

**Hearing in the Matter of California Department of Water Resources and
United States Bureau of Reclamation****Request for Change in Point of Diversion for California WaterFix****Testimony of Arve Sjovold****On Behalf of C-WIN**

I, Arve R. Sjovold, do hereby declare:

I. INTRODUCTION

I am a retired research scientist. I have Bachelor of Arts degree in Physics from the University of California (1956) and have 41 years of experience as a practicing research scientist in the fields of rocket engine development, systems engineering, systems analysis, operations research, cost analysis, cost estimation, model development and model application. I retired with position of Chief Cost Scientist from the company of my last employment. A copy of statement of qualifications has been submitted as Exhibit C-WIN-1. In my testimony I explain my analysis of Sacramento River run-off record and Delta operations with a focus on the indexes that govern much of the operations. This analysis is titled "SWP AND CVP OPERATIONS, THE INDEXES THAT GOVERN THEM AND THEIR VALIDITY" and is presented as Exhibit C-WIN-3.

II. OVERVIEW OF TESTIMONY

The Bay Delta Conservation Plan (BDCP) has taken as its mission the twin objectives of improving the reliability of export deliveries and restoration of the Delta. To meet these objectives there is a presumed need to capture and control a greater fraction of run-off which can be timely allocated to Delta restoration and increased exports. The proposed Twin Tunnels project has been selected as the best of several alternative projects to accomplish this. The implementation of the Twin Tunnels project requires a change in the point of diversion from the present point for cross

Delta transport. Given that all the available water must originate as run-off from the mountains, it is fair to ask what the possibilities actually are of capturing more water. The present operations in the Delta are proscribed by a multitude of constraints promulgated by the State Water Resources Control Board (SWRCB) in order to protect the rights of others and be faithful to their charge to protect the Delta environment. A seminal element in developing those constraints is the index “Water Year Type.”

C-WIN began its analysis by investigating the origins and validity of the index, Water Year Type. To establish its validity it was necessary to study the record of run-off from the Sacramento River. That study set out to characterize the statistical properties of the run-off record and how it is used in deriving the Water Year Type Index and its antecedents. The results of that study have revealed some remarkable shortcomings in the present use of those indexes.

III. C-WIN's FINDINGS

1. The antecedent to the Water Year **Type** Index is the Water **Year** Index. The formulation for the Water Year Index was found to be without scientific merit. It has no validity as an index for forecasting a developing water year as to the likely level of run-off. As a consequence, the derivative Water Year Type Index also has no validity.
2. The Sacramento River historical run-off record comprises two distinct and independent sets, one comprising dry years which represent 56% of the record and the other comprising wet years of 44% of the record. There is no meaningful “normal” or average for the entire record. There is no significant correlation between successive year run-off such that every water year has to be treated as an independent event. Therefore at the beginning of each water year there is a 56% chance that it will be dry and a 46% chance that it will be wet.
3. A more detailed examination reveals that if cumulative run-off by the end of January of a water year is less than 3.9 million acre-feet (as measured by the 4-Rivers index) the probability of an ensuing wet year is approximately 5%.

IV. CONCLUDING REMARKS

These findings lead to the following observations and conclusions regarding SWP operations, and the correlative CVP operations.

1. Winter export of project water should be significantly reduced or deferred until there is enough run-off to indicate that the ensuing water year will be sufficiently wet. These preliminary findings indicate that could be as late as the end of January.
2. No confident statement of project yield can be made at the beginning of a water year. Estimates of the current water yield should be based on the assumption that the ensuing water year will be dry until there is confidence that the water year will be wet.
3. Long term SWP operations should be based on a careful examination of the dry year distribution of run-off to deliver a reliable level of deliveries that the contractors can depend on.
4. **Because most of the CVP and SWP reservoir operations are tied to Water Year Type index and that index has been found invalid, all such operations must be revisited.**
5. **Because almost all Delta constraints promulgated by the SWRCB are based on the Water Year Type Index, all such constraints must be revisited.**

Executed on 14th of October, 2016 in Santa Barbara, California



Arve R. Sjovold