USE OF SNOW SURVEY DATA BY SOIL CONSERVATION DISTRICTS

by

Don G. Fredericksen[1/]

It is very likely that the pioneers, in the mountainous areas of the West, assumed that the rivers flowed roughly the same each year. However, for those ranchers and farmers who settled on small rivers, it soon became obvious that there were remarkable annual differences in the volume of water produced from the snowy watersheds. In my own case, for the past 30 years, I have been a water user in the State of Idaho and have watched the accumulation of winter snow vary from year to year.

During recent years, increased emphasis has been required in evaluating the seasonal water resource as it exists in each winter's snow pack. This is due to intensified use of water and its inherent connection to the conservation of soil.

With completion of major western irrigation reservoirs such as the ones which serve my area, American Falls Reservoir and Jackson Lake in Wyoming, our water supply was more than sufficient because of the abundance of water relative to land area under cultivation. Idaho is still blessed with an abundance of water, but it is now obvious that this resource will become the limiting factor to expansion of agriculture in Idaho. Potentially there are far more irrigable acres than there is water to complete the job.

The snow surveys on the Snake River watershed in Wyoming and Idaho, originally begun by the Bureau of Reclamation, have been conducted for more than 30 years, but real and practical confidence in the forecasts are just now developing. Likewise, the use of forecasts in farm planning and farm and ranch operations is in its infancy. The experience of any water user, engaged in irrigation, is that the soil and water, as natural resources, cannot be separated because, in our arid sections, one is useless without the other insofar as intensified agricultural production is concerned.

During the last 15 years, the confidence of the irrigators in the forecasters' ability has increased markedly. Present day cooperation between the Bureau of Reclamation and U. S. Corps of Engineers in lowering of storage contents of irrigation reservoirs to make possible a multiple purpose operation for flood control but still produce a full reservoir for irrigation has been made possible by snow surveys and seasonal water supply forecasts. These operations in turn are only possible because of the confidence gained in the minds of the irrigators in snow surveys and the seasonal forecasts derived from them. The irrigation reservoirs now unquestionably have a significant affect, from a practical standpoint, on the control of floods of the great rivers in the Columbia River Basin and throughout the West. The cooperative effort of the Corps of Engineers, Bureau of Reclamation, irrigation districts, Soil Conservation Districts, and State Reclamation engineers has resulted in undertaking these operations with the understanding and backing of the water users. A relatively empty irrigation reservoir on the first of April in these times is not at all exceptional when an unusually heavy snow pack has been found in the mountains above it. To my knowledge, there has never been an irrigation reservoir that has failed to fill, under these conditions, in the last 10 years.

For the past several months, the irrigation reservoirs of Idaho, and in a few other places throughout the West, have been releasing water because of the normal water supply for 1958 indicated by measurements of the snow pack.

Along the tributaries to the major rivers, there are many Soil Conservation Districts dependent upon water supplies from small streams. In these areas, there is always more land available than water to irrigate it. As a result, a very keen interest in the water supply each year is expressed by the farm and ranch operators on these drainages. Many of Idaho's Soil Conservation District supervisors have therefore become enthusiastic snow surveyors. They make their first trip on the first of January and complete the last one on the first of May.

1/ Don G. Fredericksen, Vice-President, Area VII, National Association Soil Conservation Districts, Gooding, Idaho.

The year's operations on their farms are geared directly to the water supply. In years of short water, they do not attempt to establish new irrigated pastures nor grow other crops of high water requirement. In areas where there are orchards, pruning of trees may be heavy in a short water season, and relatively light in the abundant water seasons. Cover crops under these orchards are sacrificed and turned under early to reduce the use of water. In a sugar beet area, contracts for growing sugar beets may not be signed until an adequate water supply has been determined through snow surveys. In seasons of most severe water shortage, acreage is reduced and of course great advantages made of the good water seasons by increasing the acreage irrigated.

The annual loss of productive agricultural soil, through erosion and flood damage, has now been equalled by the great annual withdrawals of land developed for home sites, highways, for factories and other non-agricultural uses. It thus becomes more imperative each year that we retain the soil in the headwaters of our watersheds in order to conserve its productivity as well as to control the destructive forces of water.

These basic data, such as snow water measurements and measures of soil moisture beneath the snow which have been gathered for so many years, will eventually play an important role in the watershed protection and flood prevention administered by the Soil Conservation Service. These are among the major records we have for evaluating the effects of erosion, flood control measures, water retarding structures or vegetative control measures, including forest timber harvest. In the future, they will also provide an important tool in the operating plan of the water retarding structures that will be completed, just as they are now the tool in the operation of the major irrigation reservoirs.

The control and efficient use of water and soil is a team-work job requiring the best efforts and thinking of private operators and state and federal government organizations. The present use of water supply forecasts by Soil Conservation Districts, is well exemplified in Oregon and Nevada. In the papers that have been distributed, you will find examples of the forecasts as distributed to the cooperators in the Soil Conservation Districts of these states. There are about 7,000 cooperators in the Oregon districts and a somewhat smaller number in Nevada. The success of this information has been in its simple presentation and through the scope and relative dependability of the seasonal forecasts reported therein.

In addition to our interest in the publication of seasonal water supply put out by the Soil Conservation Service and cooperating agencies, the Soil Conservation Districts sponsor many water supply forecast meetings throughout the Western states. The purpose of the meetings is to discuss the water supply for the year and all of the inherent possibilities of making the most efficient use of the water through good soil and water conservation practices.

As an example of this type of action, I would like to qpte from an article by R. N. Irving and M. W. Nelson in the March 1956 issue of Soil Conservation Magazine. The farmers in the Twin Falls, Idaho SCD get water from Salmon Falls Creek in the area. The quote is as follows:

> "A water supply forecast meeting was called by Bill Loughmiller, chairman of the Twin Falls Soil Conservation District board of supervisors, to discuss the situation for the 1955 season. Practically every resident in the Salmon Falls tract was represented at this meeting. Again an interpretation was made by the technicians of the Soil Conservation Service on the possibility of water for 1955. The forecast indicated that the snow pack would not contribute to stream-flow because of the dry soil beneath it. While there was more than 2 feet of snow, carrying between 5 and 7 inches of water, the electrodes indicated that the dry soil would absorb that much water.
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> The snow pack high in the mountains indicated a near normal snow cover, but again the electrodes indicated a very dry soil — soil that was dry for the second year in a row. An extremely low forecast was made for the coming summer. This time many operators within the district took drastic plans to conserve the short water supply available. Local technicians of the Service explained the many methods of conserving water on the farm. It is well known however, among the irrigators of southern Idaho that the farmers on the Salmon Falls tract make efficient use of their water every year and hence can make only small water savings by more economical use.

Carroll H. Dwyer and Vernon W. Baker, economists of the SCS at Portland, Oregon, recently completed a survey of the amount of work and money saved through the forecasts of 1955. Their survey brought out the following points:

The Salmon Falls tract contains about 70,000 acres which could be irrigated if adequate supplies were available. The available water supply fluctuates markedly however, from year to year depending upon the snow pack. The acreage actually irrigated varies from about 10,000 acres to 35,000 acres depending upon the watershed yield.

Heavy snows fell in the foothills in 1955 and March precipitation was 183 percent of normal. Visual evidence of hills covered by snow indicated to some people a good water supply, possibly adequate for about 25,000 acres. Lacking the water supply forecasts, the farm operators would probably have prepared, pre-irrigated, and seeded the usual acreage. However, the water supply forecast based on snow surveys in the water-producing high mountains of the tract, indicated runoff of only 60 percent of normal. Accordingly, the farm operators reduced their anticipated acreage by more than one half.

In addition, the types and percentages of various crops planted were substantially different from those which would have been planted under a normal water supply. Crops requiring a late season water supply, such as alfalfa, or irrigated pasture were materially reduced or not planted at all.

The savings in farm operations resulting from not preparing the land and planting crops were estimated as follows:

Beans	$106,050
Small Grains	91,800
Hay or Pasture	101,550
	$299,400

Since these crops were not planted, there was a saving of approximately 6,600 acre-feet of water due to the fact that pre-irrigation of the anticipated crops was not done. This saved-water was used to supplement irrigation of land actually irrigated. Using average figures this water would normally produce a net income of $79,450.

In summation, the economic benefits which are readily evaluated in monetary terms for the Salmon Falls tract as a result of practical water supply forecasting in 1955 are estimated conservatively to be:

Expenses not incurred	$299,400
Increases in net income from saved water	79,450
Total Benefits	$378,850

In addition to the monetary savings of the year, a good deal of land was left in productive covering and not prepared for seeding because there was no water available. This land was, therefore, not subject to wind and sheet erosion as it might have been if prepared for crop and allowed to go idle. These intangible benefits cannot be computed; nonetheless, they are very real."

In some years, the snow pack poses a formidable flood hazard. On many rivers throughout the West such a tremendous accumulation of snow can be measured that all of the reservoirs and conservation measures established to date cannot prevent a flood. The early and long range warning made possible by measuring the snow pack is an important factor to many areas, and it is hoped that the Soil Conservation Service and cooperating state and federal agencies can increase the intensity of this work as it correlates with the forecasts of water supply each season. We have dramatic instances in the past several years, on such rivers as the Kootenai and the Columbia, which point out the usefulness of accurate measurements of the snow pack for this purpose.

At the present time, but not including California, where the snow surveys are an activity of the State's Department of Water Resources, there are 377 Soil Conservation Districts in the West served by the Federal-State Cooperative snow survey network. There are over 10 million acres in Soil Conservation Districts directly served or benefited by snow survey data, and including California something over 20 million acres affected directly or indirectly by the snow survey information.

Farmers and ranchers have to be practical men to keep their operations on a paying basis. We therefore believe that measurements of the snow pack near the very tops of these mountains where the water is produced is a proven basis for the most accurate and practical evaluation that can be made of each season's water supply.

The information, as carried in releases to Soil Conservation Districts, gives the farm and ranch operators the advantage of the basic data of the snow pack itself for their own interpretation as well as carrying the interpretation of the technician forecasting the season in terms of acre-feet for a given seasonal period.

The highly cooperative nature of Soil Conservation District operations, in my opinion, provides an ideal unit in the West for using water supply forecasts for the maximum conservation of soil and water.

AN APPROACH TO FORECASTING THE SPRING RUN-OFF IN QUEBEC

By

George S. Cavadias[1/]

1. The purpose of this paper is to describe an approach to the problem of forecasting the Spring run-off. Particular reference will be made to conditions in Quebec and the application of the method will be shown for the case of a large storage reservoir. This is the Gouin reservoir, with a capacity of 6.5 million acre-feet, that regulates the flow for the seven plants of the St. Maurice River hydro system with a total installation exceeding 2,000,000 horsepower (Ex. 1).

Many previous studies of the Spring run-off in Quebec have shown, that the run-off is not well correlated with the water equivalent of snow, as measured during the snow surveys. It appears, on the contrary, that one of the main factors determining the volume of the Spring run-off, is the precipitation during the freshet period, a factor, unknown at the time of the preparation of the forecast.

It was attempted, therefore, to investigate thoroughly all pertinent variables, with the purpose of extracting the maximum amount of information from factors that are known at the date of the forecast.

2. The success of a correlation study depends greatly on the form in which the variables are introduced. I will therefore, describe briefly the preliminary work that led to the selection of the variables.

The first variable to be examined is the Spring run-off to Gouin. In a previous study of the same problem, (Ref. 4) the duration of the flood period was assumed to be known and the variable to be estimated was the total run-off to the Gouin Reservoir during the whole period. Subsequent preliminary studies have shown that a subdivision of the flood period would increase the accuracy of the prediction.

1/ George S. Cavadias, The Shawinigan Water and Power Company, and now with the Water Resources Branch, Department of Northern Affairs and National Resources, Montreal, P.Q., 1410 Stanley St., Room 1007. Paper presented on April 17, 1958 at the Joint meeting of the Western Snow Conference and the Upper Missouri River Water Forecast Committee, Montana State College, Bozeman, Montana.