particular index value to be attained.<sup>29</sup> The index values were to be attained by implementing management measures affecting the variables included in the index equations. For the Sacramento River, the index equation described a relationship between smolt survival and three variables: water temperature, water diversion out of the mainstem Sacramento River, and water export rates. For the San Joaquin, the variables were river flow rates, water diversion into the Upper Old River, and export rates

The Proposed Rule included index values generally representing the modeled results of the management measures developed by the USFWS based on the work of the Delta Team of the Five Agency Chinook Salmon Committee.30 These management measures consist of export limits, minimum flows, channel gate closures, etc., during critical periods in the year. The estimated effects of these management measures on smolt survival were calculated using the criteria index equations.31 EPA concluded that these management measures, and the associated criteria index values, would lead to the protection of the designated Fish Migration use.

The resulting criteria index values were also consistent with the recommendations of the Interagency Statement of Principles signed by EPA, NMFS, and USFWS, which called for a level of protection for aquatic resources equivalent to the level existing in the late 1960's to early 1970's. To make this comparison, EPA compared its proposed criteria index values with the index values attained historically on the two river systems. See generally the discussion in the preamble to the Proposed Rule at 59 FR 824. The proposed Sacramento River criteria index values represented overall protection for the Fish Migration use at approximately the 1956-1970 historical level, whereas the proposed San Joaquin River criteria index values represented slightly better protection than the 1956-1970 historical level.

The Proposed Rule also relied on the criteria index equations to determine whether the criteria were being attained. In effect, attainment would be assumed if the State adopted an implementation plan with a set of measures (export restrictions, flow requirements, etc.) that, when computed in the index equations, resulted in the criteria index value.

(3) Final Criteria. EPA received substantial comment on its Proposed Fish Migration criteria. In addition, CUWA sponsored a number of scientific workshops to discuss the Proposed Rule, and EPA participated in these discussions. In response to the comments and scientific workshops, EPA developed a revised approach to the Fish Migration criteria, which was summarized in the documents made available to the public in EPA's Notice of Availability published in the **Federal Register** on August 26, 1994 (59 FR 44095).

The final rule maintains the fundamental approach of the Proposed Rule, but it has been revised in a number of ways to address several concerns. The major changes are:

(i) The methodology for establishing the criteria index values has been revised. Consistent with the discussion in the materials made available in the Notice of Availability, the criteria values on the Sacramento and San Joaquin River systems are described separately and the index values have been derived in different ways.

(a) On the Sacramento River, the criteria index values vary according to the water temperature at Miller Park. "Ceiling" and "floor" criteria index values are included to reflect the fact that at very high water temperatures, the Fish Migration use needs additional protection, and at very low water temperatures, temperature is unlikely to affect fish migration. The actual index values have been set to replicate the survival values that would be attained if the Delta Cross-Channel 32 were closed during the critical migration period. The Sacramento River tagged-fish release results indicate that, except in very high temperature periods, those periods in which the Delta Cross-Channel is closed provide aquatic conditions allowing for the protection of the Fish Migration designated use.

(b) On the San Joaquin River, the criteria index values vary according to unimpaired San Joaquin river flow. The

actual index values have been set to approximately replicate the survival values that would be attained if a series of management measures (flow requirements, export restrictions, barriers, etc.) recommended by the USFWS based on the work of the Delta Team of the Five Agency Chinook Salmon Committee were implemented. The tagged-fish release results indicate that these or equivalent management measures are necessary to protect the Fish Migration designated use on the San Joaquin.

(ii) The criteria have been restated as sliding scales or continuous functions. As described in EPA's alternative formulation of the Fish Migration criteria referenced in the Notice of Availability, 59 FR 44095, and as in the case of the Estuarine Habitat criteria discussed above, stating the criteria index values with reference to the five water year types may create problems <sup>33</sup> in protecting the Fish Migration use. Accordingly, the final criteria index values are expressed as a continuous function.

(iii) Direct experimental measurements of salmon survival through the Delta will be used to estimate attainment of the criteria, instead of relying on estimates of attainment generated by the criteria index equations. This change allows the State Board more flexibility to develop implementation measures because it does not tie attainment of the criteria to the particular variables (exports, flows, etc.) included in the criteria index equations. This also transforms the final criteria into an explicit "performance standard", in which the criteria index

values serve as the statement of desired

protection for the Fish Migration use.

## b. Detailed Discussion

## (1) Proposed Rule

To protect the Fish Migration designated use, the Proposed Rule included "salmon smolt survival index criteria." For each of the Sacramento and San Joaquin River systems, the criteria provided a salmon smolt survival index equation and a set of index values to be attained. The index equation for each river quantified and predicted the survival of salmon migrating through the Delta.

These index equations were developed by the USFWS (Kjelson, et al. 1989; USFWS 1992a, 1992b), and were based on the results of tagged-fish

<sup>&</sup>lt;sup>29</sup> As stated above, the standard water year categories are wet, above normal, below normal, dry, and critically dry years.

<sup>&</sup>lt;sup>30</sup> This interagency group consists of representatives from the USFWS, California DFG, California DWR, NMFS, and USBR. Its reports (Five Agency Delta Salmon Team, 1991a; 1991b) represent a consensus on the most effective and feasible implementation measures to protect downstream migrant salmon smolts in the Delta.

<sup>&</sup>lt;sup>31</sup>That is, management measures were evaluated as to their effect on the variables included in the index equations, and the index equations were then computed to derive criteria index values. The result was criteria index values that reflect the effects on survival of the recommended management measures.

<sup>&</sup>lt;sup>32</sup> The Delta Cross Channel is a controlled diversion channel between the Sacramento River and Snodgrass Slough. Water is diverted from the River through the Slough and then through natural channels for almost 50 miles southward to the State and Federal pumping plants.

<sup>33</sup> For example, if a mid-year change in water year types occurs, the Proposed Rule may have called for drastic changes in the flow regime, potentially leading to dewatering or washing away newlyspawned eggs.