WESTERN STATES SNOW SURVEYS AND SEASONAL WATER SUPPLY FORECASTS

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It is a great privilege, after years of geographic separation, to attend this meeting of the Eastern Snow Conference. Your speaker had the good fortune, ten years ago, under tutelage of Arthur Harrington and Arvi Waananen, to visit a small part of the Eastern Snow Survey net. These engineers demonstrated the methods and survey procedures then favored hereabouts. I am happy to be able to return to learn more of your systems and procedures for snow surveying and runoff forecasting.

In significant respects there is marked similarity between Snow Survey activities here and farther west. Snow surveys out West may perhaps be somewhat more extensive in geographical scope, but are founded upon the identical principles of cooperation which obviously have strengthened and nourished the Eastern cooperative snow surveys through the years.

I will try to describe the job underway west of the Mississippi by the Federal-State-Private cooperative snow survey and water supply forecasts group. These agencies work in close harmony with the Soil Conservation Service of the U. S. Department of Agriculture.

The cultivated and populated sections of the West are mostly characterized by relatively rainless growing seasons. Such precipitation as occurs falls mostly in the winter and early spring months. In agriculture, the greatest need for crop-producing water coincides with the generally arid summer months. Fortunately, in western mountains, precipitation falls mostly as snow. It stays on the ground for months, later to melt and sustain river flow during the period of greatest demand for water use from the streams. Nature thus provides in snow a storage facility greater than any man-made storage ever conceived. However, man-made storage, as provided by several hundred western reservoirs, serves to regulate the runoff. Distribution of flow for man's use in industry and commerce, as well as in agriculture, is thereby improved.

Thus, the snow survey water supply forecasters maintain inventories of water stored in the mountain snow pack, beginning with the first seasonally-permanent snow-cover and extending to the peak snow accumulation. Indeed, in places, the surveys may continue late into May or even into June, in some years, if distressingly large seasonal flows are indicated.

There are at present in the Far West 1,204 snow courses, including 80 in British Columbia and 279 in California. Surveys, at the majority of these courses have been scheduled for at least 16 years and at some for more than 36 years. The oldest snow course in the West, and perhaps in the Nation, on Mt. Rose, Nevada, has been surveyed for 45 winters. Snow surveys in British Columbia are conducted by the Water Rights Branch of the Provincial Department of Lands and Forests. That organization develops and issues the runoff forecasts for British Columbia. In California, the snow surveys are conducted by the State Engineer, who develops and issues the seasonal water supply forecasts for most of that State. Elsewhere in the West, the snow surveys co-ordinated by SCS are cooperatively conducted by numerous State Engineers, State Agricultural Experiment Stations, private and public utilities, municipalities, nearly 400 irrigation and soil conservation districts, and certain Federal agencies, including importantly the U.S. Forest Service, the U.S. Geological Survey and U.S. Bureau of Reclamation. The U.S. Corps of Engineers supports the program. The U.S. Weather Bureau provides meteorological data useful in the resultant forecasts.

Needs for seasonal water supply forecasts vary throughout the West, depending upon usual planting dates, purpose for which water is used, etc. Therefore, snow survey runoff forecasts, although mostly for the period of April - September, include volume forecasts for other and sometimes shorter seasons. They include also other types of forecasts, such as for probable date and/or amount of minimum flow. The forecasts are tailored to meet water-users' needs as far as possible, since any standard forecast attempted would not always fit varying state or basin needs.

Seasonal forecasts in 1954 were developed and issued by the Soil Conservation Service and individual United States cooperators, including those issued by a principal co-developer, the State Engineer of California, for 323 points on streams in 12 states. Flow records at most of these stations are, of course, calculated and published by the U.S. Geological Survey, although in limited cases by the respective State Engineers.

Nine hundred and forty-eight men conducted snow surveys for various periods in 1954. These men traveled by foot 25-1/2 thousand miles during the snow season. They also traveled 10 thousand miles by snow machines. They utilized aircraft to further travel 14 thousand miles in their assigned measuring flights. Whereas, but a few years ago, the total snow field measuring job was accomplished by men on skis or snowshoes, nowadays nearly one-half of the wilderness travel is more economically accomplished by mechanical means. For instance, snow surveyors used 55 snow machines last season — two-thirds of these were furnished by agencies other than the Soil Conservation Service. Back in 1944, there were only three or four machines in use.

Search continues for even better over-snow machines, since availability of such machines allows the use of fewer but better trained men in the program. Unit costs are reduced and safety is improved. Western Snow Surveyors are proud of their safety record. The current season will prove

to be, we have every hope, the 14th consecutive fatality-free year. During the past 13 fatality-free seasons, western snow surveyors traveled nearly 1/3 million man-miles by ski and snowshoe through some of the most rugged terrain in our Nation. Surveyors in machines and planes logged another 100 thousand miles in the same period. Approximately 575 thousand snow water content readings were made in that time.

Mechanized travel becomes more extended each season. Even so, it continues to be necessary to maintain shelter facilities for several hundred men who move surely, even if more slowly, on foot. Shelter cabins — 298 of them — were stocked and maintained in 1953-54 along the several thousand miles of snowshoe routes.

These Herculean labors are but means to an end. They signify little if unrelated to the result — the result in this case representing dependable knowledge enabling more economical and efficient use of water supplies resulting each season for agricultural and other important uses, as forecast from the snow surveys. Snow surveys are proven tools for better water planning and more skillful water management by all water users.

In 1954 the seasonal water supply forecasts based upon snow surveys were helpful to the operators of 21 million acres of irrigated farmland in 12 states. Farm operators in 278 soil conservation districts in these same states were served.

No other system now known for the forecasting of runoff volume of western states' rivers has proven so high in average accuracy as the snow survey method. Nor has any other system shown equally dependable results for the majority of any large sequence of comparisons of forecasts of seasonal flow. This is due in part to the fact that much the greater part of the seasonal runoff is derived from the mountain snow blanket. It further results from the Service policy to place responsibility for locating and measuring the snow course directly under the engineer forecasters who also are responsible for execution and issuance of the runoff forecasts.

One recent development in western snow surveys which may interest you is the establishment of watershed soil moisture index measurement stations. Moisture content index of the soil at each foot depth is determined periodically by recording the electrical conductivity of nylon and fiber-glass units buried in the soil. About 50 such pilot stations high in the watersheds are now being recorded in eight states. The information being gathered should soon become useful in forecasting runoff and is expected to improve forecast accuracy.

Also, specially constructed snow markers have been installed high in the watersheds at more remote snow courses. Snow depth is read by the pilot of a low-flying plane and the water equivalent can later be calculated approximately. This is proving an excellent cost-cutter, but lack of precision limits this method to snow surveys early in the winter only. The resulting forecasts are then more informative than quantitative.

Now, in conclusion, the western states snow survey and water supply forecasting activity is a modest and specialized engineering program. The activity from its beginning has remained close to the water users and continually responsive to users' needs. It continues to be highly cooperative in its growth pattern. In performing its responsibility in this runoff forecasting program, the Soil Conservation Service is executing with economy a service for which there is immediate and vital need by agricultural interests and other water users.