used in this article, unless the context otherwise requires:

(1) "Aspect" means the cardinal direction the land surface faces, characterized by north-facing slopes generally having heavier vegetation cover.

(2) "Avalanche" means a mass of snow or ice and other material which may become incorporated therein as such mass moves rapidly down a mountain slope.

(3) "Corrosive soil" means soil which contains soluble salts which may produce serious detrimental effects in concrete, metal, or other substances that are in contact with such soil.

(4) "Debris-fan floodplain" means a floodplain which is located at the mouth of a mountain valley tributary stream as such stream enters the valley floor.

(5) "Dry wash channel and dry wash floodplain" means a small watershed with a very high percentage of runoff after torrential rainfall.

(6) "Expansive soil and rock" means soil and rock which contains clay and which expands to a significant degree upon wetting and shrinks upon drying.

(7) "Floodplain" means an area adjacent to a stream, which area is subject to flooding as the result of the occurrence of an intermediate regional flood and which area thus is so adverse to past, current, or foreseeable construction or land use as to constitute a significant hazard to public health and safety or to property. The term includes but is not limited to:

(a) Mainstream floodplains;

(b) Debris-fan floodplains; and

(c) Dry wash channels and dry wash floodplains.

(8) "Geologic hazard" means a geologic phenomenon which is so adverse to past, current, or foreseeable construction or land use as to constitute a significant hazard to public health and safety or to property. The term includes but is not limited to:

(a) Avalanches, landslides, rock falls, mudflows, and unstable or potentially unstable slopes;

(b) Seismic effects;

(c) Radioactivity; and

(d) Ground subsidence.

(9) "Geologic hazard area" means an area which contains or is directly affected by a geologic hazard.

(10) "Ground subsidence" means a process characterized by the downward displacement of surface material caused by natural phenomena such as removal of underground fluids, natural consol'dation, or dissolution of underground minerals or by man-made phenomena such as underground mining.

(11) "Mainstream floodplain" means an area adjacent to a perennial stream that is subject to periodic flooding.

(12) "Mudflow" means the downward movement of mud in a mountain watershed because of peculiar characteristics of extremely high sediment yield and occasional high runoff.

(13) "Natural hazard" means a geologic hazard, a wildfire hazard, or a flood.

(14) "Natural hazard area" means an area containing or directly affected by a natural hazard.

(15) "Radioactivity" means a condition related to various types of radiation emitted by natural radioactive minerals that occur in natural deposits of rock, soil, and water.

(16) "Seismic effects" means direct and indirect effects caused by an earthquake or an underground nuclear detonation.

(17) "Siltation" means a process which results in an excessive rate of removal of soil and rock materials from one location and rapid deposit thereof in adjacent areas.

(18) "Slope" means the gradient of the ground surface which is definable by degree or percent.

(19) "Unstable or potentially unstable slope" means an area susceptible to a landslide, a mudflow, a rock fall, or accelerated creep of slope-forming materials.

(20) "Wildfire behavior" means the predictable action of a wildfire under given conditions of slope, aspect, and weather.

(21) "Wildfire hazard" means a wildfire phenomenon which is so adverse to past, current, or foreseeable construction or land use as to constitute a significant hazard to public health and safety or to property. The term includes but is not limited to:

(a) Slope and aspect;

(b) Wildfire behavior characteristics; and

(c) Existing vegetation types.

(22) "Wildfire hazard area" means an area containing or directly affected by a wildfire hazard.

106-7-104. Definitions pertaining to other areas and activities of state interest. As used in this article, unless the context otherwise requires:

(1) "Airport" means any municipal or county airport or airport under the jurisdiction of an airport authority.

(2) "Area around a key facility" means an area immediately and directly affected by a key facility.

(3) "Arterial highway" means any limited-access highway which is part of the federal-aid interstate system or any limited-access highway constructed under the supervision of the state department of highways.

(4) "Collector highway" means a major thoroughfare serving as a corridor or link between municipalities, unincorporated population centers or recreation areas, or industrial centers and constructed under guidelines and standards established by, or under the supervision of, the state department of highways. Collector highway does not include a city street or local service road or a county road designed for local service and constructed under the supervision of local government.

(5) "Domestic water and sewage treatment system" means a wastewater treatment plant, water treatment plant, or water supply system, as defined in section 66-38-2 (6), (7), and (8), C.R.S. 1963, and any system of pipes, structures, and facilities through which wastewater is collected for treatment.

(6) "Historical or archaeological resources of statewide importance" means resources which have been officially included in the national register of historic places, designated by statute, or included in an established list of places compiled by the state historical society.

(7) "Key facilities" means:

(a) Airports;

(b) Major facilities of a public utility;

(c) Interchanges involving arterial highways;

(d) Rapid or mass transit terminals, stations, and fixed guideways.

(8) "Major facilities of a public utility" means:

(a) Central office buildings of telephone utilities;

(b) Transmission lines, power plants, and substations of electrical utilities; and

(c) Pipelines and storage areas of utilities providing natural gas or other petroleum derivatives.

(9) "Mass transit" means a coordinated system of transit modes providing transportation for use by the general public.

(10) "Mineral" means an inanimate constituent of the earth, in either solid, liquid, or gaseous state which, when extracted from the earth, is usable in its natural form or is capable of conversion into usable form as a metal, metallic compound, a chemical, an energy source, a raw material for manufacturing, or construction material. This definition does not include surface or ground water subject to appropriation for domestic, agricultural, or industrial purposes, nor does it include geothermal resources.

(11) "Mineral resource area" means an area in which minerals are located in sufficient concentration in veins, deposits, bodies, beds, seams, fields, pools, or otherwise, as to be capable of economic recovery. The term includes but is not limited to any area in which there has been significant mining activity in the past, there is significant mining activity in the present, mining development is planned or in progress, or mineral rights are held by mineral patent or valid mining claim with the intention of mining.

(12) "Natural resources of statewide importance" is limited to shorelands of major publicly-owned reservoirs and significant wildlife habitats in which the wildlife species, as identified by the division of wildlife of the department of natural resources, in a proposed area could be endangered.

(13) "New communities" means the major revitalization of existing municipalities or the establishment of urbanized growth centers in unincorporated areas.

(14) "Rapid transit" means the element of a mass transit system involving mechanical conveyance on an exclusive lane or guideway constructed solely for that purpose.

106-7-105. Effect of article — public utilities. (1) With regard to public utilities, nothing in this article shall be construed as enhancing or diminishing the power and authority of municipalities, counties, or the public utilities commission. Any order, rule, or directive issued by any governmental agency pursuant to this article shall not be inconsistent with or in contravention of any decision, order, or finding of the public utilities commission with respect to public convenience and necessity. The public utilities commission and public utilities shall take into consideration and, when feasible, foster compliance with adopted land use master plans of local governments, regions, and the state.

(2) Nothing in this article shall be construed as enhancing or diminishing the rights and procedures with respect to the power of a public utility to acquire property and rights-of-way by eminent domain to serve public need in the most economical and expedient manner.

106-7-106. Effect of article — rights of property owners — water rights. (1) Nothing in this article shall be construed as:

(a) Enhancing or diminishing the rights of owners of property as provided by the state constitution or the constitution of the United States;

(b) Modifying or amending existing laws or court decrees with respect to the determination and administration of water rights.

106-7-107. Effect of article — developments in areas of state interest and activities of state interest meeting certain conditions. (1) This article shall not apply to any development in an area of state interest or any activity of state interest which meets any one of the following conditions as of the effective date of this article:

(a) The development or activity is covered by a current building permit issued by the appropriate local government; or

(b) The development or activity has been approved by the electorate; or

(c) The development or activity is to be on land:

(I) Which has been conditionally or finally approved by the appropriate local government for planned unit development or for a use substantially the same as planned unit development; or

(II) Which has been zoned by the appropriate local government for the use contemplated by such development or activity; or

(III) With respect to which a development plan has been conditionally or finally approved by the appropriate governmental authority.

106-7-108. Effect of article — state agency or commission responses. (1) Whenever any person desiring to carry out development as defined in section 106-7-102 (1) is required to obtain a permit, to be issued by any state agency or commission for the purpose of authorizing or allowing such development, pursuant to this or any other statute or regulation promulgated thereunder, such agency shall establish a reasonable time period, which shall not exceed sixty days following receipt of such permit application, within which such agency must respond in writing to the applicant, granting or denying said permit or specifying all reasonable additional information necessary for the agency or commission to respond. If additional information is required, said agency or commission shall set a reasonable time period for response following the receipt of such information.

(2) Whenever a state agency or commission denies a permit the denial must specify:

(a) The regulations, guidelines, and criteria or standards used in evaluating the application;

(b) The reasons for denial and the regulations, guidelines, and criteria or standards the application fails to satisfy; and

(c) The action that the applicant would have to take to satisfy the state agency's or commission's permit requirements.

(3) Whenever an application for a permit as provided under this section contains a statement describing the proposed nature, uses, and activities in

conceptual terms for the development intended to be accomplished and is not accompanied with all additional information, including, without limitation, engineering studies, detailed plans and specifications, zoning approval, or where a hearing is required by the statutes, regulations, rules, ordinances, or resolutions thereof prior to the issuance of the requested permit, the agency or commission shall, within the time provided in this section for response, indicate its acceptance or denial of the permit on the basis of the concept expressed in the statement of the proposed uses and activities contained in the application. Such conceptual approval shall be made subject to the applicant filing and completing all prerequisite detailed additional information in accordance with the usual filing requirements of the agency or commission within a reasonable period of time.

(4) All agencies or commissions authorized or required to issue permits for development shall adopt rules and regulations, or amend existing rules and regulations, so as to require that such agency or commission respond in the time and manner required in this section.

(5) Nothing in this section shall shorten the time allowed for responses provided by federal statute dealing with, or having a bearing on, the subject of any such application for permit.

(6) The provisions of this section shall not apply to applications approved, denied, or processed by a unit of local government.

PART 2

AREAS AND ACTIVITIES DESCRIBED

CRITERIA FOR ADMINISTRATION

106-7-201. Areas of state interest — as determined by local governments. (1) Subject to the procedures set forth in part 4 of this article, a local government may designate certain areas of state interest from among the following:

(a) Mineral resource areas;

(b) Natural hazard areas;

(c) Areas containing, or having a significant impact upon, historical, natural, or archaeological resources of statewide importance; and

(d) Areas around key facilities in which development may have a material effect upon the facility or the surrounding community.

106-7-202. Criteria for administration of areas of state interest. (1) (a) Mineral resource areas designated as areas of state interest shall be protected and administered in such a manner as to permit the extraction and exploration of minerals therefrom, unless extraction and exploration would cause significant danger to public health and safety. If the local government having jurisdiction, after weighing sufficient technical or other evidence, finds that the economic value of the minerals present therein is less than the value of another existing or requested use, such other use should be given preference; however, other uses which would not interfere with the extraction and exploration of minerals may be permitted in such areas of state interest.

(b) Areas containing only sand, gravel, quarry aggregate, or limestone used for construction purposes shall be administered as provided by article 6 of chapter 92, C.R.S. 1963.

accomplished in a manner which causes the least practicable environmental disturbance, and surface areas disturbed thereby shall be reclaimed in accordance with the provisions of article 13 or article 32 of chapter 92, C.R.S. 1963, whichever is applicable.

(d) Unless an activity of state interest has been designated or identified or unless it includes part or all of another area of state interest, an area of oil and gas or geothermal resource development shall not be designated as an area of state interest unless the state oil and gas conservation commission identifies such area for designation.

(2) (a) Natural hazard areas shall be administered as follows:

(I) Floodplains shall be administered so as to minimize significant hazards to public health and safety or to property. The Colorado water conservation board shall promulgate a model floodplain regulation no later than September 30, 1974. Open space activities such as agriculture, recreation, and mineral extraction shall be encouraged in the floodplains. Any combination of these activities shall be conducted in a mutually compatible manner. Building of structures in the floodplain shall be designed in terms of the availability of flood protection devices, proposed intensity of use, effects on the acceleration of floodwaters, potential significant hazards to public health and safety or to property, and other impact of such development on downstream communities such as the creation of obstructions during floods. Activities shall be discouraged which, in time of flooding, would create significant hazards to public health and safety or to property. Shallow wells, solid waste disposal sites, and septic tanks and sewage disposal systems shall be protected from inundation by floodwaters. Unless an activity of state interest is to be conducted therein, an area of corrosive soil, expansive soil and rock, or siltation shall not be designated as an area of state interest unless the Colorado soil conservation board, through the local soil conservation district, identifies such area for designation.

(II) Wildfire hazard areas in which residential activity is to take place shall be administered so as to minimize significant hazards to public health and safety or to property. The Colorado state forest service shall promulgate a model wildfire hazard area control regulation no later than September 30, 1974. If development is to take place, roads shall be adequate for service by fire trucks and other safety equipment. Firebreaks and other means of reducing conditions conducive to fire shall be required for wildfire hazard areas in which development is authorized.

(III) In geologic hazard areas all developments shall be engineered and administered in a manner that will minimize significant hazards to public health and safety or to property due to a geologic hazard. The Colorado geological survey shall promulgate a model geologic hazard area control regulation no later than September 30, 1974.

(b) After promulgation of guidelines for land use in natural hazard areas by the Colorado water conservation board, the Colorado soil conservation board through the soil conservation districts, the Colorado state forest service, and the Colorado geological survey, natural hazard areas shall be administered by local government in a manner which is consistent with the guidelines for land use in each of the natural hazard areas.

(3) Areas containing, or having a significant impact upon, historical, natural, or archaeological resources of statewide importance, as determined by the state historical society, the department of natural resources, and the appropriate local government, shall be administered by the appropriate state agency in conjunction with the appropriate local government in a manner that will allow man to function in harmony with, rather than be destructive to, these resources. Consideration is to be given to the protection of those areas essential for wildlife habitat. Development in areas containing historical, archaeological, or natural resource shall be conducted in a manner which will minimize damage to those resources for future use.

(4) The following criteria shall be applicable to areas around key facilities:

(a) If the operation of a key facility may cause a danger to public health and safety or to property, as determined by local government, the area around the key facility shall be designated and administered so as to minimize such danger; and

(b) Areas around key facilities shall be developed in a manner that will discourage traffic congestion, incompatible uses, and expansion of the demand for government services beyond the reasonable capacity of the community or region to provide such services as determined by local government. Compatibility with nonmotorized traffic shall be encouraged. A development that imposes burdens or deprivation on the communities of a region cannot be justified on the basis of local benefit alone.

(5) In addition to the criteria described in subsection (4) of this section, the following criteria shall be applicable to areas around particular key facilities:

(a) Areas around airports shall be administered so as to:

(I) Encourage land use patterns for housing and other local government needs that will separate uncontrollable noise sources from residential and other noise-sensitive areas; and

(II) Avoid danger to public safety and health or to property due to aircraft crashes.

(b) Areas around major facilities of a public utility shall be administered so as to:

(I) Minimize disruption of the service provided by the public utility; and

(II) Preserve desirable existing community patterns.

(c) Areas around interchanges involving arterial highways shall be administered so as to:

(I) Encourage the smooth flow of motorized and nonmotorized traffic;

(II) Foster the development of such areas in a manner calculated to preserve the smooth flow of such traffic; and

(III) Preserve desirable existing community patterns.

(d) Areas around rapid or mass transit terminals, stations, or guideways shall be developed in conformance with the applicable municipal master plan adopted pursuant to section 139-59-6, C.R.S. 1963, or any applicable master

plan adopted pursuant to section 106-2-7. If no such master plan has been adopted, such areas shall be developed in a manner designed to minimize congestion in the streets; to secure safety from fire, flood waters, and other dangers; to promote health and general welfare; to provide adequate light and air; to prevent the overcrowding of land; to avoid undue concentration of population; to facilitate the adequate provision of transportation, water, sewerage, schools, parks, and other public requirements. Such development in such areas shall be made with reasonable consideration, among other things, as to the character of the area and its peculiar suitability for particular uses, and with a view to conserving the value of buildings and encouraging the most appropriate use of land throughout the jurisdiction of the applicable local government.

106-7-203. Activities of state interest as determined by local governments. (1) Subject to the procedures set forth in part 4 of this article, a local government may designate certain activities of state interest from among the following:

(a) Site selection and construction of major new domestic water and sewage treatment systems and major extension of existing domestic water and sewage treatment systems;

(b) Site selection and development of solid waste disposal sites;

(c) Site selection of airports;

(d) Site selection of rapid or mass transit terminals, stations, and fixed guideways;

(e) Site selection of arterial highways and interchanges and collector highways;

(f) Site selection and construction of major facilities of a public utility;

(g) Site selection and development of new communities;

(h) Efficient utilization of municipal and industrial water projects; and

(i) Conduct of nuclear detonations.

106-7-204. Criteria for administration of activities of state interest. (1) (a) New domestic water and sewage treatment systems shall be constructed in areas which will result in the proper utilization of existing treatment plants and the orderly development of domestic water and sewage treatment systems of adjacent communities.

(b) Major extensions of domestic water and sewage treatment systems shall be permitted in those areas in which the anticipated growth and development that may occur as a result of such extension can be accommodated within the financial and environmental capacity of the area to sustain such growth and development.

(2) Major solid waste disposal sites shall be developed in accordance with sound conservation practices and shall emphasize, where feasible, the recycling of waste materials. Consideration shall be given to longevity and subsequent use of waste disposal sites, soil and wind conditions, the potential problems of pollution inherent in the proposed site, and the impact on adjacent property owners, compared with alternate locations.

(3) Airports shall be located or expanded in a manner which will minimize disruption to the environment of existing communities, will minimize the impact on existing community services, and will complement the economic and transportation needs of the state and the area.

(4) (a) Rapid or mass transit terminals, stations, or guideways shall be located in conformance with the applicable municipal master plan adopted pursuant to section 139-59-6, C.R.S. 1963, or any applicable master plan adopted pursuant to section 106-2-7. If no such master plan has been adopted, such areas shall be developed in a manner designed to minimize congestion in the streets; to secure safety from fire, flood waters, and other dangers; to promote health and general welfare; to provide adequate light and air; to prevent the overcrowding of land; to avoid undue concentration of population; to facilitate the adequate provision of transportation, water, sewerage, schools, parks, and other public requirements. Activities shall be conducted with reasonable consideration, among other things, as to the character of the area and its peculiar suitability for particular uses, and with a view to conserving the value of buildings and encouraging the most appropriate use of land throughout the jurisdiction of the applicable local government.

(b) Proposed locations of rapid or mass transit terminals, stations, and fixed guideways which will not require the demolition of residences or businesses shall be given preferred consideration over competing alternatives.

(c) A proposed location of rapid or mass transit terminal, station, or fixed guideway that imposes a burden or deprivation on a local government cannot be justified on the basis of local benefit alone, nor shall a permit for such a location be denied solely because the location places a burden or deprivation on one local government.

(5) Arterial highways and interchanges and collector highways shall be located so that:

(a) Community traffic needs are met;

(b) Desirable community patterns are not disrupted; and

(c) Direct conflicts with adopted local government, regional, and state master plans are avoided.

(6) Where feasible, major facilities of public utilities shall be located so as to avoid direct conflict with adopted local government, regional, and state master plans.

(7) When applicable, or as may otherwise be provided by law, a new community design shall, at a minimum, provide for transportation, waste disposal, schools, and other governmental services in a manner that will not overload facilities of existing communities of the region. Priority shall be given to the development of total communities which provide for commercial and industrial activity, as well as residences, and for internal transportation and circulation patterns.

(8) Municipal and industrial water projects shall emphasize the most efficient use of water, including, to the extent permissible under existing law, the recycling and reuse of water. Urban development, population densities, and site layout and design of storm water and sanitation systems shall be accomplished in a manner that will prevent the pollution of aquifer recharge areas.

(9) Nuclear detonations shall be conducted so as to present no material danger to public health and safety. Any danger to property shall not be disproportionate to the benefits to be derived from a detonation.

PART 3

LEVELS OF GOVERNMENT INVOLVED AND THEIR FUNCTIONS

106-7-301. Functions of local government. (1) Pursuant to this article, it is the function of local government to:

(a) Designate matters of state interest after public hearing, taking into consideration:

(I) The intensity of current and foreseeable development pressures; and

(II) Applicable guidelines for designation issued by the applicable state agencies;

(b) Hold hearings on applications for permits for development in areas of state interest and for activities of state interest;

(c) Grant or deny applications for permits for development in areas of state interest and for activities of state interest;

(d) Receive recommendations from state agencies and other local governments relating to matters of state interest;

(e) Send recommendations to other local governments and the Colorado land use commission relating to matters of state interest; and

(f) Act, upon request of the Colorado land use commission, with regard to specific matters of state interest.

106-7-302. Functions of other state agencies. (1) Pursuant to this article, it is the function of other state agencies to:

(a) Send recommendations to local governments and the Colorado land use commission relating to designation of matters of state interest on the basis of current and developing information; and

(b) Provide technical assistance to local governments concerning designation of and guidelines for matters of state interest.

(2) Primary responsibility for the recommendation and provision of technical assistance functions described in subsection (1) of this section is upon:

(a) The Colorado water conservation board, acting in cooperation with the Colorado soil conservation board, with regard to floodplains;

(b) The Colorado state forest service, with regard to wildfire hazard areas;

(c) The Colorado geological survey, with regard to geologic hazard areas, geologic reports, and the identification of mineral resource areas;

(d) The Colorado division of mines, with regard to mineral extraction and the reclamation of land disturbed thereby;

(e) The Colorado soil conservation board and soil conservation districts, with regard to resource data inventories, soils, soil suitability, erosion and sedimentation, floodwater problems, and watershed protection; and

(f) The division of wildlife of the department of natural resources, with regard to significant wildlife habitats.

(3) Pursuant to section 106-7-202 (1) (d), the oil and gas conservation commission of the state of Colorado may identify an area of oil and gas development for designation by local government as an area of state interest.

PART 4

DESIGNATION OF MATTERS OF STATE INTEREST — GUIDELINES FOR ADMINISTRATION

106-7-401. Designation of matters of state interest. (1) After public hearing, a local government may designate matters of state interest within its jurisdiction, taking into consideration:

(a) The intensity of current and foreseeable development pressures; and

(b) Applicable guidelines for designation issued by the Colorado land use commission after recommendation from other state agencies, if appropriate. In adopting such guidelines, the Colorado land use commission shall be guided by the standards set forth in this article applicable to local governments.

(2) A designation shall:

(a) Specify the boundaries of the proposed area; and

(b) State reasons why the particular area or activity is of state interest, the dangers that would result from uncontrolled development of any such area or uncontrolled conduct of such activity, and the advantages of development of such area or conduct of such activity in a coordinated manner.

106-7-402. Guidelines — regulations. (1) The local government shall develop guidelines for administration of the designated matters of state interest. The content of such guidelines shall be such as to facilitate administration of matters of state interest consistent with sections 106-7-202 and 106-7-204.

(2) A local government may adopt regulations interpreting and applying its adopted guidelines in relation to specific developments in areas of state interest and to specific activities of state interest.

(3) No provision in this article shall be construed as prohibiting a local government from adopting guidelines or regulations containing requirements which are more stringent than the requirements of the criteria listed in sections 106-7-202 and 106-7-204.

106-7-403. Technical and financial assistance. (1) Appropriate state agencies shall provide technical assistance to local governments in order to assist local governments in designating matters of state interest and adopting guidelines for the administration thereof.

(2) (a) The department of local affairs shall oversee and coordinate the provision of technical assistance and provide financial assistance as may be authorized by law.

(b) The department of local affairs shall determine whether technical or

financial assistance or both are to be given to a local government on the basis of the local government's:

(I) Showing that current or reasonably foreseeable development pressures exist within the local government's jurisdiction; and

(II) Plan describing the proposed use of technical assistance and expenditure of financial assistance.

106-7-404. Public hearing — designation of an area or activity of state interest and adoption of guidelines by order of local government. (1) The local government shall hold a public hearing before designating an area or activity of state interest and adopting guidelines for administration thereof.

(2) (a) Notice, stating the time and place of the hearing and the place at which materials relating to the matter to be designated and guidelines may be examined, shall be published once at least thirty and not more than sixty days before the public hearing in a newspaper of general circulation in the county. The local government shall send written notice to the Colorado land use commission of a public hearing to be held for the purpose of designation and adoption of guidelines at least thirty days and not more than sixty days before such hearing.

(b) Any person may request, in writing, that his name and address be placed on a mailing list to receive notice of all hearings held pursuant to this section. If the local government decides to maintain such a mailing list, it shall mail notices to each person paying an annual fee reasonably related to the cost of production, handling, and mailing such notice. In order to have his name and address retained on said mailing list, the person shall resubmit his name and address and pay such fee before January 31 of each year.

(3) Within thirty days after completion of the public hearing, the local government, by order, may adopt, adopt with modification, or reject the particular designation and guidelines; but the local government, in any case, shall have the duty to designate any matter which has been finally determined to be a matter of state interest and adopt guidelines for the administration thereof.

(4) After a matter of state interest is designated pursuant to this section, no person shall engage in development in such area and no such activity shall be conducted until the designation and guidelines for such area or activity are finally determined pursuant to this article.

(5) Upon adoption by order, all relevant materials relating to the designation and guidelines shall be forwarded to the Colorado land use commission for review.

106-7-405. Report of local government's progress. (1) Not later than one hundred eighty days after the effective date of this article, each local government shall report to the Colorado land use commission, on a form to be furnished by the Colorado land use commission, the progress made toward designation and adoption of guidelines for administration of matters of state interest.

(2) Upon the basis of the information contained in such reports and any information received pursuant to any other relevant provision of this article, the Colorado land use commission may take appropriate action pursuant to section 106-4-3 (2) (a).

106-7-406. Colorado land use commission review of local government order containing designation and guidelines. (1) Not later than thirty days after receipt of a local government order designating a matter of state interest and adopting guidelines for the administration thereof, the Colorado land use commission shall review the contents of such order on the basis of the relevant provisions of part 2 of this article and shall accept the designation and guidelines or recommend modification thereof.

(2) If the Colorado land use commission decides that modification of the designation or guidelines is required, the Colorado land use commission shall, within said thirty-day period, submit to the local government written notification of its recommendations and shall specify in writing the modifications which the Colorado land use commission deems necessary for compliance with the relevant provisions of part 2 of this article.

(3) Not later than thirty days after receipt of the modifications recommended by the Colorado land use commission, a local government shall:

(a) Modify the original order in a manner consistent with the recommendations of the Colorado land use commission and resubmit the order to the Colorado land use commission; or

(b) Notify the Colorado land use commission that the Colorado land use commission's recommendations are rejected.

106-7-407. Colorado land use commission may initiate identification, designation, and promulgation of guidelines for matters of state interest. (1) (a) The Colorado land use commission may submit a formal request to a local government to take action with regard to a specific matter which said commission considers to be of state interest within the local government's jurisdiction. Such request shall identify the specific matter and shall set forth the information required in section 106-7-401 (2) (a) and (2) (b). Not later than thirty days after receipt of such request, the local government shall publish notice and hold a hearing within sixty days pursuant to the provisions of section 106-7-404, and issue its order thereunder.

(b) After receipt by a local government of a request from the Colorado land use commission pursuant to paragraph (a) of this subsection (1), no person shall engage in development in the area or conduct the activity specifically described in said request until the local government has held its hearing and issued its order relating thereto.

(c) If the local government's order fails to designate such matter and adopt guidelines therefor, or, after designation, fails to adopt guidelines therefor pursuant to standards set forth in this article applicable to local governments, the Colorado land use commission may seek judicial review of such order or guidelines by a trial de novo in the district court for the judicial district in which the local government is located. During the pendency of such court proceedings, no person shall engage in development in the area or conduct the activity specifically described in said request except on such terms and conditions as authorized by the court.

PART 5
PERMITS FOR DEVELOPMENT IN AREAS OF STATE INTEREST AND FOR CONDUCT OF ACTIVITIES OF STATE INTEREST

106-7-501. Permit for development in area of state interest or for conduct of an activity of state interest required. (1) (a) Any person desiring to engage in development in an area of state interest or to conduct an activity of state interest shall file an application for a permit with the local government in which such development or activity is to take place. The application shall be filed on a form prescribed by the Colorado land use commission. A reasonable fee determined by the local government sufficient to cover the cost of processing the application, including the cost of holding the necessary hearings, shall be paid at the time of filing such application.

(b) The requirement of paragraph (a) of this subsection (1) that a public utility obtain a permit shall not be deemed to waive the requirements of article 5 of chapter 115, C.R.S. 1963, that a public utility obtain a certificate of public convenience and necessity.

(2) (a) Not later than thirty days after receipt of an application for a permit, the local government shall publish notice of a hearing on said application. Such notice shall be published once in a newspaper of general circulation in the county, not less than thirty nor more than sixty days before the date set for hearing, and shall be given to the Colorado land use commission. The Colorado land use commission may give notice to such other persons as it determines not later than fourteen days before such hearing.

(b) If a person proposes to engage in development in an area of state interest or for conduct of an activity of state interest not previously designated and for which guidelines have not been adopted, the local government may hold one hearing for determination of designation and guidelines and granting or denying the permit.

(c) The local government may maintain a mailing list and send notice of hearings relating to permits in a manner similar to that described in section 106-7-404 (2) (b).

(3) The local government may approve an application for a permit to engage in development in an area of state interest if the proposed development complies with the local government's guidelines and regulations governing such area. If the proposed development does not comply with the guidelines and regulations, the permit shall be denied.

(4) The local government may approve an application for a permit for conduct of an activity of state interest if the proposed activity complies with the local government's regulations and guidelines for conduct of such activity. If the proposed activity does not comply with the guidelines and regulations, the permit shall be denied.

(5) The local government conducting a hearing pursuant to this section shall:

(a) State, in writing, reasons for its decision, and its findings and conclusions; and

(b) Preserve a record of such proceedings.

(6) After the effective date of this article, any person desiring to engage a development in a designated area of state interest or to conduct a designated activity of state interest who does not obtain a permit pursuant to this ction may be enjoined by the Colorado land use commission or the appro-iate local government from engaging in such development or conducting ch activity.

106-7-502. Judicial review. The denial of a permit by a local government ency shall be subject to judicial review in the district court for the judicial strict in which the major development or activity is to occur.

Section 2. Article 3 of chapter 106, Colorado Revised Statutes 1963, as nended, is amended BY THE ADDITION OF A NEW SECTION to read:

106-3-9. Statewide program for identification of matters of state interest as art of local land use planning. (1) The department of local affairs shall onduct a statewide program encouraging counties and municipalities to pre-ore, as a part of the comprehensive plan provided for in section 106-2-5 nd article 59 of chapter 139, C.R.S. 1963, a complete and detailed identifi-ation and designation of all matters of state interest within each county by une 30, 1976. The general assembly shall appropriate funds for this purpose o the department of local affairs for distribution to participating counties. ach county desiring to participate in the identification and desi nation of natters of state interest program established by this section shall be allocated n equal amount by the department of local affairs from the funds so appro-riated, to be expended by each county separately or through an organized roup of counties or counties and municipalities. The department of local ffairs, in cooperation with applicable state agencies, shall establish reason-able standards relative to the scope, detail, and accuracy of the program and shall insure that all information is comparable for each county. Each county shall, after consultation with the municipality, prepare such identification and designation for territory located within these municipalities which request such preparation and in any municipality which fails to undertake an identifi-cation and designation program. Each county shall, upon request of the municipality, assist the municipality in its identification and designation pro-gram.

(2) The general assembly shall appropriate to the department of local affairs funds to assist counties and municipalities participating in the identifi-cation and designation of matters of state interes rogram, where additional assistance is deemed by the department of local affairs to be necessary. The department of local affairs shall also allocate such funds upon request of any county participating in the identification and designation of matters of state interest program under subsection (1) of this section for implementation of supplemental planning in that county, or to any municipality, based upon priorities established by the department of local affairs and on the need and capabilities of each county and municipality.

Section 3. 106-4-3 (2) (a), Colorado Revised Statutes 1963 (1971 Supp.), is amended to read:

106-4-3. Duties of the commission — temporary emergency power. (2) (a) Whenever in the normal course of its duties as set forth in this article the commission determines that there is in progress or proposed a land development activity which constitutes a danger of irreparable injury, loss, or damage of serious and major proportions to the public health, welfare, or safety, the

commission shall immediately give written notice to the board of county commissioners of each county involved of the pertinent facts and dangers with respect to such activity. If the said board of county commissioners does not remedy the situation within a reasonable time, the commission may request the governor to review such facts and dangers with respect to such activity. If the governor grants such request, such review shall be conducted by the governor at a meeting with the commission and the boards of county commissioners of the counties involved. If, after such review, the governor shall determine that such activity does constitute such a danger, the governor may direct the commission to issue its written cease and desist order to the person in control of such activity. Such order shall require that such person immediately discontinue such activity. If such activity, notwithstanding such order, is continued, the commission may apply to any district court of this state in which such activity is located for a temporary restraining order, preliminary injunction, or permanent injunction, as provided for in the Colorado rules of civil procedure. Any such action shall be given precedence over all other matters pending in such district court. The institution of such action shall confer upon said district court exclusive jurisdiction to determine finally the subject matter thereof.

Section 4. Article 4 of chapter 106, Colorado Revised Statutes 1963, as amended, is amended BY THE ADDITION OF A NEW SECTION to read:

106-4-5. Commission staff to assist counties and municipalities. The commission, within available appropriations, shall assign full-time professional staff members to assist counties and municipalities in the program established under article 7 of this chapter and to monitor progress in the same. No later than February 1, 1975, the commission shall issue its report to the general assembly as to progress being made in such program and shall include in its report those items required by section 106-4-4 (4) (b) and (4) (c).

Section 5. Appropriation. (1) There is hereby appropriated to the department of local affairs, out of any moneys in the state treasury not otherwise appropriated, the sum of two million seventy-five thousand dollars ($2,075,000), or so much thereof as may be necessary, to implement the provisions of section 106-3-9, C.R.S. 1963, which moneys shall become available upon passage of this act and remain available until June 30, 1975, to be allocated as follows: Identification and designation of matters of state interest program — one million five hundred seventy-five thousand dollars ($1,575,000); supplemental planning — five hundred thousand dollars ($500,000).

(2) There is hereby appropriated out of any moneys in the state treasury not otherwise appropriated, to the Colorado land use commission, for the fiscal year beginning July 1, 1974, the sum of three hundred thousand dollars ($300,000), or so much thereof as may be necessary, to provide assistance to counties and municipalities pursuant to section 106-4-5, C.R.S. 1963 (10.0 FTE, five of which shall be full-time professional staff pursuant to said section 106-4-5).

Section 6. Safety clause. The general assembly hereby finds, determines, and declares that this act is necessary for the immediate preservation of the public peace, health, and safety.

Approved: May 17, 1974

STATE OF ALASKA
THE LEGISLATURE

POUCH Y - STATE CAPITOL
JUNEAU, ALASKA 99811
907 465-3800

LEGISLATIVE AFFAIRS AGENCY

M E M O R A N D U M July 25, 1979

SUBJECT: Appropriation to Department of Public Safety for state participation in the Alaska Avalanche Warning System (Work Order 7292)

TO: Representative Mike Miller

FROM: John B. Chenoweth
Legislative Counsel

After speaking with Bob Janes, I am suggesting that the appropriation requested be increased to $135,000, combining the requests for FY 80 and 81. Assuming the bills pass during the 1980 legislative session, the first $53,000 would be available immediately to meet the state share of costs of implementation in the 1979 - 1980 season, as the program funding estimate indicates, with the remaining $82,000 available for payment as the state's share during the 1980 - 81 season. In subsequent years, this would have the effect of providing a state appropriation the amount of which is known by participants in the program in advance of the winter avalanche season. If, by legislative or executive action, the full amount of the state's share were not provided, other federal or local government participants might be able to compensate.

The fiscal note on this would appear:

FY 80	$ 53,000	135,000
FY 81	82,000	
FY 82 (based on figures provided)		112,000
FY 83 (based on figures provided)		112,000

If this approach does not comply with your wishes, please advise me.

JBC:sl

THE FOLLOWING PAGES WERE TREATED AS
A UNIT IN THE ORIGINAL FILE.

A PROPOSAL

FOR AN

ALASKA AVALANCHE WARNING SYSTEM

PREPARED BY

USDA - FOREST SERVICE, DIVISION OF STATE AND

PRIVATE FORESTRY

5-10-79

Alaska Avalanche Warning System

1. Situation: The combination of the permanent ice and snow fields in the mountain terrains of Alaska with the associated heavy snow fall during the winter creates a potential avalanche danger on a year around basis. Because of these conditions, during the period 1970-78, Alaska has had more fatalities due to snow avalanches than any of the other eleven Western States of the United States. Out of 109 deaths, 29 has occurred in Alaska, or 27% of the total. Colorado is second with 24 fatalities and Washington third with 21. The number of persons caught in a snow avalanche in Alaska and survived are unknown. A good estimate would be over 100 victims since 1970.

   In reviewing Art Judson's (Snow Management Specialist from the USDA - Forest Service Mountain Snow and Avalanche Research Center in Fort Collins, Colorado) report on the Alaska Avalanche situation, there are 500+ structure directly exposed to avalanches with the City of Juneau posing the greatest potential for catastrophic avalanching in North America. In addition there are approximately 180 identified avalanche paths crossing public highways and railroads that compose a constant hidden danger to the limited land transportation corridors in the state. The public is forced to use these avalanche prime routes since there are no alternative safe roads to use.

   The report also points out there are thousands of avalanche paths, both in developed and non developed recreation areas, with significant potential for avalanche fatalities to skiers, snowmobilers, mountain climbers and hikers on a year round basis.

   With a young outdoor minded population in the State, a prolonged winter condition, and the nucleus of the population living within minutes of the mountains, they are constantly using the snow covered mountain terrain for recreation activities with little or no knowledge of how the unseen changing snow pack structure and what can cause an avalanche could turn a pleasant outdoor outing into a catastrophic phenomenon within seconds.

Alaskans with a desire of rural type of living along with a desire to obtain a vast view of the country side are pushing higher into the apline reaches of the mountains seeking a place of residency. A high number of these persons are not aware or concerned of the lurking snow avalanche danger that may exist high above them when selecting and constructing their home. Their interest lies mainly in the unobstructive view they are seeking. This creates not only an avalanche hazard situation to the owners but a demand for public access thus creating more risk exposure in high ~~prime~~ avalanche country to ~~risk~~ the public and work maintenance crews.

2. Need: Three geogrpahic areas have been identified in Alaska that have a high snow avalanche danger associated with a high concentration of outdoor users. They are the Chugach-Kenai-Talkeetna Mountains, Mt. McKinley and the Coastal Range of Southeastern Alaska in the vicinity of Juneau and Sitka. A fourth potential area has been identified in the Haines-Skagway area. There are numerous smaller isolated areas where human activity is relative small.

In the Chugach-Kenai-Talkeetna Mountains the outdoor visits are increasing tremendously between population growth and more people seeking the outdoor experience with no awareness of the snow hazard situation involved in mountainous terrain. Housing is expanding into the avalanche zones of Eagle River Drainage, Indian Creek and Rainbow Creek and in other areas of the State which is lacking both municipalities and Statewide avalanche zoning regulations.

In the Juneau area, Behrends Ave. and the immediate vicinity poses the greatest risk in North America for a catastrophic avalanche to happen. Thirty-three homes, a motel, a high school auditorium and 453 boats located in the harbor along with the numerous cars passing by the area are exposed to a 3,000 foot vertical avalanche path that has a record of causing severe damage to the home in the area. This condition also exist in several other areas around Juneau which effects five other homes and several electrical transmission lines and towers.

More people are seeking the winter outdoor experience in Juneau with the opening of Eaglecrest Ski Area in 1975, thus increasing the avalanche risk exposure and the need for a more intense avalanche awareness program.

Whereas on Mt. McKinley, the mountain climbers are knowledgeable on avalanche phenonemon and are aware of the extreme avalanche danger and adverse weather elements found on the mountain. What their lacking is advance notice on predicted weather changes that could change the climb from a pleasant expedition to a ~~holocaast~~ disaster within hours. The proposed establishment of a summer-winter visitor center in the Petersville area on the south side of McKinley National Monument will open up a ·ole new area of avalanche exposure to the public.

The Haines-Skagway area which includes Klondike Gold Rush Historical Park extends into Canada which encompasses both the Providence of British Columbia and Yukon Territory. The Park, because of its historical volume, has and will attract more people to hike over the historical trails during the winter time which are noted for their avalanche hazards. In order to fully provide an avalanche warning service to this area, weather stations will have to be installed in Canada which would involve obtaining an international agreement with the Canadians. Once the AAWS becomes operational, negotations with the Canadian Government will be made to otain their cooperation on the project.

With the few vital avalanche prone transportation corridors in Alaska, there exist a potential for all unaware travelers being caught in a snow slide along with maintenance crews clearing the blockage. The unsuspected closure of the road by the slides can also cause short term economical losses to both the public and business in addition to the high cost of opening up the roads to traffic. Travelers and maintenance crews should be aware of the existing hazards in advance in order to plan accordingly to cope with the situation.

The high avalanche problems in Alaska points to a need in developing a reliable and systematic state wide avalanche warning system along with a well organized public awareness and educational program.

3. Proposal: That an interagency Alaska Avalanche Warning System (AAWS) be established on a state wide basis for the purpose of:

   a. Forecasting snow avalanche conditions through out the State with main emphasis in Southcentral and Southeastern Alaska.

   b. Coordinate a public awareness program on avalanche.

c. Coordinate an annual Alaska Avalanche School.

d. Identify and catalog a comprehensive atlas of avalanche paths and slide occurrences.

e. Assist state and local governments in developing snow avalanche zoning regulations and identificaton of avalanche zones.

f. Providing a historical depository for avalanche snow data collected in Alaska.

With the main thrust of the AAWS being ~~similar~~ winter orinated, the slack summer months can be devoted to providing:

a. Statewide fire weather forecasting

b. Special mountain weather forecasting for Mt. McKinley

c. Flood forecasting in areas covered by the orographic percipitation model

4. Organization: The USDA-Forest Service, the most noted historical government agency in snow management research and applied science is the most logical choice as being the lead agency in operating the AAWS. The AAWS would be under the direction of the ~~FS~~ Division of State and Private Forestry who has the responsibility of providing forestry and related technical assistance to State and private land owners.

The AAWS organization structure comprises of three component parts - The Alaska Avalanche Warning System Center, (AAWSC) Primary field stations and supplemental field stations. Their structures and functions are:

AAWSC: The center will be located in Anchorage and housed in the National Weather Service Forecasting Office. It will be staffed with three Forest Service permanent professional employees - a project leader who has administrative and snow management experience, a mountain meterologist specialist who will be in charge of the forecasting and one mountain meterologist specialist assistant.

Their primary duty will be to provide a seven day service on avalanche forecasting during the period October 1 - May 15 and fire weather forecasting along with mountain weather and flood forecasting within the areas covered by the orographic precipitation model during the summer period. Secondary duties will be to assist in training and supervising the field personnel, assist in developing and carrying out an avalanche awareness program, conduct formal training sessions on mountain and fire weather meterology, catalog avalanche paths and record their activity, and provide technical assistance in developing avalanche zone regulations and zoning identification.

Primary Field Stations: Six field stations, have been identified to date which will be staffed with a temporary snow management technician between the period October 1 - May 15. The position could be a Forest Service or a cooperating agency employee who would either be detailed or assigned the primary duty of assisting the AAWSC.

The stations and where they will be housed at are:

Station	Housed at
Juneau	National Weather Service Office
Girdwood	Forest Service Office at Alyeski Ski Resort
Moose Pass	Forest Service Kenai Lake Work Center
McKinley	McKinley National Park Headquarters - McKinley
Valdez	Dept. of Transportation State Highway Office
Chugach State Park	Handled by the Park Rangers in Anchorage

The primary duties of the snow management technician are to provide on the ground weather conditions, snow pack conditions and avalanche activity to the AAWSC; carry out a public awareness program in the area; identify and catalog avalanche paths in their area of responsibility; read and record supplemental weather stations located in the immediate vicinity of their duty station.

Supplemental Field Stations: Twenty five supplemental field stations have been identified to furnish weather data to the AAWSC. Additional ones will be added as the need arises to assist in increasing the accuracy of the forecasting or expand the operation into new areas. There will be weather instrument stations located in an area where either a resident cooperator on a contractual arrangement or an employee from a cooperating agency who is assigned the task as part of his regular assignment can collect and forward the data to the AAWSC. The resident cooperator will also be requested to submit reports on any avalanche activity observed or investigated to the AAWSC.

In selected areas, remote sites will be established in high altitude locations to monitor the snow pack and weather conditions near the avalanche starting zones using the Meteor Burst System of Telemetry for recording and transmitting the data to the AAWSC.

The location of the site and type are:

Regional Area Type	Site	Type
Southcentral	Tazlina Lodge	Resident Cooperator
	Thompson Pass	Cooperating Agency
	Isabelle Pass	Cooperating Agency
	Hatcher Pass	Resident cooperator
	Granview	Cooperating agency
	Alyeska Ski Resort	" "
	Max's Mt. (Alyeska Ski Resort)	Remote site
	Arctic Valley	Resident Cooperator
	Bird Creek	Cooperating Agency
	Turnagain Pass	" "
	Summit Lake	Resident Cooperator
	Six Mile Cr.(Sunrise)	" "
	Chugach State Park	Cooperating Agency
	Cambpell Cr	
	Indian Cr.	
	Ship Cr.	
	Eagle Cr.	
	Rabbit Cr.	
	Eagle River	Remote site

McKinley	Kahiltna Glacier(7000')	Resident cooperator (Summer only)
	Mt. McKinley	Remote site
	McKinley National Park Hdq.	Cooperating agency
Southeastern	Eaglecrest Ski Area	Cooperating agency
	Salmon Cr. Reservoir	Resident cooperator
	Mt. Juneau	Remote site
	Klukwan	Resident cooperator
	White Pass	Resident cooperator
	Sitka	Cooperating agency
	Hyder	Resident cooperator
	Mt. Troy	Remote site

5. AAWS Project Cost

The following is an estimated cost of setting up and operating the AAWS on an annual basis.

a. AAWSC operating cost

1)	Staffing	
	Project leader GS-23	35,000
	Meterologist in charge CS-12	35,000
	Assist. meterologist	28,000
2)	Travel for training and supervison by staff	15,000
3)	Staff office space, office equipment, clerical, data transmission and meterologist support	18,000
4)	Commercial Communications	10,000
	Subtotal	141,000

b. AAWS field station operating cost

1)	Staffing	
	6 Snow Management Tech. GS-9 7/9 @ $12,000	72,000
2)	Project travel for field personnel	10,000
3)	Station Mtc. and Supplies	5,000
4)	Supplemental Station Cost	24,000
5)	Equipment Replacement	15,000
6)	Cooperative agreements on remote site mtc.	3,000
	Subtotal	129,000
	Overhead cost	$42,000
	Total operating cost	$ 312,000

The USDA-Forest Service, Regional Office will provide the administrative support for the AAWS.

The above operating costs are based upon the AAWS being totally financed as a seperate identity without any cooperative support. The overall package can be reduced by the cooperating agencies absorbing part of the cost by intergesting various items into their regular on-going programs such as assigning certain individuals additional duties to perform a required task. Example - a state highway empoloyee be assigned the duty of reading the supplemental weather station at Thompson Pass.

The National Weather Service has stated they will furnish the office space, office equipment, clerical staff, data transmission of the forecasting and meterological support for the AAWSC.

c. Capital Investment
The following is a breakdown of the estimated capital investment cost needed to make the AAWS fully operable

1.	Weather instruments for the supplemental field stations	25,000
2.	UHFM radio for field personnel	5,000
3.	Remote instruments and installation cost 5@ 15,000	75,000
4.	Orographic Precipitation models * for Southcentral, Mt. McKinley and Southeaster	100,000
5.	Overhead cost	28,000
	Total	$233,000

* A computor program designed for Hydrometeorological use to determine the ability to diagnose the effect of topography on winter ~~written~~ precipitation over various time periods for differing wind regimes, employing upper air data and a fine-mesh topographic grid. Attached in the appendix is a summary report on the orographic precipitation model.

6. Action Plan

Phase I - Fiscal year 1979 & 1980

FY 79
a. Install remote weather instrumentation on Max's Mt.

b. Contract orographic precipitation model for Southcentral and Southeastern.

FY 80
a. Hire one meterologist GS-11/12

b. Activate primary stations at Girdwood, Juneau and Chugach State Park.

c. Activate supplemental stations at: Thompson Pass, Isabelle Pass, Bird Cr, Turnagain Pass, 6 Mile Cr, Grandview, Tazlina Lodge, Summit Lake, Hatcher Pass, Chugach State Park, Alyeska Ski Resort, Eaglecrest Ski Area, Salmon Cr. Reservoir.

d. Project leader duties will be carried out by present USDA-FS, Division of State and Private Forestry Staff.

Phase II - Fiscal Year 1981

a. Hire project leader GS-12

b. Hire one Meterologist GS-11/12 *

c. Activate Primary Station at McKinley National Park

d. Activate supplemental Stations at Arctic Valley Ski Area, Kluckwan, White Pass, Kahiltna Glacier, McKinley National Park Hdq.

e. Contract Orographic Precipitation Model for Mt. McKinley.

f. Install remote weather instrumentation on Mt. Juneau.

Phase III Fiscal year 1982

a. Activate primary station at Moose Pass and Valdez.

b. Activate supplemental stations at Sitka and Hyder.

c. Install remote weather instrumentations on Mt. McKinley, Mt. Troy near Juneau, and one other site to be selected in Southcentral area.

Phase IV - Fiscal year 1983 and on - AAWS in full operation.

a. Activate supplemental stations as needed.

* Will be hired during third quarter of FY 80 if BLM enters into a cooperative agreement with AAWS to perform fire weather forecasting.

7. FINANCIAL PLAN:

Suggested financial plan by agencies based upon beneficial Cooperators.

AGENCY	By Fiscal Year in "M" Dollars 79	80	81	82	83
USDA - FS	50	90	115	115	100
RMF	25	-	10	-	-
SCS	9	1	2	2	2
USDC - WS	3	10	25	35	30
USDI - BLM**	-	25 **	25 **	25 **	25 **
NPS	-	-	20	25	20
USDOT -AR	-	5	6	11	10
State of Ak.	-	53	82	112	112
DNR SP (25%)	-	-	-	-	-
CS (10%)	-	-	-	-	-
FL&W (10%)	-	-	-	-	-
DOT (50%)	-	-	-	-	-
DPS (5%)	-	-	-	-	-
BOROUGHS - Juneau	-	2	6	6	6
Anchorage	-	-	-	10	7
Private - Alyeska Ski Resort	2	1	1	1	1
TOTAL	89	187	297	342	312

** For Fire Weather forecasting only. Cost estimated at $25,000 per year which is based upon the meterologist salaries for 4 months.

Appendix

1. Memorandum from John A. Sandor, Regional Forester to David E. Herrick, Director, Rocky Mountain Station dated 2-1-79.

2. Letter from J.E. DiFalco, Chief, Operations Division, National Weather Service - Anchorage to Bob Janes, Deputy Director State and Private Forestry dated 3-14-79.

3. Alaska Avalanche Report by Art Judson, Researcher, USDA-FS Mountain Snow and Avalanche Project, Fort Collins, Colorado dated 3-20-79.

4. Orographic Precipitation Model for hydrometeorology use by J. Owen Rhea, excerpts from Atmospheric Science Paper No. 287, March 1978.

5. U.S. Ski Association - Alaska Division. Resolution supporting AAWS, adopted May 12, 1979.

6. Anchorage Times newsclipping of 5-12-79 re a Mount Hunter Avalanche fatality.

National Oceanic and Atmospheric Administration
NATIONAL WEATHER SERVICE - ALASKA REGION
701 C Street, Box 23, Anchorage, AK 99513

March 14, 1979

OA/WFA11/ALC:1
(1304-55)

Mr. Robert C. Janes
Deputy Director
State and Private Forestry
U. S. Department of Agriculture
Box 1628
Juneau, Alaska 99801

Dear Mr. Janes:

We agree with the proposal that a Statewide Avalanche Warning System (SAWS) should be developed and implemented. Statistics indicate that use of State and Federal land will steadily increase.

It is logical that the Avalanche Warning Center (AWC) be colocated with WSFO Anchorage. We assume that one of the people manning the AWC would also be designated as the SAWS coordinator. This is necessary for two reasons: (1) Considerable time and talent will be needed to coordinate, implement, and maintain the system, and (2) the coordination function will enable management to justify a grade of at least GS-12 at the AWC. At any lower grade we would get very few applicants for the job, most would be young and relatively inexperienced -- not only in avalanche work but in meteorology as well, and finally they wouldn't stay around long enough to acquire the expertise needed to do a good job.

The coodinator will have to work with federal, state, municipal, and private groups. He/she should have a strong physical science background. He/she should be able to communicate well from middle management levels to recreation groups. He/she will have a supervisory function and should be knowledgeable about communications and instrumentation. It's been our experience that we can get fairly good talent and some longevity at the GS-12 level, and good to excellent talent and good longevity at the GS-13 level.

As to the financial plan, we cannot at this time provide any support other than to provide space, office equipment, and secretarial support. If there is general agreement to go ahead, and if additional resources are required, we'll have to request funds through the normal budget process, or develop a reimbursable from the Forest Service to the NWS.

Sincerly yours,

James E. DiFalco
Chief, Operations Division

cc: OA/WJ
WSFO Anchorage

REPLY TO: 3210 Cooperative Programs
2300 Recreation

FEB 1 1979

SUBJECT: Snow Avalanche Assistance

TO: David E. Herrick
Director, Rocky Mountain Station

We appreciate Dr. Pete Martinelli and Art Judson's recent assistance trip in helping to conduct the Alaska Avalanche School in Anchorage, January 12-14, 1979.

The attendance of 250 participants, and many more being turned away because of size limitations, testifies to the interest and importance of the subject in this State. The school was a good example of effective interagency cooperation, and I am pleased we could play a rather lead role.

Following the session, Pete and Art stopped by Juneau for a day and I was able to have a brief chat with them. Their number one recommendation, regarding Alaska's needs, was to develop and implement a Statewide Avalanche Warning System at the earliest possible time. I intend to followup on this with the Alaska Land Managers Cooperative Task Force, a group of Federal-State and private entities that may be able to get such a project underway.

Another of their recommendations pertained to Juneau's extreme avalanche problems. Here, there is a need to strengthen and improve the local warning system. In this respect, and because of Art Judson's previous work on Colorado's system that could be applicable, we hope to further utilize his expertise. Our goal would be to get a local system developed and operable by next winter.

Because of the interagency coordination that could be involved in the overall effort, I am asking Bob Janes, Deputy Director of our Division of State and Private Forestry, to serve as our liaison. Bob also has personal qualifications and interest that should be useful. If agreeable with you, Bob will set up and maintain direct contact with Dr. Martinelli regarding further plans.

JOHN A. SANDOR

JOHN A. SANDOR
Regional Forester

cc: Marv Meier, Dr. Martinelli
Ray Clark, Art Judson

RJ:ds

S&PF

RSW

1/30

FOREST SERVICE
ROCKY MOUNTAIN FOREST AND RANGE EXPERIMENT STATION
240 West Prospect Street
Fort Collins, Colorado 80526

March 20, 1979

Robert C. Janes
Deputy Director
State & Private Forestry, R-10
Juneau, Alaska

RE: Alaskan Avalanche Report

Dear Bob:

Alaska's widespread and varied avalanche problems are summarized in Tables 1-4. Approximately 500 structures are directly exposed to avalanches, not to mention the ones I did not see on my last two trips. The Juneau area avalanches alone, pose the greatest potential for catastrophic avalanching in North America. Strong positive action is needed to alleviate this problem in Alaska. The fatality count from 1970 to date ranks first in the nation with 29 deaths. Eighty percent of these were mountain climbers but the records are much too short to indicate any definitive trend. The number of people exposed to avalanches along highways, in permanent structures, and at recreation areas justifies a warning program now. The Forest Service should:

--1. Establish a statewide avalanche warning service.

--2. Obtain orographic precipitation models for two sections of Alaska.

--3. Publish a comprehensive atlas of avalanches along Alaskan highways, recreation areas, and railroads.

--4. Continue annual avalanche schools.

--5. Institute public awareness programs.

--6. Initiate a vigorous research program to provide instrumentation needed for effective operation of the warning network.

--7. Start zoning avalanche areas on a contractual basis.

Development in the Eagle River drainages is rapidly increasing avalanche encounter probabilities there. Avalanche zoning is needed at that site now. This requires highly specialized personnel. The RM Station has the necessary contacts for such work, and we

would be pleased to recommend qualified personnel for this work.

The Division of State and Private Forestry is best suited to coordinate the entire avalanche program in Alaska, because of the numerous interactions with Federal, state and private landowners affected. We support your efforts, and will be glad to help in any way possible.

Central warning systems have proven effective in Colorado, Washington, and Oregon. The mechanics of running such systems have been solved over the past 10 years by the Forest Service with good results. Existing programs in Colorado and Washington have wide public acceptance, and afford unusual opportunities for Federal, state and local governments to give the general public immediate returns for their tax dollars. The primary thrust is to save lives. Because these programs have been successful, I strongly recommend immediate action. It takes years to establish a complete program, but you will find it a gratifying and worthwhile venture.

Precedence

Authorization for an avalanche warning program is covered in the March 4, 1974 Memorandum of Understanding signed by the Chief of the Forest Service and the Director of the National Weather Service (NWS), enclosed. Specific application is authorized by local memorandums of understanding between the Forest Service (FS) and Weather Service Forecast Offices (WSFO's). The memorandum for Colorado is enclosed. Operations are detailed in the NWS Operations Manual Letter 1-75, also enclosed.

Some minor changes for your proposal of 1/25/79

Primary Station No. 4, Chugach State Park, could be more stratigically located at Moose Pass. Proposed additional supplemental stations include: Chugach State Park sites to be selected, DOT maintenance stations at Thompson Pass and Isabelle Pass, Grandview (railroad stop), Tsaina Lodge near Thompson Pass, Klukwan, Sitka, White Pass, Hyder and Salmon Creek Reservoir. Other supplemental stations are needed,but these can be gradually brought on stream when the warning system becomes operational. Both Meteor Burst Telemetry Systems - NWS and SCS should be incorporated in the data acquisition scheme. A standard "Westwide" wind system could be located at Arctic Valley, preferably at the Army Radar Site. Thorough and complete records on weather, snow, and avalanches will be essential. Alaskan avalanche records are nearly non-existent at the moment. This was the weak point of the early studies conducted by the Bureau of Public Roads near Girdwood in the 1950's. I have studied their data in detail and am sorry to say that the avalanche data are sadly lacking in documentation.

Research needs

The number one research priority relative to the warning system is to develop a heated, non-moving part anemometer. I am working with the Chief of NOAA's Laboratory Support Branch on this problem. A prototype model has been developed, but needs additional work, and a full winter of testing at a manned severe weather site--possibly Mt. Washington, N.H. Our project has already committed $10,000 toward this program and more will be needed. With luck we may have a working unit available for use in R-10 by 1981. Standard systems and heavy reliance on upper air data will be necessary for the present.

FM - CW Unit

We are working with the National Bureau of Standards Electromagnetics Division to develop a snow and water equivalent monitor which has great potential for measuring snow accumulation rates, loading rates, and avalanche occurrence in remote starting zones. The system uses frequency modulated continuous waves which penetrate the snow cover from an emitter buried in the ground. Present results show a one on one correlation with snow depth and water equivalent for snowpacks in the central Colorado mountains. Further testing is underway in deep snowpacks on the west coast. If we are lucky, the system will provide a major breakthrough in avalanche forecasting and warnings. I can foresee employment of several of these units in the starting zone areas of Behrends Avenue avalanche and at other critical locations.

Other Research

The Station's Mountain Snow and Avalanche Project has numerous studies underway which include quantitative measurements on blowing snow, acoustic emissions from stressed snow, avalanche dynamics, numerical models for simulating avalanche danger, wind flow in mountain terrain, passive seismic monitoring of mountain snowpacks, and analyses of seismic signals associated with avalanche slopes to mention a few. Many additional studies are underway, and all of these are pertinent to avalanche problems in Alaska and elsewhere. I know the Director is very interested in helping you solve some of Alaska's many avalanche problems, and our project knows the avalanche situation in R-10 requires action. We will do everything possible to help make Alaskan winters safer from an avalanche standpoint.

Thank you for inviting us to Alaska for a first-hand look at your avalanche problems. Our recent trips have been extremely interesting, and thanks to your unusual dedication, interest and hospitality; a great deal has been accomplished in record time.

Sincerely,

ARTHUR JUDSON
Mountain Snow & Avalanche Research

Table 1

Developments with homes or other structures in avalanche zones as of March 1979

TECHNICAL STUDY BY A QUALIFIED AVALANCHE DYNAMICS MAN RECOMMENDED AT AREAS OTHER THAN BEHRENDS AVENUE

Location	Number and Type of Structures	Return Interval	Encounter Probability	Severity of problem	Danger Trend
Juneau Area					
Behrends Avenue	33 homes 1/ 453 boats	13 years	very high	extreme	constant
	1 motel 2/ 1 high school auditorium	unknown	high	high	constant
White Subdivision	3 homes	unknown	high	high	constant
3/ North of Gold Creek	1 home	unknown	unknown	moderate	constant
Norway Point	1 home	unknown	high	high	constant
Snettisham Project	several power lines	unknown	unknown	unknown	constant
Power Line-Thane Road	3 power towers	unknown	unknown	unknown	constant
Anchorage-Seward					
Eagle River	several homes	unknown	high	moderate	increasing
Rainbow Creek	few homes	unknown	high	moderate	constant
Alyeska	1 lodge	unknown	high	high	unknown
	several other structures	unknown	high	high	constant
Indian Creek	few homes	unknown	unknown	low	unknown
Moose Pass Mile 35	unknown, homes	unknown	unknown	unknown	unknown
W. of Cooper Landing	few homes	unknown	unknown	unknown	unknown
Valdez	4/ 1 high school	unknown	low	low	constant
	1 home	unknown	high	moderate	constant

1/ Estimate of the number of boats occupied is 10 percent.

2/ Northwest section most exposed.

3/ At entrance to Evergreen bowl toward cemetary.

4/ Structural damage to north wall possible, but unlikely--parking lot to East is highly exposed to infrequent avalanches.

Table 2

Avalanches affecting state highways and other roads as of March 1979

Note: Avalanche advisories and/or warnings recommended all areas

Location	No. of Avalanche Paths	No. of Miles	No. of Paths with Frequency ≥ one/yr.	Present Control	Control Intensity	Recommendations
Seward Highway	90	90	~15	artillery	light	intensify control
1/ Thompson Pass	30	47	7	none	---	periodic closure
Juneau Area	16	10	2	artillery	light	intensify control and training
Isabelle Pass	10	4	unknown	none	---	none
Ritcher Pass	several	~10	unknown	none	---	periodic closure
Six Mile Creek	several	>5	unknown	unknown	---	periodic closure
Glenn Highway	several	>100	unknown	none	---	periodic closure
Eagle River	several	unknown	unknown	none	---	none
Chitna	several	~3	unknown	none	---	none
Nenana Canyon	several	1	unknown	none	---	none
Arctic Valley	1	---	0	none	---	none
		Areas Not Visited				
Eyak-Cordova	2	---	unknown	none	---	none
Hyder Area	few	unknown	unknown	none	---	periodic closure
Haynes-Klukwan	few	unknown	unknown	none	---	none
Ittamna Bay to Pile Bay	several	unknown	3	none	unknown	plan spring opening during stable condition
Skagway to White Pass	numerous--severe problem when highway is opened to winter travel in 1979-80.					
Aleutian Islands	several--control not yet warranted.					

1/ Thompson Pass has large destructive avalanches at infrequent intervals in addition to avalanches from 7 frequent paths. At least one of two newly planned bridges circumventing the tunnel at the upper end of Keystone Canyon will be directly exposed to a very large avalanche (4500 feet vertical fall to bridge). ALASKA D.O.T. DESIGN PERSONNEL SHOULD CONTACT A QUALIFIED ENGINEER SPECIALIZING IN AVALANCHE DEFENSE STRUCTURES FOR THIS BRIDGE. PETER SCHAERER, NATIONAL RESEARCH COUNCIL OF CANADA, VANCOUVER, CANADA, OR HANS FRUTIGER, SWISS FEDERAL INSTITUTE FOR SNOW AND AVALANCHE RESEARCH, DAVOS, SWITZERLAND, PREFERRED.

Table 3

Recreational areas with significant potential for avalanche fatalities

Location	Avalanche Paths - No.	Primary Use	No. of Fatalities 1970-1979	Degree of Hazard	Comment
McKinley National Park	thousands	climbing	8	extreme	Constant danger, no viable means of hazard reduction. Mt. McKinley is an international drawing card.
Chugach State Park	thousands	all winter uses	5	very high	Public warnings and avalanche awareness training most effective.
Turnagain Pass	>100	skiing, snowmobiling	4	high	Same as above.
Independence Mine	~100	skiing	0	high	Same as above.
Alyeska	>30	skiing	0	moderate	Excellent control program.
Eaglecrest	numerous small paths	skiing	0	low	Good control program.
Juneau Region	>100	all uses	0	high	Public warnings.
Dyea to Lake Bennett	numerous	skiing	0	high	Warnings and avalanche awareness training most effective.
Sitka-Silver Bay to Blue Lake	numerous	skiing, snowmobiling	0	high	Same as above.
Seward Region	numerous	skiing, climbing	1	high	Same as above.
Thompson Pass	numerous	skiing	0	high	Same as above.
Mt. St. Elias	thousands	climbing	4	extreme	Same as Mt. McKinley

Table 4

Avalanches affecting Alaskan railroads

Location	No. of Paths	Severity of Problem	Present Control	Control Intensity	Recommendation
Spencer to Hunter	11	high	artillery	light	Heavier control, avalanche warnings.
Moraine to Whittier	unknown	low	none	---	Avalanche warnings.
Skagway to White Pass	unknown	very high	none	---	On ground evaluation, avalanche advisories and warnings.

OROGRAPHIC PRECIPITATION MODEL FOR HYDROMETEOROLOGICAL USE

by

I. Orlo Rhea

Research report sponsored by the

Rocky Mountain Forest and Range Experiment Station
Forest Service
U.S. Department of Agriculture
Under Cooperative Agreements
16-022-CA and 16-567-CA

Department of Atmospheric Science

Colorado State University

Fort Collins, Colorado

March, 1978

Atmospheric Science Paper No. 287

Abstract

Research was performed to determine the ability to diagnose the effect of topography on winter precipitation for western Colorado over various time periods for differing wind regimes, employing upper air data and a fine-mesh topographic grid.

To accomplish the objectives, a steady, [illegible] orographic precipitation model was developed. The model is two-dimensional, steady state, and multi-layer. It follows parcels of layer mid-points through topographically-induced [illegible] and descents. Layer budgets of water substance are calculated by (a) allowing precipitation of a constant fraction of total cloud water (i. e., local condensation plus imported cloud water), (b) carrying the air under downstream where it and additional condensate is partially precipitated, and (c) permitting evaporation of cloud water upon descent and of precipitation falling into unsaturated layers. A key feature of the approach is its representation of precipitation enhancing by upstream barriers (when used with a different terrain grid for each wind direction).

Airflow is constrained to two directions and the complications of topographic effects on the flow [illegible] by using a set of gravity-dependent damping factors to limit the vertical displacement of layers. Effects of [illegible] vertical motion are [illegible] those of topography.

The model was tested for western Colorado using 12 winter seasons of twice daily upper air soundings as input. The data were summed

and compared to observed spring and summer runoff from watersheds of varying size. Correlation coefficients between seasonally-summed model watershed precipitation and observed runoff range mainly between 0.75 and 0.94. On a daily basis large discrepancies between model and observation sometimes exist, but model frequency distribution of daily precipitation totals appears realistic.

A 13 year model mean precipitation map was found to agree quite well in mountainous areas with an isohyetal map constructed by ESSA of the U.S. Department of Commerce using precipitation and snow-course data with empirical correlation to topographic features. This model underestimated broad valley precipitation in most cases.

Test quantitative precipitation forecasts (QPF's) were made (and communicated daily to the U. S. Forest Service) from November, 1975, to March, 1976, using wind direction-dependent model pattern maps as objective aids. Isohyets on these pattern maps were calibrated using forecast wind speed, moisture depth, duration, cloud coverage, and cloud temperature. Skill scores for 24 hour QPF's ranged from 0.56 to 0.67.

The derived method has utility (a) in assessing the average magnitude and the inter-season variation of topographic effects on winter precipitation in western Colorado and (b) as an objective aid for quantitative precipitation forecasting. It has substantial potential utility as input to hydrologic process models for streamflow forecasting. The basic approach should be transferable to other topographically complex areas which are dominated by stratiform precipitation.

John Owens Allen
Department of Atmospheric Science
Colorado State University
Fort Collins, Colorado 80523
Summer, 1977