

flow records prior to 1922. The Department itself has pointed out that on the basis of the 1922 to 1967 period for which actual measured records at Lee Ferry are available, the virgin flow is estimated to be 13.7 million acre-feet as contrasted to 14.9 million acre-feet for its so-called long term period of 1906 to 1967.

I do not share the confidence that the Secretary seems to have in the stream flow records prior to 1922 for several reasons. First, the Department itself in its 1954 report in H. Doc. 364 on the Colorado River Storage Project mentioned that inaccuracies are risked with the extension of records prior to 1914. In order to avoid part of these risks the Department in its report on the Colorado River Storage Project extensively used the 1914 to 1947 period of water supply records. Of course, at that time (1954) as I have mentioned above, there was plenty of water available for the Colorado River Storage Project under almost any period of records that might be used.

Second, the Secretary has mentioned that continuous water records since 1906 are available at points upstream from Lee Ferry which measure about 70% of the runoff, and continuous records are available downstream from Lee Ferry since 1906 which can be used by statistical correlation methods to produce estimates of flow at Lee Ferry prior to 1922. Considering the risks involved in a possible over estimation of the water supply, I cannot ignore the advice of eminent hydrologists of the U.S. Geological Survey that data for accurate definition of extremes of stream flows are generally deficient. It should be remembered that the estimates of stream flows prior to 1922 involve a majority of the extremely high flows of the Colorado River. According to the Geological Survey experts:

"... tests of the performance of the existing streamflow network in furnishing information from which to estimate flow at ungaged points are being carried out by the Geological Survey using multiple regression methods. A sampling of the network—in the Potomac River Basin, the Central Valley of California, Kansas and Louisiana—suggests that it performs well as a base from which to estimate flows in the medium range (error of estimate $\pm 20\%$), but that it is deficient as a base from which to estimate extremes of flow."¹

In 1968, considering the availability of our present day sophisticated hydrological methods, not much imagination is necessary to raise doubts about the estimates of extremes of the Colorado River flows between 1906 and 1922, or 45 to 61 years ago, when relatively primitive methods of measurement were used at the gaging stations that are now employed to estimate by correlation the synthesized flows at Lee Ferry.

It should be understood by the Committee, after hearing Secretary Udall and Commissioner Dominy and myself on this question of adequacy of a dependable water supply, that my objection, in a critical water supply situation, to the use of estimates (not actual measurements) of certain stream flow records prior to 1922 is based not on their questioned accuracy alone. I also question seriously the actual ability to utilize effectively the extensive spills that result on paper from the inclusion of these early estimates. No matter where the records start, an hydrologist must account for the low flow years following 1930. All of the computed annual reservoir spills cannot be carried over and fully utilized in the dry years following 1930 because of the limitations on reservoir space and the inability of man to forecast anticipated water yields from weather sufficiently far in the future with the required degree of accuracy.

Once the spills from Lake Powell have been stored in Lake Mead, it also fills. This filling is a rapid occurrence under the application of the stream flows in the years following 1906. How can you expect to store more Lake Powell spill water when both reservoirs are full?

Third, I cannot ignore the fact that in the early 1950s the late Silmon Smith, a renowned water attorney from western Colorado, found after extensive study that the ultimate stream depletion available for the Upper Colorado River Basin would be not more than 6.1 million acre-feet annually. This means that the average virgin flow at Lee Ferry would be close to 13.7 million acre-feet. Furthermore, in 1953 the State of Colorado hired the firm of Leeds, Hill and Jewett to report on availability of water for use in the Upper Basin. This report places the limit on stream depletion by the Upper Basin at 6.2 million acre-feet per year. Again, in 1965 the Upper Colorado River Commission had an exhaustive series of studies made by the worldwide engineering firm of Tipton and Kalmbach, Inc. These studies revealed that with presently existing water storage

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