METRICATION OF BRITISH COLUMBIA SNOW SURVEY OPERATIONS

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By

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Both the Canadian Federal and British Columbia Provincial Governments have made commitments to metric conversion, to be completed in 1980. This process is in various stages of planning and implementation in different agencies with which we, the Hydrology Division of the B.C. Water Investigations Branch, co-operate on a regular basis. For instance, the Atmospheric Environment Service of Environment Canada have officially published temperature and precipitation in metric units since April 1 and September 1, 1975, respectively. It is clearly desirable to work with compatible units in this type of situation. Another major factor in deciding to go metric when we did is the fact that our Summary of Snow Survey Measurements, compiled every five years, was due for publication before the 1976 snow survey season. Because metrication would definitely have to take place within the next five years, it was desirable to have a summary of all measurements to date published in metric units. So the decision was made to issue the 1935-75 Summary in metric, followed by the metric 1976 Snow Survey Bulletins.

Units

The most important units relating to snow surveying are those used to describe snow depth and water equivalent. Snow depth is now quoted to the nearest centimetre, as compared to the nearest inch (2.54 cm) in English units. Water equivalent is quoted to the nearest millimetre, compared to the nearest tenth of an inch (2.54 mm) in the old system. These units correspond with those used for snowfall and precipitation by the Atmospheric Environment Service. They are very convenient becuase the use of decimals is not required, which simplifies (manual) data processing. These units do, however, imply an increase in precision by a factor of 2.54, which may not be attainable in actual field measurements.

The metric units used for these and other measurements related to snow surveys and the B. C. Snow Survey Bulletin are summarized as follows:

snow depth	centimetres (cm)
snow water equivalent	millimetres (mm)
precipitation	millimetres (mm)
elevation	metres (m)
streamflow	cubic metres per second (m^3/s)
runoff volume	cubic metres (m^3)
reservoir storage	cubic metres (m^3)
temperature	degrees Celsius (^oC)

Computer Data Processing

Back records for regular (January 1-June 15) sampling periods of active snow courses are all stored on computer tape. Special samples and data from inactive courses are stored on punched cards. New tapes of the data in metric form were created by multiplying by the exact factor and rounding off to the desired precision, storing the data as a fixed point variable instead of floating point. Several programs were modified to include printing format changes, and averages were recalculated using converted basic data to avoid round-off errors. The computer programming related to metrication, although not very complex, did involve approximately one man-week of work, spread out over a period of time. In certain cases, metrication of the computer data processing system might provide a good opportunity to carry out other "housekeeping" work, or even the design of an improved system. We were unable to take this opportunity for a much needed re-design, but perhaps other agencies can keep this in mind when planning their changeovers.

1976 Operations

In mid-January, 1976, the Summary of Snow Survey Measurements from 1935 to 1975 was published in metric, providing a reference of back data. The 1976 series of Snow Survey Bulletins, beginning with the February 1 issue, are also metric. Because the data in the

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Bulletin is presented in comparative form referred to average values, previous extremes, and the two previous years' values, the casual reader of the bulletin should have very little difficulty comprehending the relative magnitude of the snow survey data. To the reader of these publications, it might appear that our entire operation is now metric. This is unfortunately not yet true.

For the 1976 season all field measurements and notekeeping use only the old system of English units previously described. Data is transmitted by telephone or Telex in the old system, but is converted to metric immediately upon receipt in Victoria. All manual data processing relating to the Snow Survey Bulletin is then carried out in metric. This involves:

1. computation of density, per cent of average.
2. scrutiny - comparison with long-term and current trends.
3. calculation of regional snowpack indicators.
4. estimation of missing or poor data.

After the field notes (in English units) are received and checked, data is put on the permanent records in metric units.

Certain activities related to snow surveys and the Bulletin, such as volume flow forecasting, are still carried out in the old system of units. This involves a good deal of back and forth conversion and work in mixed units, but the resulting forecast is published in metric. In time, all these procedures will be carried out entirely in metric, and hopefully by computer.

Equipment

It appears that metrication of equipment may be the greatest problem and expense of the entire changeover process. This will involve several major groups of equipment - sampling kits, automatic recorders, plus other miscellaneous equipment.

In the miscellaneous category are tools, repair equipment, snow course station reference plates, weights for calibration of snow survey scales, etc. None of the items in this group are very high priority; most will be replaced or changed over a period of time as individually necessary. Some of the present inventory of tools and equipment will not need to be changed, such as our existing supply of "metric" hammers, saws, crescent wrenches, and the like. This is good because our efforts and budget will need to be spent on other items such as our automatic recorders and sampling kits.

Our present inventory of recorders consists of two Leupold-Stevens A-71's and eleven F-type recorders, not a very large network compared to some. The conversion kit for the A-71 will cost \$330 compared to about \$1,250 for a new machine. For the F-type recorder, metrication will cost about \$280 per unit, the new cost of which is about \$700. Total cost for conversion parts for all our recorders will be \$3,500 to \$4,000. This represents approximately 35-40% of the replacement value of the inventory. Not included in these figures is the cost of time and travel involved with bringing the equipment to Victoria, rebuilding, and re-installation in the field sites. Normally, the recorders would be removed from field sites for the summer, but not returned to the head office, so extra work will be required in this respect. There will be other benefits, however, like the opportunity to perform routine inspection, maintenance and testing which should be done from time to time anyway, but is generally neglected until failure occurs. This makes it difficult to specify the labour costs of metrication alone, but it is estimated that the time required to overhaul each recorder is an hour, so this is small in comparison to parts costs.

Our biggest and most costly equipment changeover will be the snow sampling kits. Our inventory consists of about 400 tubes or 100 kits of the standard Federal (or Mount Rose) design. Based on quotes of a year ago, the present replacement cost of the components which would require changes for metrication is about \$90 per cutter tube section, \$65 per regular tube section, \$85 per weigh scale. An estimate was obtained for recalibrating the tubes in centimetres, and the price quoted was in the range of 35-40% of the cost of new tubing. For 400 tubes the total cost would be around \$10,000. At that price, it appears that it would be much more economical to hire student summer help to do the job ourselves. This would require the construction of a jig on which a tube can be mounted, adjusted for zero or any sequential, even centimetre starting point, and then have depth marks scored every centimetre by hack saw or preferably some more sophisticated cutting device. The numbers would then be added every five centimetres by metal punches. A production line operation with quality control will be needed in order to limit the possibility of errors in the sequential marking of tubes in a kit. The present marking system is sequential with 60 marks, one every half inch on a 30-inch tube. Becuase the 30-inch tubes are equivalent to 76.2 centimetres, the marking of a kit of several tubes must be done in the correct sequential order. In order to avoid use of the old inch scale in field work, the inch depth numbers (not marks) will need to be scored out, and the marks and numbering for the metric depth scale will be painted red in the indentations. Although the time involved to do this job with summer student labour can only be estimated at this time, and the resulting job may not be a professional as if it was done in a machine shop, the costs will be only 1/3 to 1/2 as much. These plans are not final at this point in time, but we would hope to proceed with this action during this summer in order to be able to carry out field work in metric for the 1976-77 snow survey season. The new field notebooks and sampling guides required for metric field work will be simple and relatively cheap to introduce.

We also need to purchase some new snow sampling kits this year to use for new snow courses, and to replace lost or damaged kits. This year we will need about 20 kits of 4 or 5 tubes each plus the driving wrench and weigh scale, at a total cost of around $10,000. The kits will be ordered with Federal type tubing, except that depth markings will be in centimetres only. Scales for these new kits, as well as for the existing inventory, will need to be calibrated to read directly in millimetres of water equivalent for the weight of the snow core.

We feel that it is unfortunate to spend about $10,000 this year on these new kits which are of "mixed" design, but this will at least result in a complete inventory of interchangeable parts at this time.

We also feel that the time has come for the design of a standard metric snow sampling kit, to be adopted by all agencies in North America at least. This new kit may have only minor changes from the Federal kit which dominates the scene today, such as changing the tube length to 80 cm (or some other even number of centimetres) and using metric threads. However, it may also be quite different in design. The only critical dimension of the Federal kits which cannot be changed much without sacrificing continuity in records is the cutter diameter. The accuracy of a snow tube sampling technique is dependent on the diameter of tubing used, and the Federal cutter diameter is known to result in an error of 8-10% above the true water equivalent at a sample site. This bias in the existing records must be retained in the design of new sampling equipment, or if new equipment is different in this respect, extensive testing must be done to determine correction factors for the back records of snow data. It may be more desirable to retain the same bias.

There are, however, many other aspects of the design of snow sampling equipment that could be changed such as tube length, coupling design, thread design, or even materials used for the kit. With the space age technology of today, it is feasible that better materials such as metal alloys or maybe even synthetics such as plastic could be suited for our use.

While the basic research required for extreme re-design and testing of sampling gear is beyond the scope of operational agencies such as ours, all operating agencies do have considerable experience in the use of the equipment which would be valuable in the process of designing a metric snow sampling kit. The sooner that a consensus is reached on this question, the better it will be for the practical and financial considerations of operating a snow course network. I hope that these comments will stimulate some continuing discussion on this matter that will result in continent-wide agreement and action by those of us involved in the field of snow hydrology.