SNOW SURVEY SAMPLING GUIDE

Province of British Columbia

Ministry of Environment

WATER MANAGEMENT BRANCH
SURFACE WATER SECTION
Parliament Buildings,
Victoria, B.C., V8V 1X5

SS13-81

TO ALL SNOW SURVEYORS

THIS GUIDE MUST BE READ AND STUDIED BY ALL SNOW SURVEYORS TO ENSURE THAT EFFICIENT, ACCURATE, AND UNIFORM SNOW SURVEYS ARE OBTAINED THROUGHOUT THE PROVINCE.

IT ALSO SERVES AS A USEFUL REFERENCE TO THE EXPERIENCED SNOW SURVEYOR WHEN DIFFICULT AND UNUSUAL SAMPLING CONDITIONS EXIST.

INTRODUCTION

Snow surveying is carried out to obtain data for water supply forecasting, flood or drought warning, and other water resource studies. It provides valuable information for the management and use of the Province's water resources in the areas of power generation, irrigation, industry, fisheries and wildlife, and recreation. The usefulness of snow survey data depends primarily on the care and integrity of the snow surveyor.

This Snow Survey Sampling Guide was prepared to promote efficient and accurate snow surveying, to standardize sampling procedures, and to ensure uniform results.

It was especially designed for snow surveyors who have limited contact with the B.C. Water Management Branch technicians and have not had the opportunity for thorough field instruction in snow sampling.

Surface Water Section
Water Management Branch
Ministry of Environment
August 1981

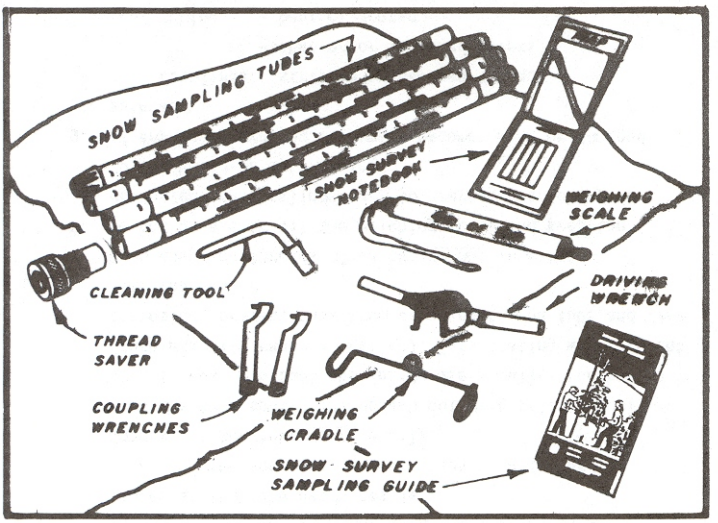
TABLE OF CONTENTS

A. GENERAL INSTRUCTIONS

FIGURE 1. Snow Survey Sampling Kit

FIGURE 1

SNOW SAMPLING KIT



1. Check Equipment

Before your snow survey trip, check all your equipment thoroughly.

a. See that tubes are properly cleaned and coated. See Section A.2.d.

b. Make sure the coupling threads are clean and that you can screw all the tubes together without binding.

c. Check the sampling kit for the following items:

Sampling tubes that match
Coupling wrenches
Driving wrench
Snow survey notebook
2 Pencils
Weighing scale (4 metre or 6 metre capacity) and cradle
Tubing thread saver (if supplied)
Snow course map
Snow Survey Sampling Guide
Cleaning tool

d. Check your equipment:

Goggles
Gloves
Snowmobiles - extra fuel, spare parts, tool kit
Skis - running surface, bindings, poles, climbers
Snowshoes - varnish coating, webbing, bindings
Personal clothing and that of your companion
Safety/first aid equipment
Survival Kit
See Section E. SAFETY.

It is much easier to check these items at home or the office where replacements are available, than at the snow course.

2. Care of Sampling Kit

Taking good care of the sampling equipment will make the difference between a good survey and a poor one.

a. Transport the equipment carefully to avoid damage. The average sampling kit costs in excess of $1,200.00.
b. Do not lean on the sampling tube while sampling on slopes as the tube bends easily.
c. Do not strike the tube against trees or with hard objects as the tube dents easily.
d. Keep the tube coated inside and out with silicone oil or auto wax. To coat the inside use a pull-through swab (Note wax will require buffing). This coating will prevent corrosion, prevent snow from adhering to the tube and make sampling easier.
e. Keep coupling threads clean but do not lubricate.
f. Do not grease or oil the weighing scale and keep the graduated inner cylinder dry to prevent inaccuracy due to ice build-up or freezing.
g. If any snow sampling equipment becomes worn or damaged such as

couplings - stripped or damaged threads
- sheared or loosened rivets
tubing - bent or dented
cutter - dull, bent or broken teeth

return it immediately for repair or replacement to:

Surface Water Section
Water Management Branch
Ministry of Environment
Parliament Bldgs.
Victoria, B.C. V8V 1X5

3. Accuracy

Accuracy is essential. An error in measurement not only affects the current month's British Columbia Snow Survey Bulletin and water supply forecasts, but also any statistical analysis of the data for years to come. Avoidance of error is particularly important while reading the snow depths and tube weights. Be sure also that the core sample represents the full depth of snow.

4. Date of Sampling

For data to be published in the Snow Survey Bulletin and to be used in streamflow forecasting, it is important that the sample be taken and reported on the scheduled sampling date. If this date is inconvenient, an earlier sampling is preferable to a later sampling. Samples scheduled for the first of the month must be done within six days before or after that date to be included in long term records.

5. Report the Data

The results of the snow survey must be reported to the Victoria office as soon after the survey as possible preferably by telephone (collect). Alternatively, the results can be reported (collect) by telegraph or telex.

Simply mailing the completed note forms is not sufficient (see Section B, Step 20).

Using Silver Star Mountain snow course as an example, the data message should contain the following information:

Date of survey: March 29
Snow Course: Silver Star Mountain, 2F10
Average Snow Depth in Centimeters: 151
Average Water Equivalent in Centimeters: 51.3
Snow Surveyor: Don Fear

Note: Double check the message before sending to Victoria as this is the only information available to prepare Snow Survey Bulletins.

EXAMPLE TELEGRAM OR TELEX

SURFACE WATER SECTION
WATER MANAGEMENT BRANCH
MINISTRY OF ENVIRONMENT
VICTORIA, B.C. V8V 1X5

MARCH 29
SILVER STAR MOUNTAIN
SNOW: 151
WATER: 51.3
D. FEAR

B. STANDARD SNOW SAMPLING PROCEDURE

The standard snow sampling procedure is the one most often used to sample a snow course. It should be used when the snowpack is believed to be greater than 50 cm in depth. If it is less, the bulk sampling procedure described in Section C should be used.

The standard snow sampling procedure is described below.

Step 1. Snow Course Map

Check the location sketch map of the snow course, (see Figure 2). Start sampling at one end of the snow course or the other, being sure not to miss any of the sampling stations. Be careful not to ski, snowshoe, or drive an over-snow machine over the sampling station.

Step 2. Fill in Heading on the Notes

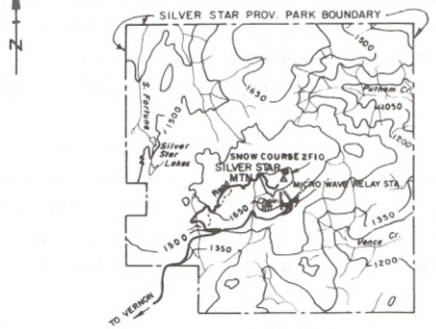
Fill in the heading on the snow survey note form, and the station numbers as shown in Figure 3.

Step 3. Assemble Sampling Tube

With gloved hands*, assemble the sampling tube by screwing tube sections together hand-tight (no wrenches).

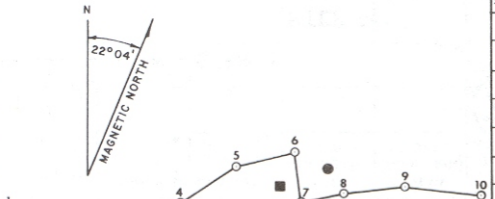
*Note: The wearing of well insulated gloves is strongly recommended throughout the snow survey to prevent problems caused by warming of the tube.

FIGURE 2



KEY MAP

SCALE : 1cm. = 1.25 km.
ELEVATIONS IN METRES



PLOT OF SNOW COURSE

SCALE : 1:1000
STEVENSON SCREEN ■
STORAGE GAUGE ●

STN	DIST (m)	BRG	REFERENCE POINTS		
			REF.	BRG.	DIST. (m)
1			15cm Spruce	344°	6
	17.4	81°	20 " "	133°	6
2			10 " "	29°	5
	15.2	66°	20 " "	136°	5
3			25 " "	95°	6
	15.2	45°	30 " "	192°	8
4			30 " "	84°	7
	17.1	34°	10 " "	329°	5
5			30 " "	360°	3
	16.8	56°	15 " "	180°	8
6			20 " "	170°	3
	13.1	152°	30 " "	78°	7
7			30 " "	187°	5
	10.7	57°	30 " "	290°	9
8			36 " "	136°	4
	15.5	63°	36 " "	206°	4
9			10 " "	23°	6
	20.4	74°	10 " "	168°	4
10			15 " "	219°	5
			30 " "	59°	8

ELEV. 1840 m LAT. 50° 22' LONG. 119° 03'

MAP No. 82L/SW MTN. RGE. INTERIOR PLATEAU

DATE ESTD. OCT. 1958 REVISED JUL 1981

DRAINAGE OKANAGAN BASIN COLUMBIA

REMARKS ALL BEARINGS MAGNETIC

Magnetic Declination 22° 04' Jul, 1981

SURFACE WATER SECTION
WATER MANAGEMENT BRANCH
MINISTRY OF ENVIRONMENT

COURSE NO. 2F10

SILVER STAR MTN.

C.H. COULSON HEAD, SURFACE WATER SECT.

FIGURE 3

S8-81

Province of
British Columbia
Ministry of
Environment

SURFACE WATER SECTION
WATER MANAGEMENT BRANCH
Parliament Buildings
Victoria British Columbia
V8V 1X5

SNOW SURVEYS

Snow Course No. 2 F 1 0 — 81 / 03 / 29 (Yr. / Mo. / Da.)

Snow Course Name *Silver Star Mountain*

Observer's Name *D. Fear*

No. Of Tube Sections Used: 3 Driving Wrench Used: Yes ____ No ✓

Station No.	Snow Depth cm: with dirt plug	Snow Depth cm: without dirt plug	Core Length cm	Weight Tube and Core	Wt. Tube Only Before Sampling	Water Equivalent cm	Density %
1					73		
		STEP 2				STEP 3	
			STEP 4				

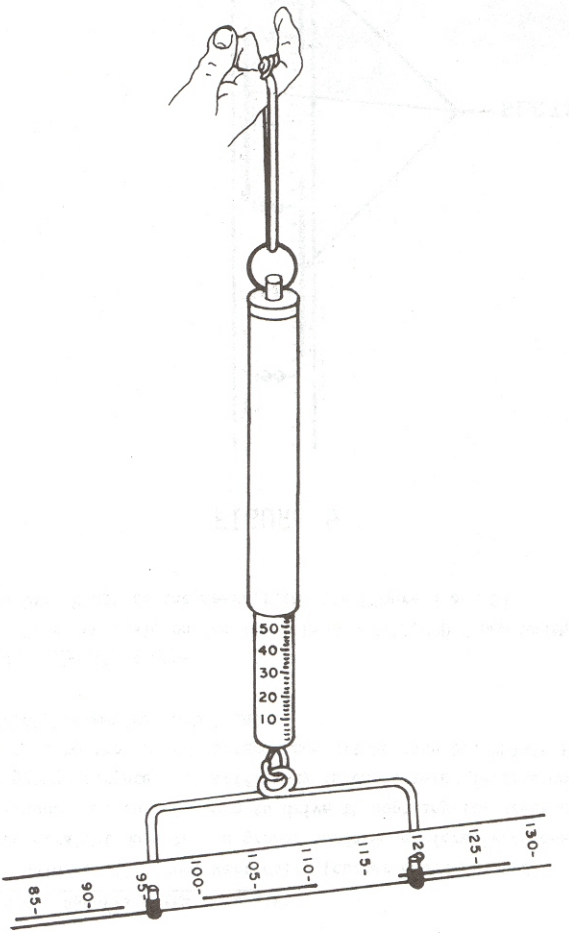
Always use 2 or more tube sections. Make sure the numbers on the assembled tube run consecutively throughout the entire length. If a threadsaver is supplied screw it onto the last section. RECORD the number of tube sections used (see Figure 3).

Step 4. Weigh Sampling Tube

Balance the empty tube on the cradle which is attached to the weighing scale (see Figure 4). The scale must hang freely like a pendulum, so be sure to hold the scale by the top ring or attached cord and never by the barrel as this will cause the scale to bind. Ensure that the scale slides freely in the barrel by slightly extending the scale and allowing it to return or by tapping it lightly with a pencil before taking a reading.

If it is windy, point the tube into the wind.

FIGURE 4



Read the scale and RECORD "Wt. Tube Only Before Sampling" to the nearest cm as circled in Figure 3. This initial weight must always be greater than zero. To achieve a greater than zero reading it may be necessary to add another section of tubing or the driving wrench. Once added, such weight must remain in place until completion of the entire snow survey.

Step 5. Locate Stations

Locate the first station you are going to sample by positioning yourself at right angles to the faces of the two yellow or red reference plates at the distance indicated on the plates. Sample within a 1.5 metre radius of this point. Before taking a sample look inside the tube to see if it is clean. To avoid eye injury look through the end opposite the cutter. Keep disturbance of the snow surface to a minimum in the sampling area as this may affect future snow measurements at the station.

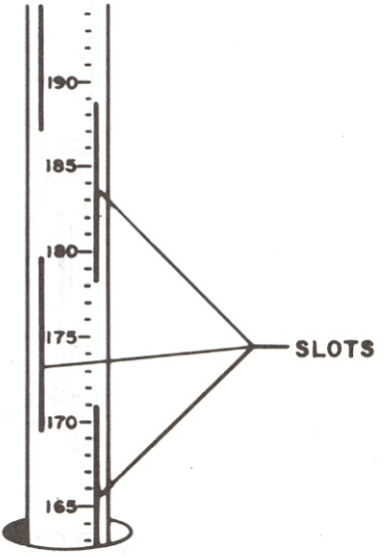
Step 6. Penetrate the Snowpack

Hold sampling tube vertically (cutter end down) and drive straight down to the ground surface, preferably in one continuous motion. Be sure to drive through any ice layer on the ground surface. If difficulty is encountered in driving the tube to the ground surface, consult Section D., "HINTS FOR DIFFICULT SAMPLING CONDITIONS".

Step 7. Depth of Snow

From the scale on the tube, READ and RECORD "Snow Depth with Dirt Plug" to the nearest cm (see Figure 5 and 6).

FIGURE 5



Step 8. Core Length

Turn the tube clockwise to cut the core loose from the ground. Carefully raise the tube, looking through the slots to READ and RECORD "Core Length" (see Figure 6). Raise the tube carefully out of the snow.

FIGURE 6

SS8-81

Province of British Columbia
Ministry of Environment

SURFACE WATER SECTION
WATER MANAGEMENT BRANCH
Parliament Buildings
Victoria British Columbia
V8V 1X5

SNOW SURVEYS

Snow Course No. 2F10 — 81/03/29 (Yr./Mo./Da.)

Snow Course Name Silver Star Mountain

Observer's Name D. Fear

No. Of Tube Sections Used: 3 Driving Wrench Used: Yes ____ No ✓

Station No.	Snow Depth cm with dirt plug	Snow Depth cm without dirt plug	Core Length cm	Weight Tube and Core	Wt. Tube Only Before Sampling	Water Equivalent cm	Density %
1	163		146		73		
2							
		STEP 7		STEP 8			

The reason for observing and noting "Core Length" is to ensure that a complete sample of snow has been obtained. The core length is generally slightly less than the snow depth but usually greater than 80% of the depth. Core lengths less than 80% are acceptable, provided they are consistent from one station to the next.

Step 9. Check for Dirt Plug

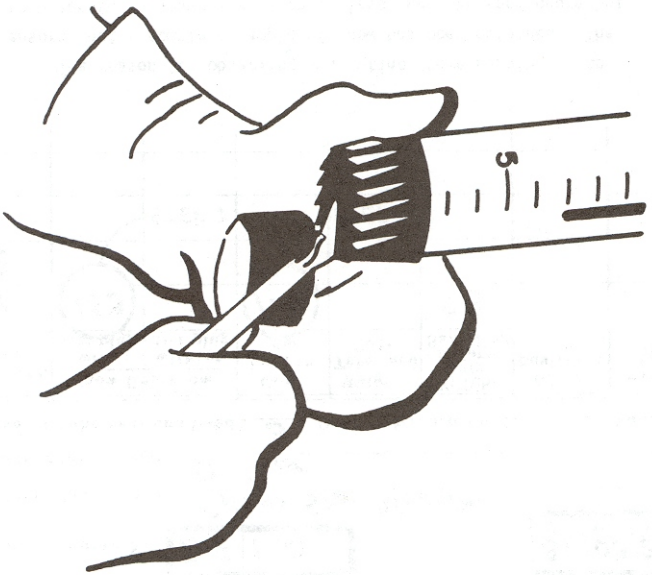
Inspect the cutter end of the tube for dirt or litter, being careful not to lose any snow core from the other end of the tube. If such evidence of having reached the ground is not present, then assume that a true snow depth has not been obtained and resample the station.

Step 10. Adjust Snow Depth

Carefully remove dirt and litter from the cutter with a knife or similar tool as shown in Figure 7.

Throw the debris well away from the sampling point. This prevents melt holes from occurring in the sampling area.

FIGURE 7



Estimate the thickness of the plug and subtract this amount from the snow depth to give the corrected value. For example: If as in Step 7, the observed snow depth was 163 cm, and you removed a 2 cm thick dirt plug, then the corrected snow depth would be 161 cm.

RECORD this corrected value under "Snow Depth Without Dirt Plug" as shown in Figure 8.

Step 11. Weigh the Sample

Using the weighing procedure described in Step 4, RECORD the "Weight Tube and Core" to the nearest centimeter, as circled in Figure 8.

FIGURE 8

SS8-81

Province of British Columbia
Ministry of Environment

SURFACE WATER SECTION
WATER MANAGEMENT BRANCH
Parliament Buildings
Victoria British Columbia
V8V 1X5

SNOW SURVEYS

Snow Course No. 2F10 — 81/03/29 (Yr./Mo./Da.)

Snow Course Name Silver Star Mountain

Observer's Name D. Fear

No. Of Tube Sections Used: 3 Driving Wrench Used: Yes ____ No ✓

Station No.	Snow Depth cm with dirt plug	Snow Depth cm without dirt plug	Core Length cm	Weight Tube and Core	Wt. Tube Only Before Sampling	Water Equivalent cm	Density %
1	163	161	146	128	73	55	34
2							
	STEP 10		STEP 11		STEP 14	STEP 15	

Step 12. Empty and Clean the Tube

Lift the tube from the cradle, turn the cutter end up and shake the core from tube away from the sampling location. If necessary jar or tap coupling end against a rubber pad on a ski or snowshoe. Do not strike hard objects with this end unless the threadsaver is affixed as the tube coupling will damage easily. If the core remains stuck inside the tube, use a thin stick or cleaning tool to remove it. It may be necessary to uncouple the tube to accomplish this. Before the next sample is taken, inspect the inside and make sure all snow has been removed.

Step 13. Recheck the Tube Weight

Check the weight of the empty sampling tube every third to fifth sample to ensure accuracy. The empty weight of the tube at this step should be the same as the reading obtained in Step 3. If this is not achieved, then some snow or ice must still be in the tubing and should be removed.

Note: If the driving wrench is put on or taken off during the sampling, a new empty weight must be obtained (see Figure 10).

Step 14. Compute Station Water Equivalent

Compute the "Water Equivalent" by subtracting the "Wt. Tube Only Before Sampling" from the "Weight Tube and Core". RECORD this result to the nearest centimeter (as circled in Figure 8). Water equivalent is the actual depth of water contained in the snowpack.

Step 15. Compute Sample Density

The percent sample density can be calculated by dividing the water equivalent by the snow depth x 100%, or by using the Density Determination Chart, Figure 9. This chart is also printed on the inside front cover of every Snow Survey Notebook. RECORD the computed density for each sample in the last column of the note page, (as circled in Figure 8).

Step 16. Repeat Steps 5-15 for All Stations

Locate and sample the remaining stations shown on the snow course map, following the procedures described in Steps 5 through 15.

Step 17. Compare Station Water Equivalents and Densities

When all stations have been sampled and water equivalents and densities calculated for each, check to see that the sample densities are consistent. In general, sample densities at a given snow course on a given date should not vary significantly from one station to another. If the density at a particular station is out-of-line with the density at the other stations, that station should be resampled.

The overall snowpack density can be as low as 10% for fresh fallen snow and as high as 60% for ripe late-season snowpacks. Generally, density will increase with the advance of winter into spring.

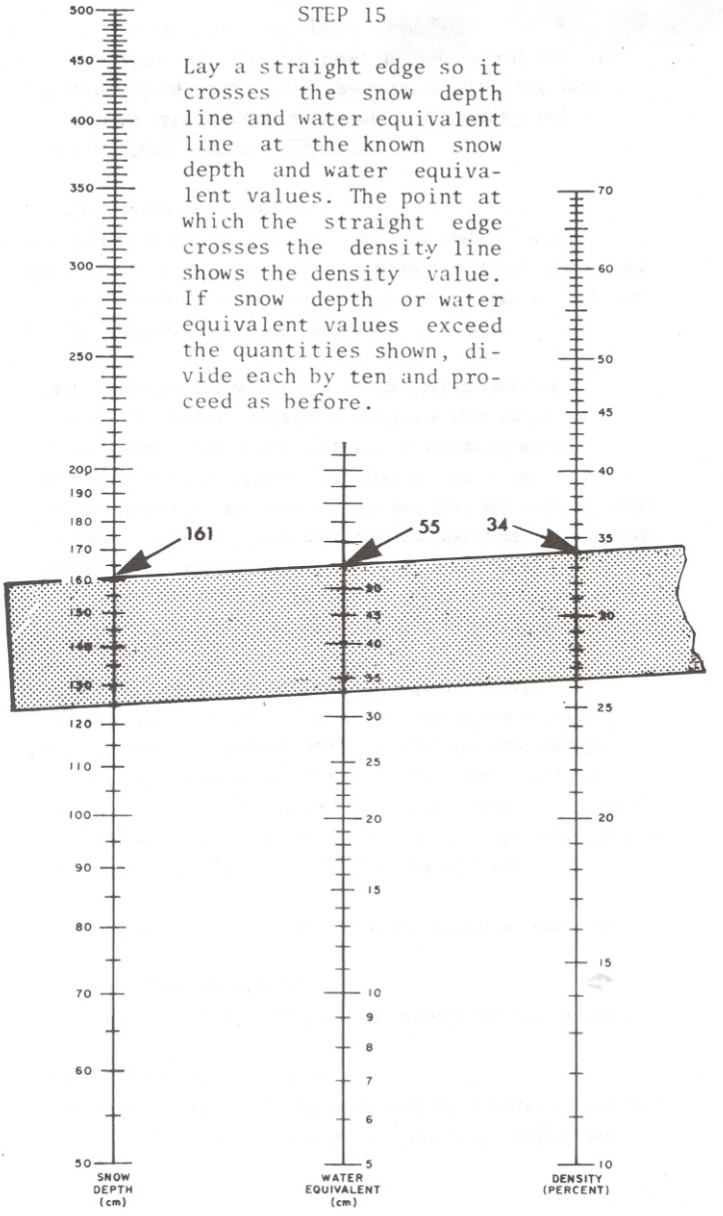
Step 18. Check Notes in the Field and Compute Average Depth and Water Equivalent for the Snow Course

Before leaving the snow course both snow surveyors must check the notes for legibility, completeness, and accuracy, and make the following calculations:

Add the figures in the "Snow Depth Without Dirt Plug" column and divide the total by the number of stations sampled to get the average snow depth.

FIGURE 9

DENSITY DETERMINATION CHART



Add the figures in the "Water Equivalent" column and divide the total by the number of stations sampled to obtain the average water equivalent.

Note: The number of stations sampled includes those with zero snow depth.

Figure 10 shows an example of the completed note page.

Step 19. Fill in Checklist on the Back of Notes

Before leaving the snow course, fill in the check list on the back of the field notes, as shown in Figure 11. Be sure to include remarks on difficult sampling conditions, and methods used to overcome them or reasons for snow sample irregularities if they occur. This information is very important to the data handling staff in the office.

Step 20. Final Check and Handling of Snow Survey Notes

Prior to reporting the data to Victoria as described in Section A-5, carefully check the snow survey notes for arithmetic errors. After reporting the data, make a duplicate copy of the notes for your records and mail the original notes to the appropriate office. The office address and telephone/telex numbers will be supplied at the beginning of each snow survey season. Keeping a duplicate copy serves as a back-up should the original notes be lost in transit.

C. BULK SAMPLING - SHALLOW SNOW

Experience has shown that when the snow depth is less than about 50 cm, it is difficult to accurately determine the weight of the snow core. In this case, the bulk sampling method described below is recommended.

Step 1. Record Weight of Container

Use a pail or other container (heavy plastic bag is acceptable) and attach it to the weighing scale and add enough weight (e.g., rocks, snow, driving wrench, etc.) to obtain a scale reading of greater than zero.

FIGURE 10

SS8-81

Province of British Columbia
Ministry of Environment

SURFACE WATER SECTION
WATER MANAGEMENT BRANCH
Parliament Buildings
Victoria British Columbia
V8V 1X5

SNOW SURVEYS

Snow Course No. 2F10 — 81/03/29 (Yr./Mo./Da.)

Snow Course Name Silver Star Mountain

Observer's Name D. Fear

No. Of Tube Sections Used: 3 Driving Wrench Used: Yes ____ No ✓

Station No.	Snow Depth cm with dirt plug	Snow Depth cm without dirt plug	Core Length cm	Weight Tube and Core	Wt. Tube Only Before Sampling	Water Equivalent cm	Density %
1	163	161	146	128	73	55	34
2	164	162	138	126	"	53	33
3	160	159	139	124	"	51	32
4	155	153	142	123	"	50	33
5	150	148	142	123	73	50	34
6	154	152	143	124	"	51	34
7	148	146	133	128	"	55	38
8	146	143	130	123	"	50	35
9	136	132	114	174	126 *	48	36
10	153	152	125	176	126 *	50	33
Total		1508				513	
Average		151				51.3	

FOR REGIONAL OFFICE VERIFICATION ONLY

NEAREST cm ____ cm

NEAREST TENTH OF cm ____ mm ____

* Driving wrench added

Verified By: _____ Date: _____ Density: _____

FOR VICTORIA USE ONLY

Approved By: _____ Date: _____ Density: _____

FIGURE 11

Please complete in field or as soon after snow sampling as possible

Time sampling began 8:15 (a.m.) p.m. ended 9:00 (a.m.) p.m.

A. Weather Conditions at Snow Course

Freezing ✓ Thawing _____ Temp -5 °C
Blowing _____ Calm ✓
Skies: Clear _____ Partly Cloudy ✓ Overcast _____
Precipitation: None ✓ Raining _____ Snowing _____

B. Surface Snow Conditions at Snow Course

Fresh fallen snow depth 10 cm
Wet _____ Dry _____
Soft ✓ Crusted _____
Support: None _____
Person on skis/snowshoes ✓
Person on foot _____
Serious Drifting: No ✓ Yes* ___; Which stations _____
Evidence of oversnow traffic: Yes* _____ No ✓

C. Sampling Conditions

Easy ___ Moderately difficult* ✓ Very difficult* ___
Ground reached on all samples? Yes ✓ No* _____
Ice layer(s) in snowpack ✓ on ground _____
Ground under snow: Dry _____ Damp ✓
Very wet _____ Frozen _____

D. General Conditions en Route

Snow line elevation 1400 metres
Thaw: None ✓ Sunny slopes _____ General _____
Small streams: Bridged with snow ✓ Open _____
Clear ✓ Muddy _____

*Describe fully under remarks

E. Remarks: * Driving wrench used at stations 9 & 10 to push through ice layer half way down.

Note: Any added weight must remain in the container or attached to the scale until all samples have been collected and the weight of snow has been recorded.

RECORD the scale reading (i.e., weight of container) at the bottom of the "Wt. of Tube Only Before Sampling" column in the notes.

Step 2. Sample Each Station

Sample each station in the standard manner as outlined in Section B, Steps 5 to 10. Do not discard the snow cores, but instead, empty them into the container. It is not necessary to weigh each core separately.

Step 3. Weigh Total Snow Course Samples

When all the stations have been sampled, weigh the container including snow cores plus any added weight, and RECORD this reading at the bottom of the "Weight Tube and Core" column.

Step 4. Compute Average Water Equivalent

By subtracting the weight of the container from the weight of the container plus cores, obtain the weight of snow. RECORD this at bottom of the "Water Equivalent" column. Divide it by the number of stations on the snow course and RECORD this result as the Average Water Equivalent to the nearest tenth of a cm.

Step 5. Compute Average Snow Depth

Similarly, compute the Average Snow Depth by totalling the snow depths and dividing by the number of stations.

An example of field notes for bulk sampling is illustrated in Figure 12. Remember that if a sampling station is bare of snow, RECORD zero for depth and include it in the calculation of the average.

FIGURE 12

SS8-81

Province of British Columbia
Ministry of Environment

SURFACE WATER SECTION
WATER MANAGEMENT BRANCH
Parliament Buildings
Victoria British Columbia
V8V 1X5

SNOW SURVEYS

Snow Course No. 1 E 0 1 A

81/04/01 (Yr. / Mo. / Da.)

Snow Course Name Blue River Town

Observer's Name S. Quinn

No. Of Tube Sections Used: 2 Driving Wrench Used: Yes ____ No ✓

Station No.	Snow Depth cm: with dirt plug	Snow Depth cm: without dirt plug	Core Length cm	Weight Tube and Core	Wt. Tube Only Before Sampling	Water Equivalent cm	Density %
1	24	23	22	WEIGHT OF CONTAINER & SAMPLES	WEIGHT OF CONTAINER	WEIGHT OF SAMPLES ONLY	
2	17	15	15				
3	0	0	0				
4	20	19	18				
5	30	28	26				
6	33	32	30				
7	29	26	25	BULK SAMPLED			
8	30	29	28				
9	26	23	20	↓	↓	↓	
10	40	37	35	143	21	122	
Total		232				122	
Average		23				12.2	

FOR REGIONAL OFFICE VERIFICATION ONLY

[ ] cm [ ] mm [ ]

Verified By: _____ Date: _____ Density: _____

FOR VICTORIA USE ONLY

Approved By: _____ Date: _____ Density: _____

D. HINTS FOR DIFFICULT SAMPLING CONDITIONS*

1. Snow Jamming in Tube

When a snow core jams in the tube, further penetration of the snowpack may be difficult, if not impossible. If further penetration is possible, additional core will not be cut and instead the snow will be ploughed aside as the tube penetrates to the ground. Upon reaching the ground, a dirt plug may or may not be cut, depending on how tightly the snow core is jammed in the tube. Although dirt or litter is required to indicate that the ground has been reached, this does not always mean that a complete core has been obtained. To help assess this situation refer to Section B, Step 8 and 17.

Assuming the sampling tube is clean, coated, and in good condition, the main causes of snow jamming and how to overcome them are as follows:

(a) Deep Dense Snowpack

Thrust the tube quickly and smoothly down to the ground using a continuous hand-over-hand motion. This is accomplished most effectively by two people working together. If this method is unsuccessful, then "Sampling in Sections" will be necessary (see Section D-2).

(b) Snow Core Freezing in Tube

This condition usually occurs where the tube temperature is above freezing and that of the snowpack is below freezing. The following steps may help to overcome this difficulty:

(i) Cool the tube by setting it in the shade or burying it in the snow.

(ii) Clean the tube thoroughly, then thrust the tube rapidly through the snow without stopping until the ground is reached.

*Note: Be sure to describe difficulties in the "Remarks" section on the back of the note page.

(iii) Take the samples in the early morning or evening when the air temperature is cooler.

(iv) Carry the snow core in the tube to the next sampling station before removing.

(v) A clean, well lubricated tube will help prevent the core from sticking. Thoroughly cleaning and oiling the tube (especially the cutter section) during sampling could make the difference between success or continued difficulty. If this procedure does not work, try "Sampling in Sections" (see Section D.2).

(c) Ice Layers in the Snowpack

Ice layers in the snowpack are a result of thawing and refreezing of the snow surface between snowfalls. When an ice layer stops the progress of the tube, the following hints may help overcome the problem:

(i) Sometimes applying a quick push by jerking down on the driving wrench will push the cutter through an ice layer that is not too thick. Never try to push through by pumping the tube up and down as this will trap extra snow in the tube.

(ii) Cut through the ice layer by turning the tube clockwise (turning the wrong way could unscrew the couplings). When you are through the ice, quickly thrust the tube downwards to the ground.

(iii) A clean, well lubricated tube will help prevent the ice layer from jamming, and ploughing the snow below the ice layer.

2. Sampling in Sections

The problems of deep snow, core freezing in tube and ice layers will hopefully be solved by the hints given above. However, if these suggestions do not produce results, follow the procedure below:

(a) Thrust the tube hand-over-hand until it resists further penetration.

(b) Remove the tube carefully so as not to disturb the hole.

(c) Weigh and RECORD the "Core Length" and "Weight Tube and Core".

(d) Empty the tube and return it very carefully to the bottom of the hole.

(e) Again thrust the tube deeper in the snow until it resists or reaches the ground.

(f) Repeat above as many times as necessary to reach the ground.

(g) Record data as shown on the sample note in Figure 13. The overall depth is recorded directly, but the station water equivalent and the core length is the sum of individual sections. Total snow depth and water equivalents are the sum of individual station values as usual.

Use as many note sheets as required.

FIGURE 13

SS8-81

Province of British Columbia
Ministry of Environment

SURFACE WATER SECTION
WATER MANAGEMENT BRANCH
Parliament Buildings
Victoria British Columbia
V8V 1X5

SNOW SURVEYS

Snow Course No. 3A01 | 81/03/01 (Yr./Mo./Da.)

Snow Course Name Grouse Mountain

Observer's Name J. Atkinson

No. Of Tube Sections Used: 5 Driving Wrench Used: Yes ✓ No ____

Station No.	Snow Depth cm: with dirt plug	Snow Depth cm: without dirt plug	Core Length cm	Weight Tube and Core	Wt. Tube Only Before Sampling	Water Equivalent cm	Density %
1		76	74	80	48	32	
	302	300	221	147	48	99	
1		300	295			131	44
2		95	91	86	48	38	
	318	315	216	140	48	92	
2		315	307			130	41
3		54	51	71	48	23	
	283	282	223	145	48	97	
3		282	274			120	43
Total							
Average							

FOR REGIONAL OFFICE VERIFICATION ONLY

[ ] cm [ ] mm [ ]

Verified By: _____ Date: _____ Density: _____

FOR VICTORIA USE ONLY

Approved By: _____ Date: _____ Density: _____

3. Tube Too Short for Depth of Snow

(a) Procedure I

If the depth of snow is greater than the length of sampling tube at hand, proceed as follows (see Figure 14a):

(i) Drive the tube to its full length into the snow.

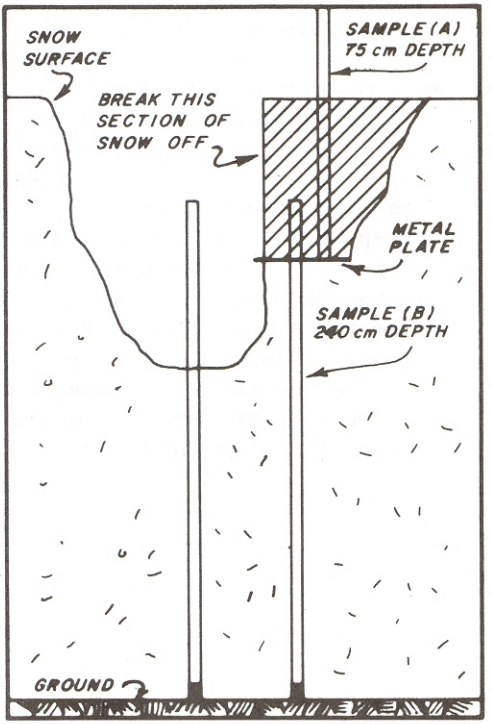
(ii) Dig down around the tube to a depth of 15-30 cm, and make sure additional snow does not fall into the open end of the tube.

(iii) Place a gloved hand on top of the tube and continue to force it down. When the core has reached the top of the tube, you have reached the limit of this method of measurement.

(iv) If the ground is reached, the snow depth will be the distance from the snow surface down to the top of the tube added to the length of the tube.

FIG. 14a
WHEN SNOW DEPTH IS SLIGHTLY MORE THAN LENGTH OF SAMPLING TUBE

FIG. 14b
WHEN SNOW DEPTH IS CONSIDERABLY GREATER THAN LENGTH OF SAMPLING TUBE



(b) Procedure II

If the snow is too deep to get a whole sample by the above method, then proceed as follows (see Figure 14b):

(i) Dig a hole in the snow at the sampling point to a depth of 75 to 100 cm. Do a test sample in the bottom of the hole. If the ground is not reached, dig deeper. Use a ski heel or tip of snowshoe for a shovel if nothing else is available.

(ii) Slide a metal plate or firm flat object into the side of the hole at a depth that is below the top of the grounded sampling tube.

(iii) Remove and clean out the tube.

(iv) Drive the tube down to the metal plate.

(v) Measure the depth and core of the first section of the snowpack.

(vi) Weigh and RECORD the "Weight of Tube and Core" and "Wt. Tube Only Before Sampling". (See sample note, Figure 14c).

(vii) Remove the snow above metal plate.

(viii) Sample from the metal plate down to the ground surface. Weigh and RECORD as in (vi).
Add the snow depths and water equivalents for that sampling station. (See sample note, Figure 14c).

(ix) For safety reasons, be sure to fill the hole before leaving the snow course.

(x) If the course is to be sampled again during the current season, be sure to bring additional tube sections and avoid sampling in the previously disturbed snow.

Figure 14c

SS8-81

Province of British Columbia
Ministry of Environment

SURFACE WATER SECTION
WATER MANAGEMENT BRANCH
Parliament Buildings
Victoria British Columbia
V8V 1X5

SNOW SURVEYS

Snow Course No. 3A01 | 81/04/01 (Yr./Mo./Da.)

Snow Course Name Grouse Mountain

Observer's Name J. Atkinson

No. Of Tube Sections Used: 4 Driving Wrench Used: Yes ✓ No ___

Station No.	Snow Depth cm with dirt plug	Snow Depth cm without dirt plug	Core Length cm	Weight Tube and Core	Wt. Tube Only Before Sampling	Water Equivalent cm	Density %
1A		75	71	77	48	29	
1B	240	240	229	154	48	106	
1		315				135	43
-etc.							

E. SAFETY

Snow surveyors travel in remote mountainous country by a variety of means and are subject to the hazards of cold temperatures, snow storms, avalanche and high altitudes. It is strongly recommended that all snow surveyors strive to prevent disasters by being well prepared, exercising a high degree of caution, and being trained in first aid and survival for emergencies. These subjects are briefly discussed below, and it is recommended that the snow surveyor study and apply these suggestions.

1. Preparation and Equipment

Go prepared for the worst that might happen. A minor difficulty can become a major emergency if you are not prepared and equipped to deal with it. Clothing should be chosen to keep you warm and dry and keep the snow out. Pay particular attention to your hands, feet and head. Layers of clothing are advisable so you can wear the right amount to keep warm at different activity levels, but not become wet with perspiration. Also, do not forget sunglasses or goggles.

A well equipped first aid kit, a pocket knife, and survival kit are not much extra trouble to bring along and are invaluable when you need them.

Depending on the terrain and mode of travel, there are certain necessities that should not be overlooked. If a snowmobile is used for travel, extra fuel and oil, tools, spare parts, and especially snowshoes should be carried. If snowshoes or skis are used for travel, bring a kit of repair materials to fix any damage that could occur.

2. Care and Caution

The consequences of a minor injury or accident in the mountains under winter conditions can be serious. It is advisable to use a high degree of caution in your travel and work in order to avoid trouble. It is not advisable to travel in wilderness areas alone. You should make yourself familiar with the terrain and snow conditions so as to avoid the danger of avalanches and getting lost in poor visibility.

Before leaving for a snow survey, leave word as to your itinerary so a search can be started if you are late in returning. Notify the appropriate people when you do return.

3. Survival

If you do find yourself in a survival situation on a snow survey trip, you can cope quite well by keeping your head and paying attention to the following five points:

a. travel only according to a plan
b. camp early
c. build the best shelter possible: snow cave, lean-to, etc.
d. keep busy but don't overexert
e. remember your basic needs - warmth, water, food.

It is hoped that snow surveyors will avoid emergency and survival situations by careful preparation and the use of common sense in the mountains. Being proficient at first aid and survival will enable you to cope with these situations if necessary. All snow surveyors should take it upon themselves to learn more about these techniques. The book "Outdoor Safety and Survival", available at the nearest B.C. Parks office or from the Surface Water Section, Water Management Branch, provides much more detail and information.

ACKNOWLEDGEMENTS

This manual was patterned after a similar one published by the Soil Conservation Service of the U.S. Department of Agriculture.

NOTES