

Standardization of Snow Course Data:
Reporting and Publishing

by

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Introduction:

During the past ten years there has been a dramatic increase in the amount of hydrometeorological data collected, processed, published and archived by many different agencies in North America. There has been an expansion of national climatological and hydrological networks, and there has been a rapid increase in research and experimental basin studies as part of the International Hydrological Decade (1965-1974). This rapid increase in the amount of data handling has necessitated the refinement of data storage and processing, particularly in association with computer analysis.

Many agencies, particularly the larger ones, have computerized their data handling procedures. These efforts are generally internal, designed to meet specific data requirements. For many types of hydrometeorological data such a system is more than adequate. However, as Davar and Li (1971) emphasize, for long-term inventory-type data collection and utilization, standardization is an optimal goal for data storage and retrieval.

The need for standardization of snow cover data was pointed out by Ferguson and Goodison (1974). At present, in Canada, the Atmospheric Environment Service publishes, on an annual basis, Snow Cover Data, the information for which is collected by various agencies operating snow courses. In addition, some agencies publish their own monthly and/or annual snow survey summaries, which often contain additional historical data for comparative purposes (e.g. British Columbia Water Resources Service; Water Survey of Canada, Calgary District). There is no national standardized procedure for the reporting and publishing of snow survey data.

In the Eastern United States, much of the snow survey data is contained in Snow Cover Surveys which is published annually by the National Weather Service. In the Western United States the United States Department of Agriculture Soil Conservation Service has a very organized snow survey program. Monthly and annual Water Supply Outlook Reports are prepared for the eleven western states based on reports from federal, state and private co-operators. The Soil Conservation Service uses computer processing for handling this snow survey data, and as such, it has a well documented procedure for preparing the data. (Soil Conservation Service, 1972). As in Canada, however, there is no national standardized procedure for reporting and publishing snow cover data.

Many members of the Eastern Snow Conference expressed the need for improved organization of snow course information, and consequently, as a member of the Research Committee of the ESC, I set out on the initial phases of standardization, especially as related to snow course site descriptions and snow course reporting.

Two forms, with accompanying detailed explanations, are presented and discussed in this paper. The format of the forms and the type of information required is not final, but is subject to amendment based on suggestions received from interested persons or agencies. Discussions concerning implementation of the following proposals will continue during 1975.

Site Description of a Snow Course

At present, a few agencies prepare written descriptions and up-date the basic information on the snow courses they operate. However, this is not a common practice and background information the site and sampling procedures often relies on word of mouth exchange of information by the individuals involved. It is therefore proposed that every agency operating snow courses should prepare written site descriptions, which can be provided upon request to users of the data. A proposed form and accompanying explanation is outlined in Table I. Some additional comments on this form are warranted.

The responsibility for preparing such descriptions and keeping them up-to-date is that of the operating agency, and not the publishing agency. It is suggested that the latter hold a central file of site descriptions for all courses for which it publishes data. A copy of any revised site descriptions must be forwarded to it, as may be necessary. Ultimately, interested persons may obtain a copy of any site description from either the appropriate operating or the publishing agency.

An integral part of the site description is the provision of a map or maps which would show the snow course in relation to other nearby courses, would outline a route for reaching the course, and would illustrate in detail the exact siting of the sampling points. An example of such a set of maps is shown in Figure 1 (from Soil Conservation Service, 1972, p.2-6). A great deal of information is summarized in these maps. For example, the map of the site shows spacing and identification of the sampling points, direction of the course, its relation to north, associated drainage near the course and vegetation characteristics at the site. If minor or major changes occur at the course location, they should be shown on a revised map. The old map should not be destroyed; it should be retained for reference with the years it was applicable being clearly noted.

A complete explanation of each item of the site description form is provided in Table I. The only piece of information which the operating agency cannot initially provide is the "Station Identification". It would be easiest for the publishing agency to organize the assignment of this identification code since it coordinates information from many agencies. In most cases the station identification will be different from the agency number. A code which is capable of identifying every snow course irrespective of the operating agency is necessary if a central file is to be maintained and the data is to be computer processed.

The identification system suggested is similar, but not identical, to the one used by the United States Soil Conservation Service and the Water Survey of Canada (Calgary). The first four digits refer to latitude - longitude coordinates of the course, and the last two digits are the course's number as provided by the publishing agency. Complete details are provided in the explanation in Table I.

The system outlined provides for the unique identification of each course anywhere in North America. As new courses are established they can easily be given an identification number by the publishing agency, since it is suggested that course numbers be based on order of date established. Even if a course is discontinued, the identification number will be used to identify that snow course since the data and description will be archived for future reference. If a course is moved significantly, a new site description would be required and a new identification number given. If the name remained unchanged, the shift could be identified by a number after the name and the course would be given a new station identification. Using the snow course 'ALBION' as an example, if it is moved but the name unchanged, the old course could become ALBION-1 (794307 being its hypothetical station identification) and the information archived under this code. The new site may be named ALBION-2 (794323, being the new hypothetical identification) and appropriate new site information would be provided. It is important that changes in the siting of snow courses, and/or their name, be properly recorded for this system to operate efficiently.

Following the explanation accompanying Table I, all other items of the site description are to be completed, and kept up-to-date, by the operating agency. One of the most important items is the last one where all changes, minor or major, are recorded. This section must be kept up-to-date if this method is to be successful.

The outline presented for the site description contains information which is required if snow course data is to be put to the test of scientific analysis. These are suggestions, and if an agency presently has their own snow course site biography which covers most of the categories, it may not be necessary to compile a new one. The form should be useful to those agencies who have no systematic record, which if required, would be available to users of the snow course data.

Reporting of Snow Course Data

Table II, and the accompanying explanation, presents a suggested format for reporting snow course information and data in a manner which can be computer processed by the publishing agency. The number under the blanks indicates the corresponding column number on a computer punch card. A master card contains the background information, listed on the reporting form, for every course based on information provided each year by the operating agency. Data cards follow with five days observations on each card. The explanation provides details on the coding required on the form.

Most of the categories are self-explanatory, but one important point must be emphasized. The form is designed to allow reporting in either metric or English units. Under "Units of Measurement" the correct code must be completed before data processing is possible. In Canada, metric conversion is presently in progress and Snow Cover Data is to be published in metric units in 1977. If it is possible, the agency should report its data in metric units, but if this is not feasible, English units may be used and the necessary conversions would be done during the computer processing prior to publication. Metrication will be affecting all agencies, and it is important for the publishing agency to be able to handle the data quickly and easily. A standardized format, as presented, will help achieve this goal.

To increase the amount of information available to users of the data, and yet keep the process simple, a series of codes are necessary for certain categories, for example, the type of snow sampler used by the agency for the survey. Up to now, this information has not been readily available, yet its inclusion would allow the user to correct the data if he felt this to be necessary in his study. Where codes are supplied, it is very important that they be used, as outlined, in order to make the system most effective. This is particularly the case when completing the depth and water equivalent sections of the reporting form. All coding is given in the explanation accompanying Table II.

Summary

The snow course site description and snow course reporting form are the initial steps in the process of standardizing snow course information. At this stage, design of the snow course and frequency of the survey have not been investigated, but future discussions may include these aspects. During 1975, it is hoped operating agencies will comment on the applicability of these forms and on the implementation of standardization procedures. Undoubtedly, there are areas for improvement in these proposals and it is felt that a consensus of suggested modifications will be achieved.

The advantages of the proposed standardization procedures may be summarized as follows:

1. The process allows for a computerized data handling procedure.
2. The forms allow for changes necessary to facilitate metric conversion.
3. More information can be published, allowing for a more complete analysis of the data by the user, if he so desires. Also, there would be a complete site description available to provide background information.
4. The proposed standard format provides a procedure to follow for small agencies, private users, or others, who have no organized data processing method.
5. The amount of work involved in publishing snow course data collected by several agencies will be reduced.

It is hoped all agencies involved in snow course data collection in Eastern North America will seriously consider these proposals and the implementation of standardization. The next step would be national standardization in both the United States and Canada. All agencies are asked to consider these suggestions, and any suggested modifications should be forwarded to the author directly or to the Research Committee of the Eastern Snow Conference.

Addendum

At the 1975 meeting a few initial modifications were suggested and will be incorporated in a revised form to be prepared after other agencies or persons have forwarded their comments. The suggestions include the following points:

- 1) On the reporting form:
 - i) the occurrence of rain or snow since the last snow survey
 - ii) the occurrence of ice layers in the pack and/or notation that there was difficulty in obtaining complete cores
- 2) On the site description form:
 - i) the name of the property owner where the course is located and the date permission was granted for operation of the snow course

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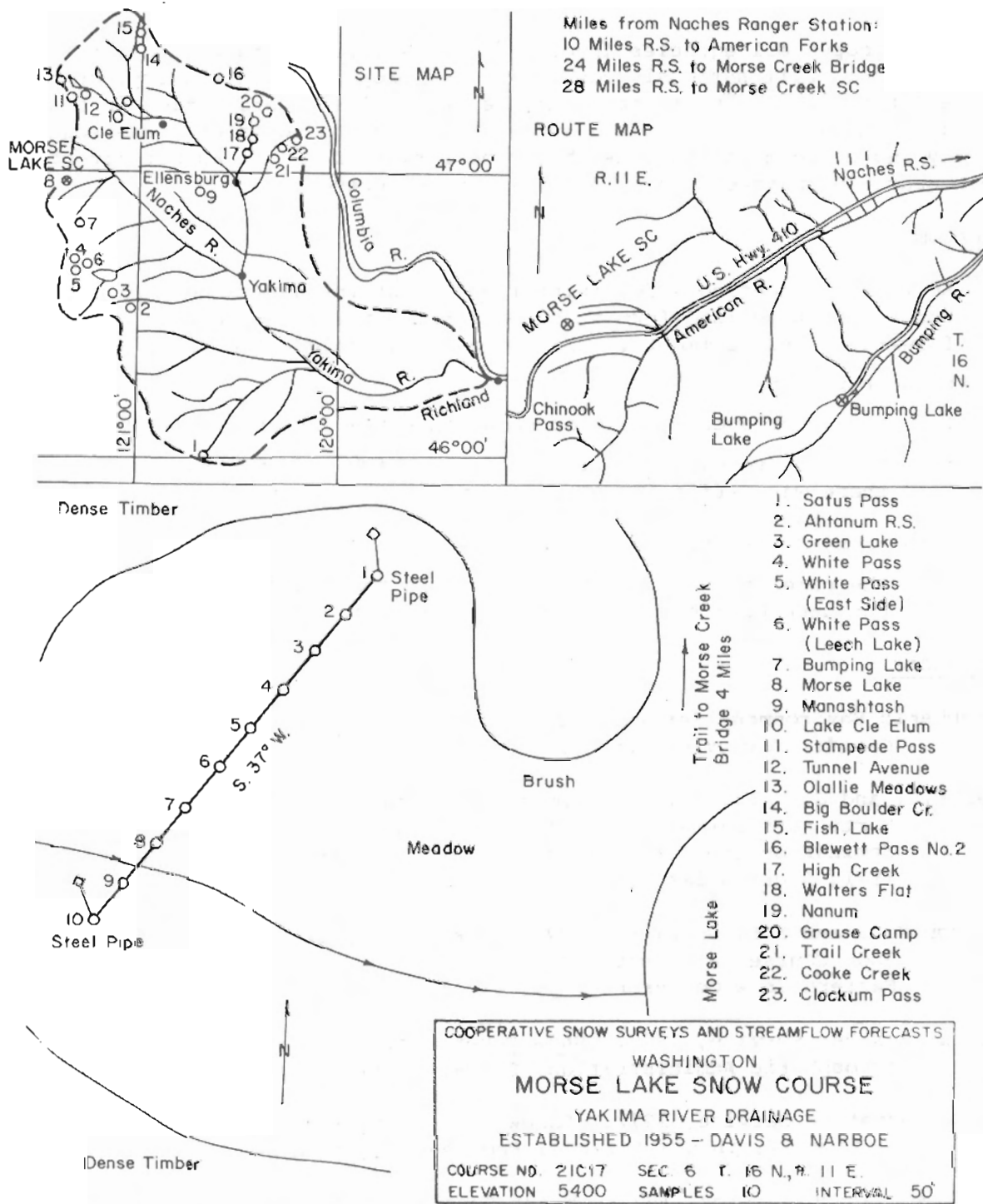


Figure 1 --Typical snow course map.

TABLE I
SNOW COURSE SITE DESCRIPTION

EFFECTIVE DATE: _____

SNOW COURSE
A. NAME: _____ AGENCY COURSE NUMBER: _____

STATION IDENTIFICATION: _____ PROVINCE: _____
STATE: _____

B. LOCATION:
MAP REFERENCE: SCALE _____ NAME _____ NUMBER _____

LATITUDE: _____ LONGITUDE: _____ ELEVATION: _____

DRAINAGE BASIN: _____ MAJOR DRAINAGE: _____ LOCAL: _____

C. GENERAL TOPOGRAPHIC DESCRIPTION OF REGION: _____

ASPECT AND SLOPE: _____ EXPOSURE: _____

LAND USE (base vegetation): _____ DENSITY: _____ HEIGHT: _____

D. MARKERS: _____ NO. POINTS: _____ SPACING: _____

E. NAME/TYPE OF SNOW SAMPLER USED: _____

NAME/TYPE OF CUTTER ON SAMPLER: _____

METHOD OF SAMPLING: _____

MEASUREMENT SCHEDULE: _____

F. DATE ESTABLISHED: _____ BY: _____

OPERATED BY: _____ OBSERVER: _____

G. ADDITIONAL INSTRUMENTATION: _____

H. REMARKS, GENERAL COMMENTS: _____

I. CHANGES IN SNOW COURSE LOCATION AND/OR LAND USE (INCLUDE YEAR AND LOCATION)

Snow Course Site Description

- 1) The snow course site description should be prepared and maintained by the operating agency and held by the agency itself, and in a central file maintained by the publishing agency. It should be available on request to private users of the data.
- 2) A snow course map should be prepared showing the general location of the course; included should be a sketch map of the exact site location. A photo in winter and/or summer would be useful.

Explanation of Snow Course Site Description

Effective Date: effective date of snow course site description.

A. Snow Course Name: as given by the agency operating the survey.

Agency Course Number: this is the number given by the operating agency to the course, if applicable.

Station Identification: this is to be similar to the system used by the U.S.D.A. Soil Conservation Service and the Water Survey of Canada (Calgary), which is based on latitude and longitude coordinates.

e.g. Albion, Ontario (43° 56'; 79° 50') 7943XX
Andover, New Hampshire (43° 26'; 71° 48') 7143XX

- i) The first two digits of the index number correspond to the last two digits of the meridian to the east of the snow course.
- ii) The second two digits of the index number correspond to the two digits of the parallel of latitude to the south of the snow course.
- iii) The last number is the snow course number within the latitude and meridian reference square (in order of date established).

Province, State: self-explanatory.

B. Location: Scale - scale of national topographic map which best depicts location of the snow course (expressed as a representative fraction e.g. 1:50,000)

Name - name of the selected map sheet (e.g. Bolton)

Number - location index of above map sheet (e.g. 30M/13W)

Latitude, Longitude - in degrees, minutes

Elevation - mean elevation of snow course (in metres above sea level)

Drainage Basin - major basin within which snow course is located (e.g. St. Lawrence River)

Major Drainage - major sub-basin, if applicable (e.g. Humber River)

Local - local tributary drainage name, if applicable.

C. General Topographic Description of Region

This gives an indication of the terrain of the region for which the snow course is representative. Descriptors may include the following:

mountain, foothill, flat plain, rolling farmland, river valley, tundra, etc.

A more complete description may read: incised prairie river valley; or, steeply rolling inter-lobate moraine; or, alpine meadow; or flat clay plain.

The agency should use its judgement on describing the region.

Aspect and Slope:

Aspect and slope of the snow course often influences accumulation or ablation patterns. The direction in which the course faces and the approximate slope (in %) should be recorded.

Exposure:

Whether the snow course is sheltered in a meadow, is open and exposed, is in a forest stand, or has some other exposure, should be recorded. Specific features and their distance from the course should be shown on the sketch map of the course.

Land Use:

The principal vegetation over the snow course should be recorded. Examples of such descriptors may be the following: short grass, long grass pasture, aspen forest, corn stubble, spruce forest, cultivated field, rock, etc.

Density:

Some indication of density of the base vegetation should be included. This is particularly relevant for forest stands, e.g. sparse, dense. In a forest a note of the distance between trees may be useful.

Height:

Height of the base vegetation should be recorded. This applies to all vegetation categories, forest, or grass (in metric units).

D. Markers: (if applicable) - the type of marker used to identify sampling points.

Number of points: number of sampling points in the snow course.

Spacing: distance between sampling points (in metres).

E. Name/type of snow sampler used: give the name of the sampler used for the snow survey, e.g. Federal, Adirondack, M.S.C. etc.

Name/type of cutter on snow sampler: provide some indication of type of cutter e.g. 16-tooth, 8-tooth, bung, etc.

Method of Sampling: technique commonly used - individual point, or bulk weighing.

Measurement Schedule: once a week, biweekly, once a month, etc. or just once a season at time of maximum accumulation.

F. Date Established: month and year.

By: original agency establishing the snow course.

Operated by: agency presently operating course.

Observer: name of observer and date he commenced observation.

G. Additional Instrumentation: if there is additional instrumentation at or near the snow course it should be mentioned. If a different agency handles and processes the data, it should be indicated. Examples of such instrumentation include: snow pillow, temperature, humidity, soil moisture, etc.

H. Remarks, General Comments: if there is something special about the snow course it should be mentioned.

e.g. - course discontinued

- extra depth measurements are taken between density sampling points
- gradual changes in the base vegetation.

I. Changes in Snow Course Location and/or Land Use:

Significant changes in any of the above descriptors should be recorded here. The change and the year it occurred should be recorded, e.g. change in type of sampler used, sampling method, spacing of points, observer etc. Such information would supercede previous information. Changes in site location would require a new diagram and site description to be prepared. The old description should be retained on file and the years of operation clearly noted. This is particularly important if the course is moved and the old name retained. Changes in land use should be recorded, and gradual annual changes in the base vegetation should be periodically noted. For example, a new planting of seedlings will produce a mature stand of trees over a period of years, which will influence snow cover characteristics along the course. A note of their changing height and density could be easily recorded every few years.

TABLE III
 SNOW COURSE REPORTING FORM
 FOR THE YEAR 19__ - 19__

STATION IDENTIFICATION: 1 - - - - - 6
 STATE, PROVINCE: 8 9
 DRAINAGE BASIN NAME: 10 - - - - - 29
 SNOW COURSE NAME: 30 - - - - - 52
 ELEVATION (metres): 53 - - - 56
 LATITUDE: 57 - - - 60 LONGITUDE: 61 - - - 65
 CONTRIBUTING AGENCY: 66 67 NUMBER OF YEARS OF RECORD: 68 69
 UNITS OF MEASUREMENT: 70
 NUMBER OF SAMPLING POINTS: 71 72 SPACING OF POINTS (metres): 73 - 75
 TYPE OF SNOW SAMPLER: 76 77
 SIGNIFICANT CHANGES IN SNOW COURSE FROM PREVIOUS YEAR: 78
 SNOW COVER DATA FOR THE YEAR 19__ - 19__ 79 80

<u>YEAR</u>	<u>MONTH</u>	<u>DAY</u>	<u>MEAN DEPTH</u>	<u>MEAN WATER EQUIVALENT</u>	<u>NUMBER OF SAMPLE POINTS WITH NO SNOW</u>
<u>11</u>	<u>12</u>	<u>13</u>	<u>15</u>	<u>19</u>	<u>23</u>
<u>25</u>	<u>25</u>	<u>27</u>	<u>29</u>	<u>33</u>	<u>37</u>
<u>39</u>	<u>40</u>	<u>41</u>	<u>43</u>	<u>47</u>	<u>51</u>
<u>53</u>	<u>54</u>	<u>55</u>	<u>57</u>	<u>61</u>	<u>65</u>
<u>67</u>	<u>68</u>	<u>69</u>	<u>71</u>	<u>75</u>	<u>79</u>
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Additional Remarks _____

SNOW COURSE REPORTING FORM
EXPLANATION

STATION IDENTIFICATION: Assigned as outlined in snow course site description.

STATE, PROVINCE: The publishing agency should assign a code for each province or state. This code will be filled in here.

DRAINAGE BASIN NAME: Name of the major basin and sub-basin within which the snow course is located. (Short forms or coding may be necessary).

SNOW COURSE NAME: Name given by the agency responsible for the survey.

ELEVATION: Mean elevation of snow course (in metres above sea level).

LATITUDE, LONGITUDE: In degrees, minutes.

CONTRIBUTING AGENCY: The publishing agency should assign a numeric code to all contributing agencies. This number is used in these columns. For example, this has been done by the Atmospheric Environment Service for all Canadian contributions to Snow Cover Data.

NUMBER OF YEARS OF RECORD: The number of years, including the present one, for which snow cover data is available.

UNITS OF MEASUREMENT: The following code must be completed: SI: 1
English: 2

NUMBER OF SAMPLING POINTS: Number of points in the snow course at which both depth and density are measured.

SPACING OF POINTS: Distance between sampling points (in metres).

TYPE OF SNOW SAMPLER: The following code should be used:

Federal (16 tooth)	01	Bowman (plastic)	05
Federal (8 tooth)	02	CRREL 500-cm ³ tubes	06
Adirondack	03	Other	10
Canadian M.S.C.	04		

SIGNIFICANT CHANGES IN SNOW COURSE FROM PREVIOUS YEAR: A change in any of the descriptors on the snow course site description may constitute a significant change in the snow cover data. The change should be recorded as follows: NO: Blank
YES: 1

Details of changes should be recorded on the agency's site description. The notation of a change on the reporting form will allow users to consider this fact when comparing snow course data.

SNOW COVER DATA SUMMARY FOR THE YEAR 19__ - 19__

- insert appropriate years.

Form should be completed by row in order of consecutive surveys, commencing with first fall or winter survey completed.

Year: Insert the unit digit of the year of the particular survey, e.g. for 1974, insert 4.

Month: Insert month of the survey according to the following code:

1 JANUARY	6 JUNE
2 FEBRUARY	7 JULY
3 MARCH	8 AUGUST
4 APRIL	9 SEPTEMBER
5 MAY	

Letter (Ø) punch for October.

"11 punch" and a (1) punch for November (Letter "J")

"11 punch" and a (2) punch for December (Letter "K")

Day: The exact day the survey was done.

Mean Depth:

- a) SI units: to be entered in centimetres and tenths of centimetres.
- b) English units: to be entered in inches and tenths of inches.

As well, the following conditions must be coded if applicable:

NO SNOW: 0.0
PATCHES: P(insert right hand column)
TRACE: T(insert right hand column)
NOT
MEASURED: - (insert in right hand column)
MISSING
OR NOT
REPORTED: M (insert in right hand column)

Mean Water Equivalent:

- a) SI units: to be entered in even millimetres (right justified: e.g. 150 millimetres is entered as 0150 - units digit is in far right hand column).
- b) English units: to be entered in inches and tenths of inches (right justified - tenths digit in far right hand column).

The additional codes given under mean depth should be employed if necessary. A common one would be "not measured" (-).

e.g. mean depth: T
mean water equivalent: -

Number of sampling points with no snow:

During certain periods of the winter some sampling points will have no snow, yet there will still be a mean depth and water equivalent determined for the course. Enter here the number of sample points with no snow.

e.g. on a 10 point course 4 sampling points may be bare. Enter 04 in the appropriate spaces. Enter NA if the information is not available.

Additional Remarks: Special circumstances may prevail on a course during any winter. Appropriate comments could be entered here.