SNOW SURVEYING MANUAL

Standards and Procedures

CONSERVATION AUTHORITIES AND WATER MANAGEMENT BRANCH

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CHAPTER 1

SNOW SURVEY - GENERAL INFORMATION

Snow surveys at designated stations are made at regular intervals during the winter months to determine the depth of the snow pack and its water equivalent. The data obtained are of value in estimating the spring run-off potential, agricultural productivity and fertilizer requirements, waterfowl populations, etc. Furthermore, they have application concerning livestock and wildlife survival, and in such problems as snow loads on roofs, etc.

SITE SELECTION

Much of the success of any snow survey program rests with the selection of the observation sites. The snow survey sites should be representative of the surrounding area, easily accessible, free from excessive wind drifting, and should be in locations where permanence of the site, and thus continuity of record, can be reasonably assured.

The requirements for a snow survey course are, in general, similar to those for the best site for a precipitation gauge. The type of site which has been found to yield the most consistent and reliable results is an opening in a wooded area surrounded by hills for protection from high winds, and sloped sufficiently to permit run-off of water beneath the snow pack.

The ideal site, however, is seldom available. Courses should sample the areas of both heavy and light snow accumulations. The sample points should be away from snow fencing, buildings, trees, hedges and other obstructions which cause abnormal winds and consequently abnormal drifting of snow. For streamflow prediction, it is often desirable to select representative sites which contribute most to runoff. In forest areas, meadows usually provide good locations. Snow courses are normally selected and maintained in areas having natural grass cover, since land manipulation can affect snow accumulation and retention.

A number of practical matters should be kept in mind when selecting a snow course site. First of all, the observation points should not be located in areas where a small rivulet runs or where water becomes ponded after a rainstorm or during snowmelt periods. Secondly, sharp irregularities in the ground level should be avoided, and observation points kept away from boulders, fallen logs, underbrush or shrubs.

It is also important to select sites accessible on foot, skis or by vehicles, remote from road and runway snow removal and snow dumping activities, free of secular trends and topographic effects.

THE SNOW SURVEY COURSE

A snow survey course consists of 10 fixed sampling locations at which the survey is made twice per month, on the 1st and 15th.

NOTE: The above dates are desirable, but not mandatory. If the survey on the specified date is not feasible, it may be delayed or advanced one or two days.

The 10-point course should be established as follows:

a. Preferably along a straight 270 m base line.

b. If a 270 m base line is not possible, a "T", "Z", "L", "+" or other shaped course is acceptable, provided no sampling bias is introduced.

c. 10 sampling points, 30 m apart.

d. All sampling points clearly designated - first and last points clearly indicated, preferably by markers on metal posts.

PREPARING, MARKING AND MAPPING THE SNOW COURSE

After a suitable site has been selected, the observing points should be located and numbered. This may involve the installation of numbered stakes to mark the sampling points or the suitable marking of trees, fence posts, telephone poles, etc. The marker should be precisely at the sampling point.

Sketch maps or photographs of each course must be prepared showing the location of each of the 10 sampling points, the vegetation area, the type of marker for each observing point and giving the topography of the land at the course site. Copies of this sketch map or photograph will be used by the observers in taking samples along the course, and, one copy should be forwarded to Headquarters to be used as a reference by data processing personnel who interpret the data.

In addition, the snow survey course site should be marked on a regular topographic map of the region, which will show the surrounding influences on wind and snow deposition at the course site. Two such maps will be required, one for retention in the Office and one for Branch Headquarters.

CHAPTER II

SNOW SURVEY EQUIPMENT

THE MOUNT ROSE (FEDERAL) SAMPLER

a. For use in areas where the snow depth does not exceed 150 cm.

b. Inside diameter of the cutter is 1.485 inches (37.7 mm).

c. One ounce (28.35 g) of snow/ice core from this sampler has a water equivalent of 1 inch (25.4 mm).

NOTE: A core of snow from this sampler is said to have a water equivalent of one inch if its weight equals that of a 1 inch column of water having the same cross-section; i.e., the water equivalent is the depth (in inches) of water of an equal cross-section that would result from the melting of a core of snow.

Parts of the Mount Rose Sampler (See Figure 1).

A complete set of Mount Rose snow-sampling equipment consists of:

ITEM

(1) One length of tubing with a 16-tooth cutter

(2) One length of extension tubing (extra extension tubes may be added as required)

(3) A spring balance and weighing scale

(4) A turning and driving handle

(5) Two spanner wrenches for screwing and unscrewing the tube sections.

(6) A snow removal tool (bent blade)

(7) Weighing cradle

(8) A notebook

(9) Carrying case

(10) Markers 1 to 10 - Marker No.1
Marker No.2
Marker No.3
Marker No.4
Marker No.5
Marker No.6
Marker No.7

Marker No.8
Marker No.9
Marker No. 10

The Cutter Section and Extension Tube. The lowest section of the tube carries a 16-tooth cutter; each section of the tube has several milled slots into which the turning and driving handle fits and through which the length of the core may be seen. The sections carry inch graduations numbered from bottom to top. The sections should always be coupled in the correct sequence of numbers.

The Spring Balance and Weighing Scale (See Figure 2).

An extensible spring balance is provided. Two scales are inscribed on the balance. The scale with the shorter, closely-spaced calibration marks will be used with the Mount Rose Sampler. These graduations are coloured black and each division represents one inch of water equivalent, or one ounce of the snow core.

Carrying Case. All of the components fit into the carrying case shown in Figure 1. The lowest tube section must be inserted so that the protective flap prevents the cutter from damaging the carrying case.

Tube. Normally, the cutter tube and one extension will be sufficient. However, additional extension tubes may be required in certain localities. Connect the sections together using the spanner wrenches provided, but do not tighten excessively. As the cutter teeth are very sharp, extreme care should be taken when carrying the cutter section with the teeth exposed.

PARTS OF THE MOUNT ROSE SAMPLER

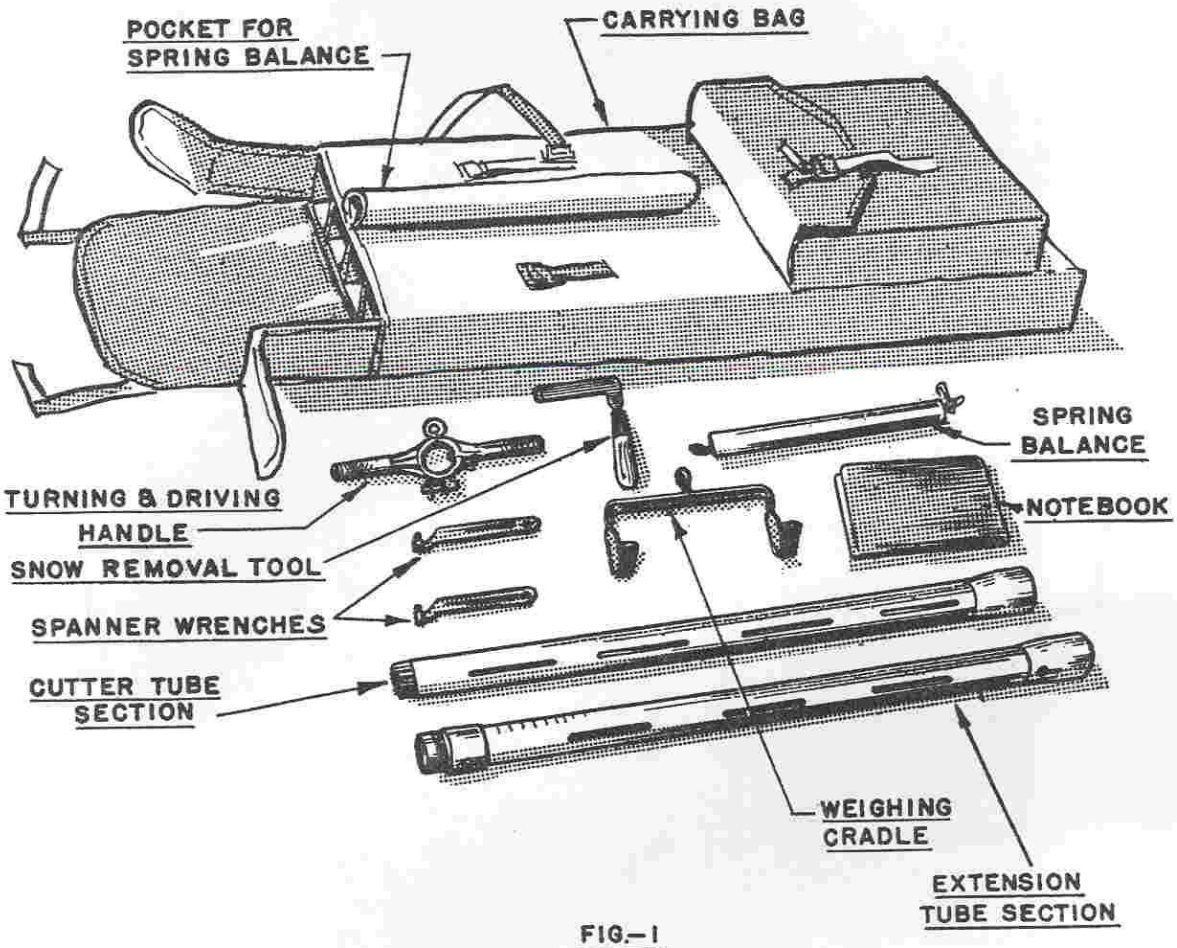

FIG.—1

THE SPRING BALANCE AND WEIGHING SCALE

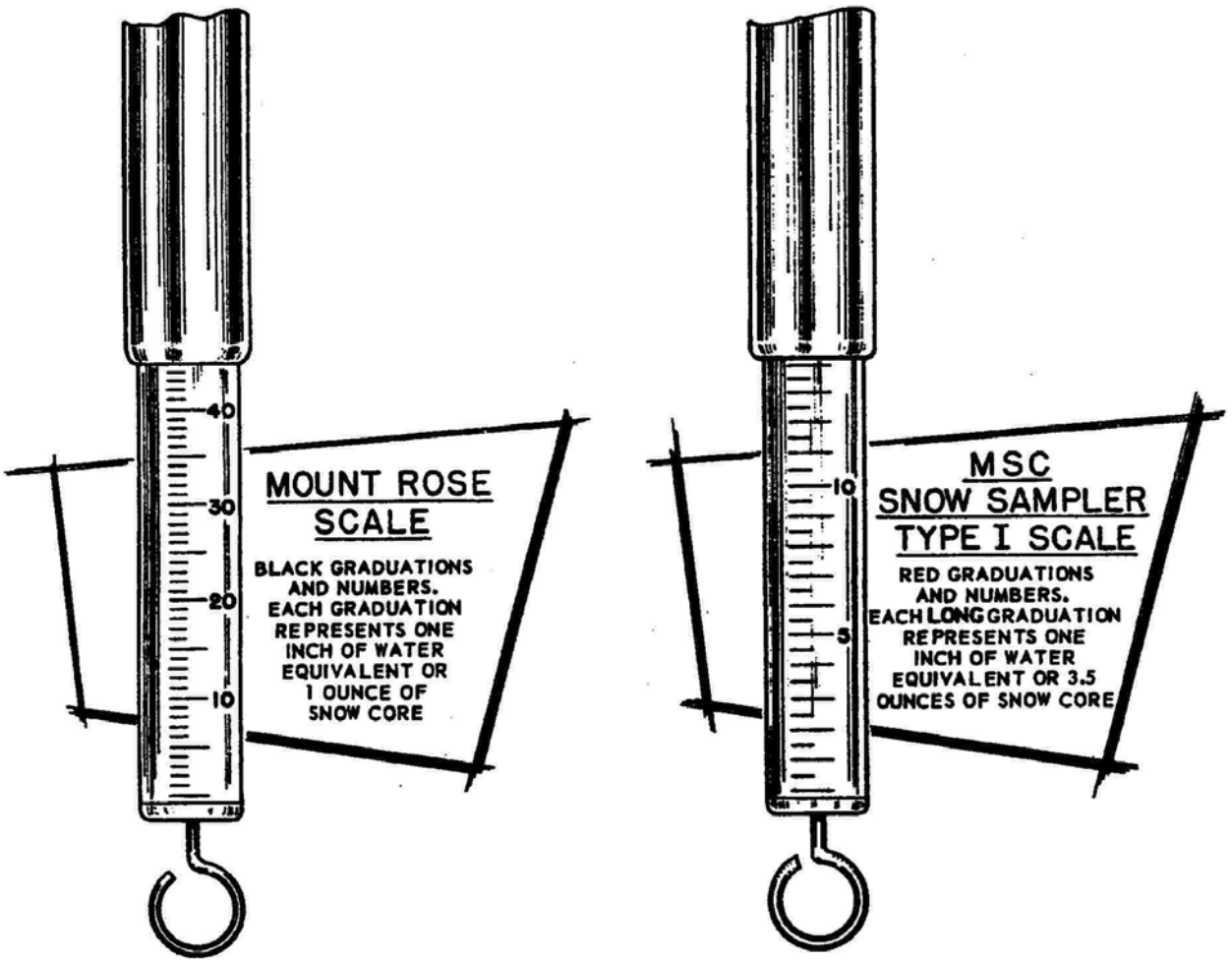

FIG.-2

CARE AND MAINTENANCE OF EQUIPMENT

Proper care and maintenance of snow sampling equipment, in conjunction with proper observing techniques, are absolutely essential if consistently reliable snow survey data are to be obtained. Clean, well-waxed snow tubes and a sharp cutter will eliminate many of the difficulties encountered in obtaining accurate samples.

Waxing. The snow tube should be given an application of wax at the beginning of the

season, at midseason, at the end of the winter, and more frequently if, in the opinion of the observer, it is considered necessary. This prevents the metal from becoming wet, and thus allows the tube to slip through the snow easily. Self-polishing liquid wax is the easiest to apply. However, paste wax has been found to work well and is easily applied.

Dull Cutter. The cutter may become dull from repeated use. A dull cutter can cause significant errors, as well as making the sampling in some types of snow more difficult. Care should be taken to maintain the cutter in good condition by drying and greasing after use and by regular sharpening, at least once a year, or more often if damaged by rocks, etc. As far as possible, the selected sampling points should be free from rocks, concrete, asphalt or other surfaces that will blunt or break the cutter.

Spring Balance Check. The spring balance should be checked for accuracy (:t 1 oz.) at the beginning and ending of each snow survey season. This check can be performed as follows:

a. Suspend from the balance a pail which is heavy enough to register a positive reading on the scale.

b. Repeat Step "a" several times, to ensure that the balance will give consistent repeat readings.

c. Add one quart of water to the pail. The combined weight of pail and water should be 40 ounces more than the weight recorded in Step "a". (On the black scale, each graduation represents one ounce.)

The spring balance should also be checked from time to time during the season. Consistent repeat readings should be observed, with no indication of appreciable sticking.

Do not apply oil or wax to the spring balance.

If the balance is clearly defective, a replacement should be requisitioned, and the defective balance should be returned to Headquarters with accompanying information as to the nature of the defect.

CHAPTER III

MAKING THE SNOW SURVEY

The snow survey should commence on the first snow survey date after the snow cover first reaches 2 inches (5 cms) or more in depth, and should continue as scheduled until the survey date following the final disappearance of snow on the ground at four or more points on a 10-point course.

Accuracy is essential. An error in measurement affects not only the current year's report but also statistical analyses of the data for years to come. Special care should be taken to avoid errors while reading snow depths and weights, and to ensure that the core sample represents the full depth of the snow.

BEFORE TAKING THE FIRST SAMPLE

a.

Cool the sampling tube to ambient air temperature. It is not advisable to place the tube in the snow for this purpose, since an irregular crust may form on the tube surface.

b.

Record the spring balance scale reading for the empty sampling tube.

i)

Check the spring balance scale reading for the empty tube after every third sample.

ii) Obtain a new spring balance scale reading for the empty tube whenever the turning handle is put on or taken off.

SAMPLING

The snow sampler is used as a drill to cut and extract a core of snow from the snow pack. To ensure that the core is complete, it is desirable to cut into the sod or prepared surface beneath the snow, removing a little of the top soil or litter in the form of a plug. The sample must be taken with the tube held vertically.

Very slight pressures are required to drill through the snow. The sampler should be rotated gently, caution being used to see that it remains vertical. The weight of the sampler will cause it to descend in a light snow pack. Excessive downward pressure should be avoided, as this may cause the instrument to "snow-plough" if ice layers are contained in the pack. Such blocking of the sampler tube is indicated when the snow level within the tube is observed to be well below that of the pack.

More vigorous cutting rotation is required when ice layers are encountered in the pack. At the ground level, considerable downward pressure may be exerted. However, excessive prying or bending may cause the instrument to buckle and should be avoided. If the sampler should encounter crusty or icy layers, a slight amount of clockwise turn should be imparted to the sampler. This brings the cutter into play, which allows for penetration of the rigid layers. Hesitation or stoppage in the downward motion tends to encourage clogging. If the snow pack is deep and dense or otherwise difficult to sample, slower and more or less interrupted progress is unavoidable. In some cases, it may be necessary to sample down to an ice layer in one operation, and then below this in a second operation.

A difference in sawtooth "bite" will indicate when the soil is reached. The soil should be penetrated about an inch, or deeper if necessary, so that a soil "button" or trash is removed along with the snow sample. When the soil is penetrated, give the tube a half turn; this may help retain the core. If the surface at the sampling point indicates that it would be difficult to obtain a soil "button", these areas may be prepared prior to the first snow by spreading a one-inch layer of sawdust or peat moss in the sampling areas. It has been found that a

sheet of Ten-Test placed on the bare ground at each sampling point makes an excellent base from which a plug or button is easily obtained. When making use of prepared sampling surfaces, it is recommended that a definite sampling pattern be followed at each point, to ensure that sections previously cut are not used in the subsequent samples.

When the ground is first encountered, observe the depth of snow on the outside of the tube and check that the length of the snow core is reasonable. If the snow depth does not appear reasonable or if the snow core is excessively less than the snow depth, empty the tube and re-sample. Record the snow depth in inches and tenths.

The sampler should be extracted from the sample hole with care to prevent spillage from the tube. Care must also be taken to prevent soil from spilling on the snow in the sampling area, since this may produce melt holes and thus make the snow unsuitable for future sampling.

At each sampling area, the first sample should be taken at the initial point as shown on the sketch map of the course, and subsequent samples should be taken at points indicated by the sketch map, indicator stakes or signs. Care should be taken to sample close to the same spots each time.

Before taking each sample, inspect the sampling tube to make sure it is free from snow, dirt or other extraneous material. The cutter teeth must be clean prior to each sampling. (Never look through tubes with the cutter next to your eye.) The core may be removed by tapping or shaking the sampler tube or by using the snow removal tool to remove the remaining core. Care must be taken not to dent or otherwise damage the sampler tubes.

Each sample should be taken in undisturbed snow. Particular care should be taken to avoid trampling of the snow where subsequent samples will be taken.

Survey Invalidated. Under some conditions, the survey will be discontinued:

a. If major interference with the snow cover is encountered, i.e., trampling or removal, etc., and suitable alternate points are not available, the survey should cease.
b. If, at 4 or more points on a 10-point course, total loss of snow cover (due to natural causes) is encountered, discontinue the survey. However if, at a later date, the snow pack is restored, resume sampling.

WEIGHING THE SAMPLE

Before weighing the sample, all soil or litter should be removed from the end of the core. In most cases, it will be necessary to cut the plug out with the cleaning tool or a pocket knife.

If weighing is done in the field, it may be necessary to suspend the balance from a firm support in order to prevent oscillation of the scale during the weighing process. The balance should hang freely and be suspended from the ring only. A loop of wire or a thong through the ring may be required in order to suspend the balance from the firm support. The weight of the empty tube and cradle, as read on the scale markings, will always be greater than zero.

If weighings are made in the field, the wind may make it difficult to obtain accurate readings on the spring balance. If shelter is not available, stand with back to the wind, sheltering the balance.

All weights are recorded in water equivalent inches and tenths.

WEIGHING IN THE FIELD

If there is a local or regional requirement for complete data from each sampling point on the course, individual samples shall be weighed in the field. The procedure is as follows:

a. Record the spring balance scale reading for the empty sampling tube.

b. At each sampling point, weigh the tube and snow core, making sure that the sample remains in the tube. Record the total water equivalent. From the total, subtract the previously-determined empty tube weight; the difference is the water equivalent of the sample.

c. When complete data are required for each sampling point and it is not convenient to weigh individual samples in the field, plastic bags may be used as containers in which individual samples are collected for weighing indoors, after the other field measurements have been made. When this procedure is followed, one plastic bag is required for each snow core sample, and all weight calculations are performed indoors, prior and subsequent to field sampling. The snow surveyor, prior to taking field measurements, should weigh and label one plastic bag for each sampling point on the snow course. It will be necessary to add to each bag sufficient weight to obtain a positive reading on the scale. The snow surveyor should then ensure that the snow core from sampling point Number 1 is deposited in a plastic bag labeled No. I., etc.

RECORDING SNOW SURVEY DATA

Field notebooks will be provided for rough initial recording of observations.

A Snow Survey Bi-Monthly Report shall be completed in duplicate, to provide a record of snow survey observations.

Completing Form:

Enter month, year, station name and Province.

Equipment - Indicate type and any significant notes concerning instrument repair, replacement, etc.

For each survey, the following information is required:

a. Observer's name.

b. Date.

c. Time began (LST).

d. Time ended (LST).

e. Crust information, Le., thickness, crust layers, etc.

f. Soil condition, Le., frozen - not-frozen - dry - wet - etc.

g. Ice layers and thickness at ground level or in the snow above ground level.

h. Values of mean snow depth and mean water equivalent in the "Average" near the bottom

of the form. (These are obtained from Columns 2 and 5).

i. Remarks. This section should be used to report any problems concerning equipment, . maintenance and other facts relating to the snow surveying program.

Entries, as follows, are required in Columns 2 through 7, with complete data for each point on the course:

INDIVIDUAL SAMPLING (Each point on the course)

Column 2 Record depth of snow in inches and tenths for each point on the course (as read from the outside of the sampling tube). Enter total and mean.

Column 3 Record, for each sampling point, the weight of the empty sampling tube or, if individual samples are collected in plastic bags, record the weight of the plastic container.

Column 4 Record, for each sampling point, the combined weight of the sampling tube or plastic container and the snow core.

Column 5 Record, for each sampling point, the weight of the snow core (ounces and tenths). Enter total and mean (ounces and tenths.)

Column 6 Record the condition of the snow crust:

A = no crust
B = light crust
C = crust strong enough to support a man on snowshoes D = crust strong enough to support a man

Column 7 Record the condition of the soil:

F = frozen
UD = unfrozen dry UW = unfrozen wet

Keeping in mind the nature of the snow pack at the various sampling points, a seemingly

unrealistic value for snow density should alert the snow surveyor to check for a possible discrepancy in scale readings, scale accuracy, calculations, etc.

NOTE: Means and totals shall not be recorded if any point on the course is without snow cover.

A nil report will be required at the end of each snow cover season.

DISTRIBUTION OF SURVEY FORM

Promptly at the end of each survey, the original copy of data sheets will be forwarded to the regular collection centre. The duplicate copy will be retained at the station.

NOTE:

On the completion of each survey. the course water equivalent shall be sent promptly to the Branch collection centre. This information is of particular value to water users in calculating the potential run-off during the late winter and spring.