ENVIRONMENTAL PROTECTION AGENCY

40 CFR Part 131

[OW–FRL–5084–4]

Water Quality Standards for Surface Waters of the Sacramento River, San Joaquin River, and San Francisco Bay and Delta of the State of California

AGENCY: Environmental Protection Agency.

ACTION: Final rule.

SUMMARY: This final rule, required under Section 303 of the Clean Water Act, is part of an interagency effort designed to ensure that the fish and wildlife resources of the San Francisco Bay/Sacramento-San Joaquin Delta Estuary (Bay/Delta) are protected and to minimize the likelihood of future listings of Bay/Delta species under the Endangered Species Act. The Bay/Delta is the West Coast's largest estuary, supplying habitat for over 120 fish species and large populations of waterfowl. Over the past two years, the U.S. Environmental Protection Agency (EPA) has worked closely with the Departments of the Interior and Commerce, as well as the State of California, to address the severe and continuing decline of Bay/Delta fish and wildlife resources. This decline has been so severe that a number of fish species, including the winter-run chinook salmon are considered threatened or endangered under the Endangered Species Act. In coordinating their respective actions in the Bay/Delta, the Federal agencies endorsed an ecosystem (as opposed to a species-by-species) approach. EPA's final rule establishes four sets of water quality criteria protecting habitat conditions in the estuary.

EFFECTIVE DATE: This rule shall be effective February 23, 1995.

ADDRESSES: The public may inspect the administrative record for this rulemaking, including documentation supporting the criteria, and all public comments received on the proposed rule at the Environmental Protection Agency, Water Management Division, 11th Floor, 75 Hawthorne Street, San Francisco, California 94105 (Telephone Sara Hedrick at 415–744–2200) on weekdays during the Agency's normal business hours of 9 a.m. to 5 p.m. A reasonable fee will be charged for photocopies. Inquiries can be made by calling Sara Hedrick at 415–744–2200.

FOR FURTHER INFORMATION CONTACT: Judy Kelly, Bay/Delta Program Manager, Water Management Division, W–2–4, Environmental Protection Agency, 75 Hawthorne Street, San Francisco, California 94105, 415/744–1162.

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A. Background

1. Introduction

This section of the Preamble introduces the topics which are addressed subsequently, provides a brief description of the environmental issues at stake in the San Francisco Bay/Sacramento-San Joaquin River Delta Estuary (Bay/Delta), and reviews the U.S. Environmental Protection Agency's (EPA or the Agency) recent involvement in these issues. Section B of this Preamble describes the statutory framework of section 303 of the Federal Water Pollution Control Act (33 U.S.C. 1251 to 1387) (CWA or the Clean Water Act), as well as the regulatory process for developing and revising water quality standards. In addition, Section B summarizes the recent actions of the State of California (State) and EPA under section 303 of the CWA. Section C describes the Final Rule, focusing especially on the changes from the criteria proposed at 59 FR 810, January 6, 1994 (Proposed Rule). Sections D, E, F, G, and H discuss the public comments, the requirements of Executive Order 12866, the Regulatory Flexibility Act, Executive Order 12875, and the Paperwork Reduction Act, respectively.

In addition to publishing the Proposed Rule, EPA, on August 26, 1994, at 59 FR 44095, published a Notice of Availability announcing the availability of two documents prepared since the close of the comment period. The first of these documents was a summary of a series of scientific workshops on EPA's proposed Fish Migration criteria that were sponsored and facilitated by the California Urban Water Users (CUWA) and four environmental organizations. The second document was an internal EPA staff paper presenting a reformulation of the Fish Migration criteria based upon the comments at the workshops. EPA accepted public comments on the issues raised in these two documents until September 30, 1994. EPA received two written comments in response to the Notice of Availability.

This final rule satisfies EPA's obligations under a settlement agreement approved and entered as an order in *Golden Gate Audubon Society et al.* v. *Browner* (E.D. Cal. Civ. No. 93–646 (LKK)).

2. Background

a. Environmental Concerns

The Bay/Delta is the West Coast's largest estuary, encompassing nearly 1600 square miles, and draining over 40 percent of California. The Bay/Delta is the point of convergence of California's two major river systems—the Sacramento River system flowing southward and draining a large part of northern California, and the San Joaquin River system flowing northward and draining a large part of central California. These two river systems come together at the western tip of the Delta, forming an estuary as fresh water mixes with marine water through a series of bays, channels, shoals and marshes and ultimately flowing into San Francisco Bay and then to the Pacific Ocean.

The Bay/Delta constitutes one of the largest systems for fish production in the country, supplying habitat for over 120 fish species. It also comprises one of the largest areas of waterfowl habitat

in the United States, providing a vital stopover for rest and feeding for more than one-half of the waterfowl and shorebirds migrating on the Pacific Flyway. Within the boundaries of the Bay/Delta is the Suisun Marsh, the largest contiguous brackish water marsh in the United States.

The Bay/Delta is also the hub of California's two major water distribution systems—the Central Valley Project (CVP) built and operated by the U.S. Bureau of Reclamation (USBR) and the State of California's State Water Project (SWP). These two projects account for approximately 60% of the watershed's diversions (San Francisco Estuary Project (SFEP) 1992). In addition, at least 7,000 other permitted water diverters, some large and some small, have developed water supplies from the watershed feeding the Bay/Delta estuary (California State Lands Commission 1991). Together, these water development projects divert, on average, 50% of the natural flow in the Bay/Delta estuary (SFEP 1992). Most of the State's developed water—75 to 85 percent—is used for irrigation purposes by agriculture, irrigating over 4.5 million acres throughout the State. The Bay/Delta watershed also provides part or all of the drinking water supply for over 18 million people.

In large part due to the effects of these water diversions, and as discussed in more detail in the preamble to the Proposed Rule, the fish and wildlife resources in the Bay/Delta estuary have deteriorated drastically over the past twenty years. One common measure used to quantify this deterioration is the Striped Bass Index (SBI) (a measure of the relative abundance of young striped bass in the estuary). The SBI measures the relative health of an indicator species for the Bay/Delta, the striped bass. In its 1978 Water Quality Control Plan (1978 Delta Plan), the California State Water Resources Control Board (State Board) committed to maintaining an SBI value of 79. Since that time the SBI has never attained its targeted value of 79, but instead has plummeted to unprecedented low values.[1]

The precipitous decline in striped bass is indicative of the poor health of other aquatic resources in the Bay/Delta estuary. Several species have experienced similar declines, including chinook salmon (the winter-run of chinook salmon has recently been reclassified as an endangered species under the Federal Endangered Species Act, 16 U.S.C. 1531 to 1540 (ESA)), Delta smelt (listed as a threatened species under the ESA), and the Sacramento splittail (recently proposed for listing as a threatened species under the ESA). The California Department of Fish and Game (California DFG) recently testified that virtually all of the estuary's major fish species are in clear decline. (CDFG 1992b, WRINT–DFG–8)[2] Another recent report suggests that at least three more of the Bay/Delta estuary's fish species (spring-run Chinook salmon, green sturgeon, and Red Hills roach) qualify for immediate listing under the ESA (Moyle and Yoshiyama 1992). Furthermore, the decline in aquatic resources is not limited to fishes. One recent workshop noted that the available data ''indicate clearly that species at every trophic level are now at, or near, record low levels in the Delta and in Suisun Bay.''[3] (SFEP 1993) The ecological communities under stress include the plant and animal communities in the tidal portions of the brackish water marshes adjacent to Suisun Bay (Collins, J.N. and T.C. Foin, 1993).

b. State Designation of Uses in the Bay/Delta

Under section 303(c) of the CWA, states review their water quality standards every three years and submit any new or revised standards to EPA for approval or disapproval (the ''triennial review''). A water quality standard for a waterbody consists of two components: (1) Designated uses for the waterbody and (2) water quality criteria which support such designated uses.[4] In California, designated uses are equivalent to state law ''beneficial uses'' and criteria are equivalent to state law ''water quality objectives.'' Thus, the water quality objectives and beneficial use designations adopted under the California Water Code serve as water quality standards for purposes of section 303 of the CWA.

Pursuant to state and federal law, the State Board, on May 1, 1991, adopted State Board Resolution No. 91–34, formally approving the 1991 Bay/Delta Plan. The Plan restated the specific designated uses that had been included in the 1978 Delta Plan and related regional board basin plans. As restated in the 1991 Bay/Delta Plan and submitted to EPA for review under the Clean Water Act, the designated uses for waters of the Bay/Delta included the following: Agricultural Supply, Cold and Warm Fresh-Water Habitat, Estuarine Habitat, Fish Migration, Fish Spawning, Groundwater Recharge, Industrial Process Supply, Industrial Service Supply, Municipal and Domestic Supply, Navigation, Contact and Non-Contact Water Recreation, Ocean Commercial and Sport Fishing, Preservation of Rare and Endangered Species, Shellfish Harvesting, and Wildlife Habitat.[5]

c. EPA Activity Under CWA Section 303

As explained in detail in the preamble of the Proposed Rule, the serious environmental crisis for fish and wildlife resources in the Bay/Delta has been the source of an ongoing dialogue between EPA and the State for many years. Pursuant to section 303(c)(3) of the CWA, EPA reviewed the 1978 Delta Plan in 1980. While EPA approved the Plan, it was concerned that the 1978 Delta Plan standards would not provide adequate protection of striped bass and the estuary's fishery resources. EPA therefore sought and received assurances from the State Board as to the interpretation of the standards, and secured the State Board's commitment to review and revise the 1978 Delta Plan standards immediately if there were measurable adverse impacts on striped bass spawning, or if necessary to attain ''without project'' levels of protection for the striped bass as defined by an SBI value of 79. The ''without projects'' level of protection is the level of protection that would have resulted in the absence of the state and Federal water projects (the SWP and the CVP). EPA also conditioned its approval on the State Board's commitment to develop additional criteria to protect aquatic life and tidal wetlands in and surrounding the Suisun Marsh. The State Board concurred with these

[1] During the 1980's, the SBI averaged approximately 23.5, and in 1985 reached an all-time low of 4.3. Some of the decline in the SBI may be attributable to drought conditions in the late 1970's and again in the late 1980's. In all but two years since the 1978 Delta Plan was adopted, the SBI has ranged from 4.3 to 29.1, a substantial shortfall from the stated goal of 79.

[2] If a reference was presented to the State Board during one of its hearings, this preamble will present citations in both the standard scientific form and in the State Board hearing record form. Accordingly, the eighth exhibit submitted by California DFG at the Board's interim water rights hearings in the summer of 1992 is cited as indicated.

[3] The workshop report went on to state that this low level of biological diversity was ''not surprising considering the recent drought, the introduction of exotic species, and the increased diversion of water.''

[4] In addition, a state's criteria must be consistent with the state's antidegradation policy. The federal regulations provide that, at a minimum, the state's policy must maintain ''[e]xisting instream water uses [those existing in the waterbody at any time on or after November 28, 1975] and the level of water quality necessary to protect the existing uses. * * *'' 40 CFR 131.12(a)(1).

[5] As explained in more detail below, under certain circumstances a state may revise or even remove designated uses. However, in the Bay/Delta context, the State Board has made no effort to revise the designated uses adopted and restated in the 1991 Bay/Delta Plan.

interpretations in its letter to EPA dated November 21, 1980.

As fish and wildlife resources in the Bay/Delta continued to decline, EPA on several occasions expressed its continuing concern to the State Board about the need to develop standards that would adequately protect these resources. Throughout the first and second triennial reviews ending in 1981 and 1985, EPA urged the State Board to review and revise the 1978 Delta Plan in accordance with EPA's 1980 approval letter. After its second triennial review, in a letter to EPA dated June 23, 1986, the State Board acknowledged that the 1978 Delta Plan standards were not adequate to protect the estuary's fishery resources. It then outlined the hearing process it was planning for revising the standards. In response, and as part of its consideration of the State Board's second triennial review, EPA, on June 29, 1987, sent a letter to the State Board stating that EPA could no longer approve the striped bass survival standards (or the related provision allowing relaxation of the spawning standard in drier years) because these standards did not adequately protect the designated fish and wildlife uses. EPA recognized, however, that the State Board had initiated new hearings to revise the 1978 Delta Plan standards. EPA therefore indicated that it would await the results of the new hearings and approve or disapprove the revised standards after the State Board's submission to EPA of a complete set of revised standards. Following the first phase of the new hearings, the State Board in November 1988 issued a draft Plan that included revised salinity and flow standards to protect the fisheries and other designated uses (SWRCB 1988). The State Board subsequently withdrew that draft Plan, however, and issued a revised workplan that served as the basis for the State Board's present Water Quality Control Plan for Salinity for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary (1991 Bay/Delta Plan).

The 1991 Bay/Delta Plan, which the State Board submitted to EPA for review on May 29, 1991, amended certain salinity criteria and adopted new temperature and dissolved oxygen criteria for specified locations in the estuary. The 1991 Bay/Delta Plan did not, however, revise the earlier 1978 Delta Plan to address EPA's longstanding concerns about adequate protection for the designated fish and wildlife uses of the Bay/Delta.

On September 3, 1991, EPA approved in part and disapproved in part the provisions of the 1991 Bay/Delta Plan. EPA's letter found that ''[t]he record * * * does not support the conclusion that the State has adopted criteria sufficient to protect the designated uses'' of the estuary. The designated uses at risk, as defined by the State Board, include Estuarine Habitat, and also Cold and Warm Water Habitat, Fish Migration, Fish Spawning, Ocean Commercial and Sport Fishing, Preservation of Rare and Endangered Species, Shellfish Harvesting, and Wildlife Habitat. In addition to its general finding that the 1991 Bay/Delta Plan did not contain sufficient criteria to protect the designated uses, EPA also disapproved the absence of salinity standards to protect the Estuarine Habitat and other fish and wildlife uses in the Suisun, San Pablo, and San Francisco Bays and Suisun Marsh, the absence of scientifically supportable salinity standards (measured by electrical conductivity) to protect the Fish Spawning uses of the lower San Joaquin River, and the absence of scientifically supportable temperature standards on the San Joaquin and Sacramento Rivers to support the Fish Migration and Cold Fresh Water Habitat uses, including the fall-run and winter-run chinook salmon.

In the summer of 1992, the State Board held hearings for the purpose of establishing interim measures to protect the natural resources in the Bay/Delta estuary. EPA participated in these hearings—rather than proposing federal standards at that time—in the hope that the hearings would result in state adoption of approvable standards and preclude the need for a federal rulemaking. EPA submitted its own recommendations to the State Board and joined with the National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (USFWS) in submitting an Interagency Statement of Principles. These statements specifically recommended that the State Board adopt a habitat and ecosystem-based approach to standards that would satisfy CWA requirements and meet the State Board's goal of reversing the decline of the estuary's fish and wildlife resources.

At the conclusion of these hearings, the State Board, on December 10, 1992, issued its recommended interim measures in Draft Water Rights Decision D–1630 (hereinafter D–1630). After the close of the comment period for D–1630, however, the State Board declined to adopt D–1630. Accordingly, the State criteria EPA disapproved on September 3, 1991, are still in effect. In response to the State Board's failure to revise these criteria, EPA, pursuant to section 303 (c)(3) and (c)(4) of the Act, published a Proposed Rule that would establish Federal water quality criteria for the Bay/Delta which would in effect supersede and supplement the disapproved State criteria for purposes of the CWA. EPA's Proposed Rule also satisfied its obligations under a partial settlement agreement approved and entered as an order in *Golden Gate Audubon Society et al.* v. *Browner,* (E.D. Ca. Civ. No. 93–646 (LKK)).

EPA's Proposed Rule was one component of a coordinated initiative by the several Federal agencies having regulatory or operational responsibilities in the Bay/Delta. In early 1993, these four agencies—EPA, USFWS, NMFS, and USBR—formed the Federal Environmental Directorate (now known almost exclusively as ''Club FED'') for the purpose of assuring that the Federal agencies worked in a coordinated manner in taking actions under their respective statutory authorities that would affect the estuary. The Federal initiative announced in December 1993 included the EPA Proposed Rule, the USFWS proposal to list the Sacramento splittail as a threatened species under the ESA, the USFWS proposal for critical habitat for the threatened Delta smelt, and the NMFS reclassification of the winter-run chinook salmon as endangered. This initiative also coincided with the USBR's preliminary water allocation forecast for CVP deliveries for the 1994 water year.

d. Post-Proposal Activities

Since the publication of the Proposed Rule, EPA has moved towards final promulgation of protective criteria in an expeditious and open manner. EPA held several public hearings throughout the state in late February, 1994, to hear comments on the Proposed Rule. In addition, EPA met with a number of interested parties to discuss the economic analysis prepared in conjunction with the Proposed Rule. The purpose of these meetings was to solicit recommendations as to how to improve the analysis of potential economic impacts resulting from the State's implementation of the Federal criteria.

EPA also participated in a series of scientific workshops arranged and facilitated by California Urban Water Agencies (CUWA), the Bay Institute, the Natural Heritage Institute, Save San Francisco Bay Association, and the Environmental Defense Fund. These workshops were designed to discuss the extensive scientific comments submitted by CUWA on the criteria proposed in the Proposed Rule. Dr. Wim Kimmerer, the reporter for these workshops, prepared written summaries of the discussions on the Estuarine

Habitat criteria and the Fish Migration Criteria (Kimmerer 1994b). As discussed above, the summary of the workshops on the Fish Migration criteria and EPA's alternative formulation of the Fish Migration criteria were made available to the public in EPA's Notice of Availability published on August 26, 1994, 59 FR 44095.

The Federal interagency cooperation effort begun before the publication of the Proposed Rule has continued during the past year. The most formal aspects of this cooperation effort have been the consultations under Section 7 of the ESA between EPA and the USFWS and NMFS on the potential effects of EPA's criteria on threatened and endangered species and their critical habitat.[6] EPA and the Services began consulting informally in December 1991. Formal consultations were initiated in August 1993. In recognition of the tentative nature of a proposed rule, the Services deferred preparing a formal biological opinion for the Proposed Rule and instead, on November 24, 1993, submitted formal comments to EPA on the Proposed Rule. These formal comments raised the major concerns of the respective Services about potential effects of the proposed criteria on threatened and endangered species. Since publication of the Proposed Rule, the Services have worked closely with EPA to assure that the final rule complies with the ESA. The Services have been actively involved in reviewing comments received from the public, and participated in the CUWA scientific workshops on EPA's Proposed Rule.

In early November 1994, after discussing the probable final criteria with EPA, NMFS and USFWS concluded their reviews of the final criteria and issued their respective final conclusions as to the anticipated effects of the implementation of these criteria on threatened and endangered species. The USFWS issued a ''no jeopardy'' biological opinion under Section 7 of the ESA, finding that implementation of these criteria would not likely jeopardize the continued existence of any listed species or result in adverse modification of habitat deemed critical to the survival of listed species. In recognition of the fact that the final EPA criteria may be implemented only when the State Board adopts final implementation plans, the USFWS biological opinion also called for the reinitiation of consultations when the implementation plans are finalized by the State Board so that any possible problems for endangered or threatened species caused by implementing the criteria can be addressed.

NMFS concluded its review by making a finding that implementation of these criteria would not adversely affect the threatened and endangered species or result in adverse modification of critical habitat of those species (anadromous fishes) under its jurisdiction. The NMFS findings also called for reinitiation of consultation when implementation plans are developed by the State Board, so that any possible problems for threatened or endangered species caused by implementing the criteria can be addressed.

In addition to the formal ESA consultation process, the four Club Fed agencies have again coordinated several of their regulatory and operational duties and are announcing two Federal actions simultaneously. In addition to EPA's final promulgation of water quality criteria under the CWA, the USFWS is making it's final designation of critical habitat for the Delta smelt under the ESA. These coordinated Federal actions serve as the underlying basis for the long-term solution to fish and wildlife protection in the Bay/Delta estuary.

Finally, in an effort to facilitate the long-term resolution of Bay/Delta issues, the Club Fed agencies and their counterpart agencies in the State of California executed, as of July 1994, a Framework Agreement laying out the Federal and State intentions as to how these agencies would work together cooperatively on a range of issues in the estuary. One key element of this Framework Agreement was EPA's agreement to sign a final rule regarding these water quality criteria by the end of 1994. At the same time, the State Board agreed to prepare a draft revision to its water quality plan by the end of 1994, and to finalize that plan in early 1995. The Framework Agreement envisions that, if EPA finds that the revised State plan submitted to EPA meets the requirements of the CWA, EPA will initiate action to withdraw this rule.

Consistent with its commitment in the Framework Agreement, the State Board conducted a series of workshops on Bay/Delta issues throughout the spring, summer and fall of 1994. EPA participated in these workshops, and has continued to work with the State Board to assure that the revisions adopted by the State Board will meet the requirements of the CWA. It is EPA's hope that the cooperative process outlined in the Framework Agreement will lead to approvable state standards for protecting the designated uses in the Bay/Delta estuary.

EPA is aware of efforts by urban and agricultural users, in cooperation with environmental groups, to identify alternative standards that may meet the requirements of the CWA. EPA encourages affected parties to continue to work with EPA and the State to develop proposals that meet the requirements of the CWA. EPA would welcome the adoption by the State of a revised plan based in whole or in part on such private proposals provided that it complies with the requirements of the CWA.

B. Statutory and Regulatory Background

Section 303(c) of the Act requires that state water quality standards ''* * * be such as to protect the public health or welfare, enhance the quality of water and serve the purposes of this [Act]. Such standards shall be established taking into consideration their use and value for propagation of fish and wildlife, recreational purposes, and agricultural, industrial, and other purposes. * * *'' Key concerns of this statutory provision are the enhancement of water quality for the protection of the propagation of fish and other aquatic life. The ultimate purpose of water quality standards, as with the other provisions of the CWA, is ''to restore and maintain the chemical, physical, and biological integrity of the Nation's waters.'' CWA section 101(a).

Under section 303(c) of the Act, a water quality standard for a specific waterbody consists of two components: designated uses for which a waterbody is to be protected (such as recreation in and on the water, protection and propagation of fish and wildlife, or agricultural uses) and the water quality criteria which support those designated uses.[7]

The Act gives primary responsibility for the adoption of water quality standards to the states. After adopting its initial water quality standards, a state is required, no less than every three years, to review those standards, and, if necessary, modify them. Under section 303(c)(1) of the Act, if a state revises or adopts a new standard, it must submit such a standard to EPA for approval or disapproval.

[6] As stated above, the species of concern include primarily the winter-run chinook salmon (a listed endangered species under the jurisdiction of NMFS) and the Delta smelt (a listed threatened species under the jurisdiction of the USFWS). The USFWS has also formally proposed that the Sacramento splittail be listed as threatened.

[7] As discussed below, a state's water quality standards must also contain an antidegradation policy.

EPA's Water Quality Standards regulations at 40 CFR part 131 specify the requirements for designated uses. ''Designated Uses'' are those uses specified in water quality standards for each water body or segment whether or not they are being attained. 40 CFR 131.3(f). Examples of designated uses are listed in section 303(c)(2)(A) of the CWA. They include: public water supplies, protection and propagation of fish, shellfish, and wildlife, recreation, agricultural and industrial, and navigation. Other uses have been adopted as well (e.g. aquifer protection, coral reef preservation).

Under certain circumstances, States may remove a designated use which is not an existing use. 40 CFR 131.10(g). ''Existing Uses'' are those uses actually attained in the water body on or after November 28, 1975, whether or not they are included in the water quality standards. 40 CFR 131.3(f). Generally, existing uses, whether or not they are ''designated uses,'' may not be removed. 40 CFR 131.3(g) and (h). A state must conduct a ''use attainability analysis'' as defined in 40 CFR 131.3(g) whenever (1) the State designates uses that do not include the uses specified in section 101(a)(2) of the CWA, or (2) the State wishes to remove a designated use that is specified in section 101(a)(2) of the CWA or to adopt subcategories of uses which require less stringent criteria. 40 CFR 131.3(j). The state may take economics into account when it designates uses, as, for example, in a use attainability analysis. 40 CFR 131.3(g)(6).

EPA's Water Quality Standards regulations at 40 CFR part 131 specify the requirements for water quality criteria.

> States must adopt those water quality criteria that protect the designated use. Such criteria must be based on sound scientific rationale and must contain sufficient parameters or constituents to protect the designated use. For waters with multiple use designations, the criteria shall support the most sensitive use. 40 CFR 131.11(a).

Thus, once designated uses are established, the water quality criteria are based on what is necessary scientifically to protect the most sensitive designated use.

In addition, a state's criteria must be consistent with the state's antidegradation policy. The federal regulations provide that, at a minimum, the state must have an antidegradation policy that maintains ''[e]xisting instream water uses [those existing in the waterbody at any time on or after November 28, 1975] and the level of water quality necessary to protect the existing uses. * * *'' 40 CFR 131.12(a)(1).

In order to approve a state's water quality criteria, EPA must determine that the state has adopted ''water quality criteria [that are] sufficient to protect the designated uses.'' 40 CFR 131.6(c).

Section 303(c)(4) of the Act provides that the Administrator shall promptly prepare and publish proposed regulations establishing a new or revised standard in either of two situations: first, when the Administrator has disapproved a state standard under section 303(c)(3) and the state has not taken corrective action within 90 days; and, second, in any case where the Administrator determines that a revised or new standard is necessary to meet the requirements of the Act. Once promulgated, the federal regulations are applicable to the state's waters, and, if they are more stringent, have the effect of supplanting and supplementing the state's standards for all purposes under the CWA. However, it is EPA's longstanding policy that the federal water quality standards will be withdrawn if a state adopts and submits standards that in the Agency's judgment meet the requirements of the Act.

The chronology of State and EPA actions under the CWA in the Bay/Delta estuary over the past two decades were described in more detail in the preamble to the Proposed Rule, and in paragraph A.1.c. herein. Briefly stated, the State Board's adoption of the 1978 Delta Plan, and of the revised Bay/Delta Plan in 1991, were intended to meet the State's obligations to establish water quality standards under the CWA. Pursuant to its mandate under section 303(c)(3) of the Act, on September 3, 1991, EPA disapproved several of the criteria contained in the State Board's plan. EPA's letter found that ''[t]he record * * * does not support the conclusion that the State has adopted criteria sufficient to protect the designated uses'' of the estuary. The designated uses at risk, as defined by the State Board, include Estuarine Habitat, and also Cold and Warm Water Habitat, Fish Migration, Fish Spawning, Ocean Commercial and Sport Fishing, Preservation of Rare and Endangered Species, Shellfish Harvesting, and Wildlife Habitat. In addition to its general finding that the 1991 Bay/Delta Plan did not contain sufficient criteria to protect the designated uses, EPA also disapproved the absence of salinity criteria to protect fish and wildlife uses in the Suisun, San Pablo, and San Francisco Bays and Suisun Marsh, the absence of scientifically supportable salinity criteria (measured by electrical conductivity) to protect the Fish Spawning uses of the lower San Joaquin River, and the absence of scientifically supportable temperature standards on the San Joaquin and Sacramento Rivers to protect the Fish Migration and Cold Fresh Water Habitat Uses.

For the reasons outlined herein, in the Proposed Rule, and in EPA's letter of September 3, 1991, the Agency finds that the water quality criteria adopted by the State fail to protect the designated uses and that the criteria below meet the requirements of the Act. Accordingly, pursuant to sections 303(c)(3) and 303(c)(4) of the Act, the Administrator is promulgating the following water quality criteria applicable to the Bay/Delta's waters.

C. Description of the Final Rule and Changes From Proposal

1. Estuarine Habitat Criteria

a. Overview

(1) Importance of the Estuarine Habitat Designated Use. The State's 1991 Bay/Delta Plan included ''Estuarine Habitat'' as a designated use for the Bay/Delta estuary. This Estuarine Habitat designated use is intended to provide ''an essential and unique habitat that serves to acclimate anadromous fishes (salmon, striped bass) migrating into fresh or marine conditions. This habitat also provides for the propagation and sustenance of a variety of fish and shellfish, numerous waterfowl and shore birds, and marine mammals.'' *See* Water Quality Control Plan, San Francisco Bay Basin [2], December 1986, at II–4.

EPA considers protection of the Estuarine Habitat designated use to be important for a number of important reasons. As described in detail in the Preamble to the Proposed Rule, conditions in the estuary are of critical importance because the estuary's particular characteristics provide a unique food source, spawning habitat or nursery habitat for a whole range of aquatic and aquatic-dependent species. The Estuarine Habitat designated use protects this vital ecosystem, an ecosystem that has a crucial role in restoring and protecting the fish and wildlife populations of the Bay/Delta. EPA and the other Federal agencies are committed to multispecies or ecosystem protection approaches, rather than focusing on the peculiar needs of individual species. In addition, the resource values benefitting from the protection of the Estuarine Habitat use include resources described in other state-designated uses, including Ocean Commercial and Sport Fishing, Preservation of Rare and Endangered Species, Fish Migration, and Wildlife

Habitat.[8] Indeed, many of the resources targeted for protection by these related uses would not be fully protected without adequate protection of the Estuarine Habitat designated use. In developing criteria protective of the Estuarine Habitat use, EPA has been mindful of the overlapping designated uses and of the range of natural resources affected by the broad Estuarine Habitat.

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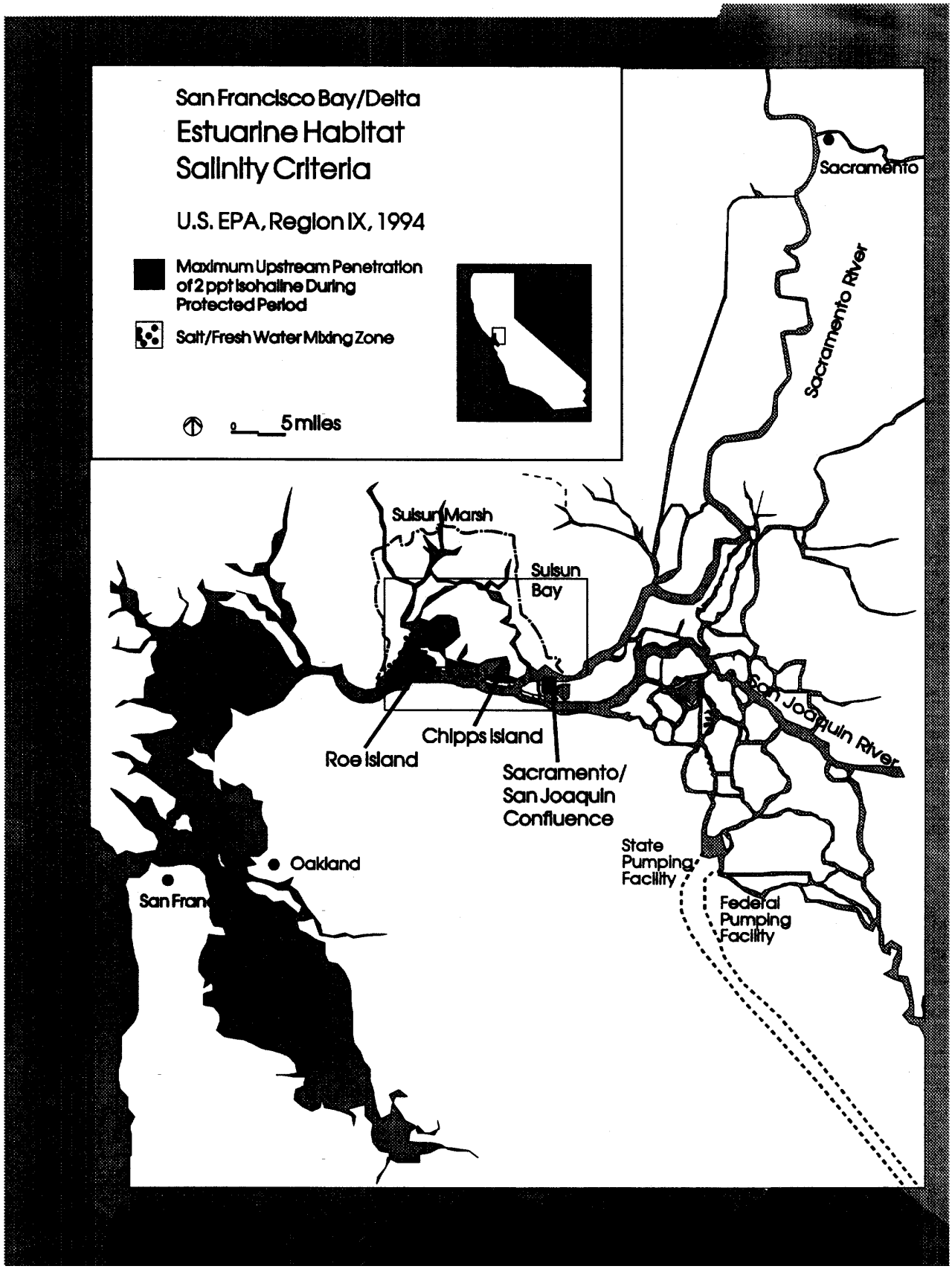
[8] As described by the State Board, the Ocean Commercial and Sport Fishing designated use protects the ''commercial fishing and collection of various types of fish and shellfish, including those taken for bait purposes, and sport fishing in ocean, bays, estuaries and similar non-freshwater areas.'' The Preservation of Rare and Endangered Species use ''[p]rovides an aquatic habitat necessary, at least in part, for the survival of certain species established as being rare and endangered species.'' As described below, the Fish Migration use ''[p]rovides a migration route and temporary aquatic environment for anadromous or other fish species.'' Finally, the Wildlife Habitat ''[p]rovides a water supply and vegetative habitat for the maintenance of wildlife.''



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(2) Proposed Criteria. As stated in the Proposed Rule, the Estuarine Habitat criteria consisted of three interrelated components:

(i) A salinity requirement of 2 parts per thousand (2 ppt);

(ii) Maintained at one or more of three monitoring locations in the Suisun Bay;

(iii) For a specified number of days during the critical spring months.

These criteria were designed to reflect the conditions in the estuary at a time when it attained protection of the designated Estuarine Habitat use.

As a preliminary matter, EPA determined the ''reference period,'' the historical time period during which the salinity regime in the estuary was sufficient to protect the designated uses. To determine the reference period, EPA was guided by the Interagency Statement of Principles signed by EPA, USFWS and NMFS, which called for estuarine conditions similar to the late 1960's to early 1970's as necessary to protect the Estuarine Habitat. However, the decade from 1965 to 1974 did not include water years types from each of the five water year type categories.[9] Therefore, in order to estimate those conditions over the entire range of possible hydrological conditions that may occur in the future, EPA used data from the years 1940 to 1975 to represent the conditions in the reference period of the late 1960's to early 1970's, and used this larger set of historical data to determine the minimum number of days of compliance.

As explained in more detail below and in the preamble to the Proposed Rule, EPA then focused on the salinity regime in the estuary to develop criteria that protect the Estuarine Habitat. Salinity was selected for several reasons: it is closely associated with the abundance and distribution of species at all trophic levels, it can be measured accurately and easily, and it integrates a number of important estuarine properties and processes.

Salinity conditions in the estuary vary dramatically from month to month and year to year, primarily in response to natural factors such as precipitation and snowmelt upstream, and to man-made factors such as reservoir operations, upstream diversions and export rates. EPA concluded that maintaining salinity conditions reflecting the natural hydrology in the Bay/Delta during the reference period would provide estuarine habitat conditions that protect the fish and wildlife resources dependent on that habitat. In other words, because precipitation varies naturally from year to year and within each year, salinity conditions reflecting this natural variability at a time period when the Bay/Delta attained its designated uses would protect the natural resources dependent upon estuarine habitat. While it may seem counterintuitive to provide *less* fresh water to the estuary in a dry year, and *more* water in a wet year, the natural resources in the Bay/Delta ecosystem have adapted to the cycle of both within-year hydrological fluctuations and substantial year-to-year fluctuations in hydrology. The intent of the proposed criteria was to restore a pattern and magnitude of those hydrological fluctuations that reflected the historical period during which the designated uses were fully protected.

To provide these conditions, EPA proposed maintaining the low salinity[10] 2 ppt isohaline (an isohaline is simply a line joining all points of equal salinity) in Suisun Bay during the critical wet season months of February to June. This particular time period is important because many different species use the low salinity habitat in the spring for spawning, as nursery habitat, for transportation through the Delta, or for a combination of these three purposes. To take account of the variation in natural hydrological conditions, EPA proposed criteria that varied according to the water year type. In all water years, the 2 ppt salinity criteria would be met at the furthest upstream monitoring site (the confluence of the Sacramento and San Joaquin Rivers at the upstream end of Suisun Bay). In wetter years, the 2 ppt salinity criteria would also be met at one or both of two downstream monitoring sites (Chipps Island and Roe Island, in the middle and downstream end of Suisun Bay, respectively).

The proposal was stated as requiring attainment of the 2 ppt salinity criteria at or below one of the three monitoring sites for a specified number of days during the February to June period, depending on the water year type. For example, under the Proposed Rule, in a ''below normal'' water year, the 2 ppt isohaline would have been required at or downstream of Chipps Island for a total of 119 days during the February to June period. This ''number of days'' approach allowed the criteria to be responsive and replicative of the varying natural hydrology during February to June. That is, if February or March were particularly wet, the criteria's ''number of days'' could be met at that time using those natural storm flows, rather than requiring reservoir releases later in the February to June period.

Finally, again in an attempt to match the criteria with the natural hydrology, the Proposed Criteria included a ''trigger'' for compliance with the farthest downstream monitoring site (Roe Island). Compliance at that site would not be required unless and until the 2 ppt isohaline had been pushed that far downstream through natural storm events.

(3) Final Criteria. The Estuarine Habitat criteria in the final rule have been revised to address many of the technical issues raised in the public comments. The fundamental structure of the Estuarine Habitat criteria is unchanged: The criteria require maintenance of the 2 ppt[11] isohaline at or downstream of one of three monitoring sites in Suisun Bay during a specified portion of the February through June period. The final criteria continue to require a 2 ppt salinity value at the Confluence of the Sacramento and San Joaquin rivers each day between February through June in all years. The 2 ppt salinity value is to be met at Chipps Island for a specified number of days, depending on the amount of precipitation. The greater the precipitation, the higher the number of days the criteria must be attained. The 2 ppt salinity value must be met at Roe Island only if it is triggered by precipitation sufficient to push the 2 ppt salinity value downstream to Roe Island during the last half of the previous month. Once triggered, the 2 ppt salinity value is to be met at Roe Island for a specified number of days, depending on precipitation.

The changes to the final criteria are primarily refinements to how the rule determines the number of days the salinity standard must be met at Chipps and Roe Islands. The primary revisions include:

[9] ''Water year'' type categories in California refer to precipitation patterns for the year. The standard water year categories are wet, above normal, below normal, dry, and critically dry years.

[10] Low salinity in the 2 ppt range is being used to describe salinity conditions in the ''mixing zone'' between freshwater coming downstream and marine water moving inland from the ocean in response to tidal influences and fluctuations in freshwater outflow. This mixing zone generally contains low surface salinity of 1 to 6 ppt, whereas ocean salinity is over 30 ppt and freshwater salinity is generally less than 1 ppt (Arthur and Ball 1979).

[11] The Proposed Rule stated the criteria as a requirement for 2 ppt salinity. As discussed more fully below, in order to state the requirement more precisely, the final rule language will define the criteria in terms of micromhos per centimeter specific conductance at 25 °C instead of parts per thousand salinity. Accordingly, the final rule will state the criteria value as ''2640 micromhos/cm,'' which is equivalent to 2 ppt salinity. Although EPA is restating the actual rule language in the more precise specific conductance language, it will continue to refer to this criteria value as 2 ppt in this discussion of the final rule.

(i) *Shift from water year categories to a ''sliding scale''.* Rather than basing the number of days on data reflecting average salinity for each of the five water year types, EPA is basing the number of days on a ''sliding scale'' or ''smooth function'' that more precisely states the correlation between precipitation and the number of days of the 2 ppt value. For example, whereas the previous approach would require the same number of days of the 2 ppt value for all ''above normal'' years, the sliding scale requires fewer number of days for a *dry* ''above normal'' year than for a *wet* ''above normal'' year. In other words, rather than stating the criteria as five discrete points representing water year types, the sliding scale uses all the data underlying those five points to construct a continuous function or line reflecting salinity as a function of flow. The sliding scale is a more realistic description of the relationship between salinity and flow as it existed at the time during which the estuary attained its designated uses.

(ii) *Shift from yearly hydrology to monthly hydrology.* Instead of basing the number of compliance days at Chipps and Roe Islands on the expected hydrological conditions for the entire year, the final criteria base the current month's requirements only on the previous month's hydrological conditions. This change requires that these criteria specify a ''sliding scale'' for each month, but allows a much more accurate reflection of variations in natural hydrology.

(iii) *Revising the data used to reflect more accurately conditions in the estuary during the reference period.* As explained above, the reference period is the historical time period when the estuary attained its designated uses. In the Proposed Rule, EPA used the late 1960's to early 1970's as the reference period because the available information about the fish and wildlife resources in the Bay/Delta suggests that this time period encompasses the most recent time period during which the designated uses were attained. To describe hydrological and salinity conditions in this late 1960's to early 1970's reference period, the Proposed Rule used data from 1940 to 1975. This longer period was used because the actual conditions in the late 1960's to early 1970's did not provide representative samples of the possible broad range of hydrological conditions in the estuary. The Proposed Rule suggested that the period 1940–1975 could be considered representative of the late 1960's to early 1970's because the longer period was one of fairly consistent hydrological conditions bracketed by the completion of Shasta Dam on the Sacramento in the early 1940's and by the severe drought of the mid-1970's.

EPA received much comment on the approach in the Proposed Rule, with some commenters arguing convincingly that the 1940 to 1975 was in fact not one of consistent hydrological conditions, since the ''level of development''—the change in the facilities used for water diversion and storage—changed over time during this period due to additional construction activities at the state, federal, and local levels. EPA agrees with these comments and has reevaluated the historical data to account for the effects of the level of development on the salinity regime in Suisun Bay. As discussed below, EPA has determined that it is appropriate to use the level of development—and corresponding salinity regime—represented by calendar year 1968 as a surrogate for the late 1960's to early 1970's reference period when the estuary attained its designated uses.

(iv) *Alternative measures of attainment.* Under the CWA, the State Board has the responsibility for developing an implementation plan, including the methodology for measuring attainment. Based on the comments received as discussed below, EPA believes that attainment could be measured at the Roe Island and Chipps Island monitoring sites by any of (1) the daily salinity value, (2) the 14-day average salinity, or (3) the ''flow equivalence'' of the salinity value, as predicted in the recent Contra Costa Water District (CCWD) model described below. For reasons that are peculiar to that model, attainment at the Confluence monitoring site could be measured by either of the first two of these approaches only.

b. Detailed Discussion

(1) Proposed Estuarine Habitat Criteria

The Estuarine Habitat criteria included in the Proposed Rule specified the location and number of days that the 2 ppt salinity value would need to be met to protect the designated use. EPA's proposed criteria are shown in Table 1. They consisted of 2 ppt salinity criteria [12] to be attained for a specified number of days at Roe Island, Chipps Island, and at the Sacramento/San Joaquin River confluence during the period of February through June. The Proposed Rule provided that the 2 ppt salinity value must be met at the Sacramento/San Joaquin River confluence monitoring station for the entire 150 day period from February through June. The number of days of compliance with the 2 ppt value at Chipps and Roe Islands were based on the late 1960's to early 1970's ''reference period'' representing a time in which the conditions in the estuary were adequate to protect the designated uses. To represent this reference period, the criteria replicated the average number of days in each of the five water year types during which the 2 ppt salinity value occurred at or downstream from each of these locations during the historical period 1940–1975. Because no critically dry years occurred in the period from 1940 to 1975, the required number of days for critically dry years was based on an extrapolation of the data. In addition, in a number of years in the 1940–1975 period, data existed for flow conditions in the estuary but not for salinity. For these years, the Kimmerer-Monismith model (SFEP 1993) was used to estimate the salinity regime based on the existing flow data.

The proposed criteria were to be measured using a 14-day moving average.[13] The use of a 14-day moving average allowed the mean location to be achieved despite the varying strength of tidal currents during the lunar cycle, because any 14 day period would include the full range of spring and neap tidal conditions.[14]

[12] EPA's proposed Estuarine Habitat criteria were stated as a certain number of days when the average daily near-bottom salinity at each of three locations in the estuary is less than 2 parts per thousand. This salinity is approximately equivalent to electrical conductivity less than 2.640 mmhos/cm EC when corrected to a temperature of 25°C.

[13] A 14 day moving average would compute the salinity for a given day by taking the overall average of daily averages of salinity values for the measurement day and each of the previous 13 days. At the monitoring sites used in the Estuarine Habitat criteria, salinity is generally measured at least hourly, thereby facilitating computation of daily averages.

[14] Spring and neap tides refer to the times during the 28 day lunar cycle when tides are strongest and weakest, respectively.

TABLE 1.—PROPOSED 2 PPT ESTUARINE HABITAT CRITERIA [1]

Year type	Roe Island [km 64]	Chipps Island [km 74]	Confluence [km 81]
Wet	133 days	148 days	150 days.
Above normal	105 days	144 days	150 days.
Below normal	78 days	119 days	150 days.
Dry	33 days	116 days	150 days.
Critically dry	0 days	90 days	150 days.

[1] Numbers indicate the required number of days (based on a 14-day moving average) at or downstream from each location for the 5-month period from February through June. The water year classifications are identical to those included in the 1991 Bay/Delta Plan for the Sacramento River Basin. Roe Island salinity shall be measured at the salinity measuring station maintained by the USBR at Port Chicago (km 64). Chipps Island salinity shall be measured at the Mallard Slough station, and salinity at the Confluence shall be measured at the Collinsville station, both of which are maintained by the California Department of Water Resources. The Roe Island number represents the maximum number of days of compliance, based on the adjustment described in the text.

As explained in more detail in the Proposed Rule, the proposed Estuarine Habitat criteria also included a ''trigger'' that limited the applicability of the Roe Island criteria to wetter years. This trigger provided that the Roe Island criteria would not apply in a particular year unless and until the average daily salinity at Roe Island attained the 2 ppt level through natural uncontrolled flows. If that occurred, the 2 ppt salinity value would have to be met at Roe Island for the number of days specified in Table 1 (or the number of days left in the February to June period, if that number was less). In effect, this ''trigger'' provided that the additional water needed to move the 2 ppt isohaline downstream to Roe Island would come from natural storms rather than from reservoir releases or export restrictions. This approach helped the criteria reproduce the natural variability in timing and quantity of runoff that existed during the reference period.

In the Proposed Rule, EPA requested public comment on a number of issues, including the desirability of stating the criteria as a ''sliding scale'' rather than by water year categories, the appropriate compliance measurement period, and the appropriate reference period for criteria target levels. EPA has incorporated many of the comments received on these and other issues in its revisions to the Proposed Rule.

(2) Technical Changes to the Estuarine Habitat Criteria

The fundamental structure of the Estuarine Habitat criteria in the final rule is unchanged from the Proposed Rule: The criteria require maintenance of the 2 ppt isohaline at or downstream of one of three monitoring sites in Suisun Bay during a specified portion of the February through June period. The final criteria continue to require a 2 ppt salinity value at the Confluence of the Sacramento and San Joaquin rivers each day between February through June in all years.

Virtually all of the changes to the final Estuarine Habitat criteria involve refinements for determining the number of days the salinity standard must be met at Chipps and Roe Islands. In general, these changes either make certain measurements more accurate or provide a closer approximation of the natural hydrological cycles. The changes, which are highly technical, can be grouped into four broad categories: (i) underlying computational revisions, (ii) using a sliding scale, (iii) using monthly rather than annual compliance, and (iv) alternative measurement of attainment of the criteria. These changes to the final rule are reflected in the final criteria at 40 CFR 131.37(a)(1).

(i) *Underlying Computational Revisions.*

The first group of changes in the final criteria are slight refinements to the methodology of some of the computations used in the rule. These include:

(I) *Updated model correlating salinity and flows.* As described above, the Proposed Rule used data from the historical period 1940 to 1975 to approximate conditions in the targeted late 1960's to early 1970's reference period. For years during that historical period when actual salinity data was unavailable, the Proposed Rule used the Kimmerer-Monismith model to estimate salinity conditions based on the available flow data. This earlier model, which was used by the San Francisco Estuary Project (SFEP) (SFEP 1993), was considered at that time to be the most accurate available for this purpose. Since the Proposed Rule was published, a revised model correlating salinity and flow has been developed by the CCWD (Denton, R.A. 1993, and Denton, R.A. 1994). EPA concluded, and the participants at the CUWA scientific workshops generally agreed (Kimmerer 1994b), that the CCWD model is a more appropriate model to use in developing the Estuarine Habitat criteria.[15] The final rule will use this new CCWD model to estimate the number of days that salinities have been less than 2 ppt historically at each of the compliance monitoring stations.

The earlier model used for the Proposed Rule measured salinity one meter above the bottom. The new CCWD model measures salinity measured at the surface. There is substantial evidence that at salinities near 2 ppt there is little variability in stratification so that bottom salinities are accurately predicted from surface salinities (CCWD 1994; Monismith 1993). Therefore, bottom salinities of 2 ppt as modeled by the Kimmerer-Monismith model correspond to surface conductivities described, as discussed below, in terms of electroconductivity of 2.640 mmhos/cm EC in the CCWD model.

(II) *Use of entire basin unimpaired flow.* In calculating the applicable Estuarine Habitat criteria value, the Proposed Rule measured flow by reference to the Sacramento Basin Water Year Type classification. EPA did this primarily to simplify calculations and to reflect the dominant role of Sacramento River flows in the Bay/Delta estuary.[16] Nevertheless, as commenters noted, in some circumstances the omission of the San Joaquin River basin flows from the calculation could significantly overstate

[15] The CCWD model developed by Denton and Sullivan models salinity at a particular location, whereas the Kimmerer-Monismith model models the location of a particular salinity. Thus, the Kimmerer-Monismith model can predict whether the 2 ppt salinity value is upstream or downstream of a given location whereas the CCWD model can predict if the salinity at the same point is greater or lesser than 2 ppt. The CCWD model is more accurate because it predicts salinity based not only on flow (as in the Kimmerer-Monismith model) but also based on the location being modeled. For example, the relationship between flow and salinity is slightly different at Roe Island than at the Confluence, and only the CCWD model reflects that difference in the relationship.

[16] The Sacramento River basin usually accounts for about 80% of net Delta outflow, with the remainder coming primarily from the San Joaquin River basin.

or understate the actual hydrological conditions in the estuary because precipitation patterns in the two river basins are not identical. Further, one of the reasons EPA chose the three locations for compliance (all at or downstream of the confluence of the Sacramento and San Joaquin Rivers) was to give the State Board maximum flexibility in determining the source of flows to meet the Estuarine Habitat criteria. To reflect the importance of the San Joaquin River basin, the final criteria have been revised to measure unimpaired flow by reference to both the Sacramento River basin (Sacramento, Feather, Yuba, and American rivers) and the San Joaquin River basin (Stanislaus, Tuolumne, Merced, and San Joaquin rivers). EPA believes that the Sacramento/San Joaquin Unimpaired Flow Index described by CUWA is the best statement of how this unimpaired flow should be computed, and will generally refer to this index as the ''8–River Index.'' [17]

(III) *''Parts per thousand'' versus ''electroconductivity''.* The Proposed Rule stated the criteria as a requirement for 2 ppt salinity at the three compliance stations for varying numbers of days. In order to state the requirement more precisely, the final rule language will define the criteria in terms of millimhos per centimeter electroconductivity or ''mmhos/cm EC'' instead of parts per thousand salinity. This change is being made to conform the final rule to the more traditional methodology for measuring fresh water salinity. Accordingly, the final rule will state the criteria value as ''2.640 mmhos/cm EC,'' which is equivalent to 2 ppt salinity.

Although EPA is restating the actual rule language in the more precise electroconductivity language, it will continue to refer to this criteria value as 2 ppt in this discussion of the final rule. To do otherwise would unnecessarily confuse the interested scientific and policy community, which for a number of years has been using the 2 ppt language in its discussion of estuarine habitat criteria.

These revisions to the underlying computational methodology apply to the Estuarine Habitat at all three monitoring sites (the Confluence, Chipps, and Roe Islands). The remaining revisions to the final criteria pertain primarily to the methodology used in defining the number of days of compliance to be met at Chipps and Roe Islands.

(ii) *Using a Sliding Scale.*

In the final Estuarine Habitat criteria, EPA is restating the number of days that the 2 ppt salinity value must be met as a sliding scale correlating the number of days of compliance with unimpaired flow. The sliding scale approach has also been called the ''continuous function'' or ''smooth function'' approach. This approach replaces the Proposed Rule's statement of the criteria as a single fixed number of days of compliance for each of the five water year categories. The previous approach did not account for the substantial differences in hydrological conditions *within* water year types. For example, an ''above normal'' water year type could range from a *wet* ''above normal'' year to a *dry* ''above normal'' year. Given the extreme variation of hydrological conditions in the Bay/Delta, these variations within each of the five standard water years types are substantial, and should be factored into the calculation of the number of days of compliance with the 2 ppt salinity criteria.

The sliding scale approach addresses this problem by transforming the average salinity values for the five discrete water year categories into a more precise equation (graphically, a single line or curve) correlating the number of days of compliance with the specific observed hydrological conditions. This sliding scale approach would result in the same *average* number of days of compliance for each year type, and therefore represents the same level of protection for the Estuarine Habitat use as the Proposed Rule. The new approach, however, more accurately reflects differences *within* water year categories, thereby allowing a more accurate reflection of the natural hydrological cycles representative of the reference period necessary for protection of the use.

In addition, while the sliding scale approach equally represents the conditions under which the estuary attains its designated uses, the sliding scale results in lower water costs and, for operational reasons, may actually enhance protection of the uses. Testimony at recent State Board hearings criticized the use of water year type categories. Because water year types can change as the year progresses, criteria based on the historical mean for each water year type can cause major changes in project operations and habitat conditions if a given year shifts from one water year type to another over the course of the winter months. For example, a later season storm could cause the water year type to be reclassified from the below normal category to the above normal category. This shift would increase the number of days the criteria must be met at one of the monitoring sites. Such large and sudden changes are inefficient for water resource management and may harm aquatic resources by dewatering or washing away newly spawned eggs. Incorporating a sliding scale definition of the criteria would likely ease the actual operational procedures necessary to meet the criteria and would avoid the relatively sudden, large scale changes in operations that might come from a sudden shift in the determination of year type as spring progresses.

The comments EPA received on the Proposed Rule were generally supportive of this change in approach (CUWA 1994a, California DWR 1994, NHI 1994, and Kimmerer 1994a). Both written comments and the discussions at the CUWA scientific workshops offered several suggestions as to how the sliding scale function should be formulated.

There are two major components to the sliding scale approach. First, the shape of the scale must be determined. Second, the actual scaled values must be determined.

(I) *Defining the sliding scale.* There are a number of possible mathematical definitions of a sliding scale, including (a) a straight line, (b) a quadratic equation, or (c) a logistic equation.[18]

In the Proposed Rule, EPA suggested that a quadratic equation could be used to define the sliding scale. After reviewing the public comments, EPA has concluded that the Estuarine Habitat criteria should be stated as a logistic equation defining the sliding scale. Dr. Wim Kimmerer, in his comments on the Proposed Rule (Kimmerer 1994a), noted that the logistic model is ''appropriate

[17] As stated on page 3 of Appendix 1 to the California Urban Water Agencies ''Recommendations to the State Water Resources Control Board for a Coordinated Estuarine Protection Program for the San Francisco Bay-Sacramento and San Joaquin River Delta Estuary'' dated August 25, 1994, the Sacramento/San Joaquin Unimpaired Flow Index ''shall be computed as the sum of flows at the following stations:

1. Sacramento River at Band Bridge, near Red Bluff
2. Feather River, total inflow to Oroville Reservoir
3. Yuba River at Smartville
4. American River, total inflow to Folsom Reservoir
5. Stanislaus River, total inflow to New Melones Reservoir
6. Tuolumne River, total inflow to Don Pedro Reservoir
7. Merced River, total inflow to Exchequer Reservoir
8. San Joaquin River, total inflow to Millerton Lake.''

[18] The standard forms of these types of equations are (a) a straight line (y=a+b*x), (b) a quadratic equation (y=a+b*x+c*x2) or (c) a logistic equation ($y=1/(1+e^{3(a+b*x)})$).

for a relationship between a dichotomous variable (i.e. compliance or no compliance) and a continuous variable.'' A logistic model cannot require fewer than 0 or more than the number of days available in the month, whereas linear equations (such as one included in written comments of CCWD (CCWD 1994) or quadratic equations (such as the one EPA suggested in the Proposed Rule) can result in unrealistic extrapolations (e.g., resulting in the criteria having to be met less than zero days or more than the number of possible days each month).[19]

Kimmerer suggested a sliding scale based on logistic equations that stated the percentage number of days of compliance during the February to June period as a function of the unimpaired flow for those five months. An example of graphic representations of these equations for Roe Island is shown in Figure 1. EPA has adopted this basic approach; however, as discussed below, EPA has revised the logistic equations to reflect monthly computations of compliance.

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[19] While uncommon in some fields, the logistic equation is the basis of many ecological models, especially for population dynamics and epidemiology. In these ecological applications, the logistic model is useful because of the nature of the dichotomous variables (such as how many individuals are alive or dead in population dynamics, or how many individuals are infected or healthy in epidemiological studies). In each case, the dichotomous variables are arrayed along time as the continuous variable. In both cases, also, the function is constrained between 0 and the total population size, which is biologically realistic. EPA is using the logistic equation to model the number of days of attainment of the 2 ppt value (the dichotomous variable) against unimpaired flow (as the continuous variable). The logistic model also provides that no less than 0 and no more than the total number of days in the month can be required for attainment.

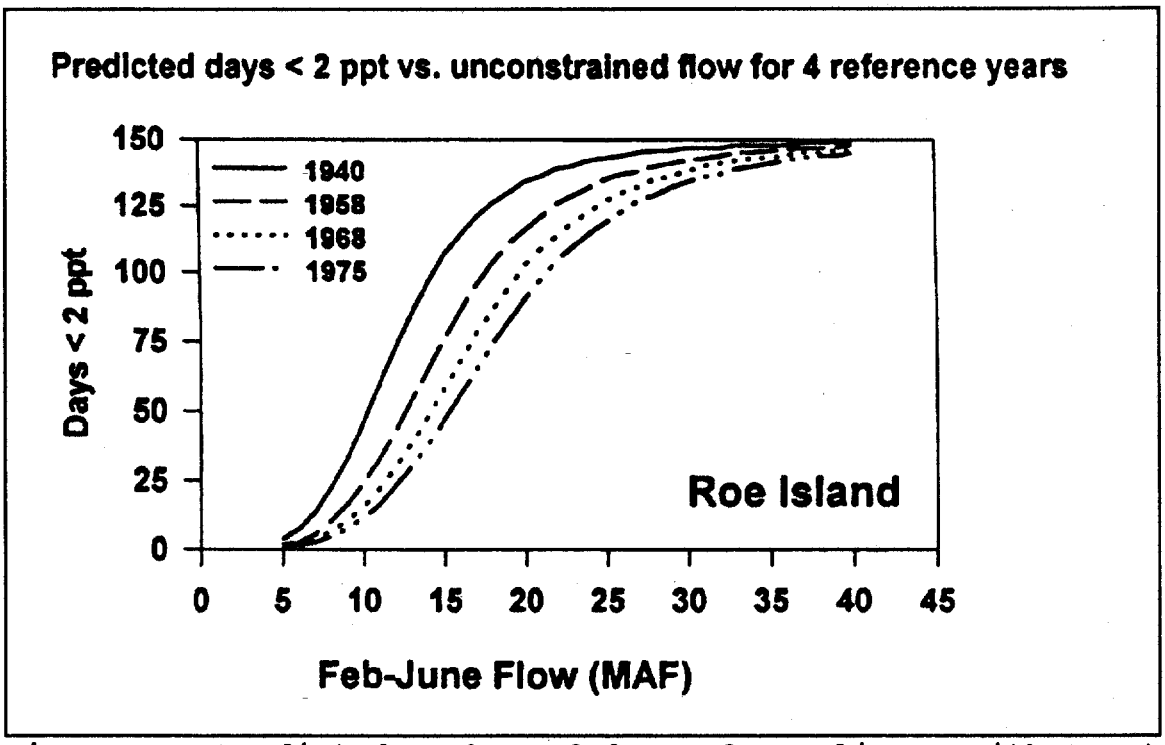

Figure 1. Predicted number of days of compliance with 2 ppt criteria during February to June at four levels of development across a range of unimpaired flows.

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(II) *Selecting sliding scale values: the reference period that would reflect protection of the designated uses.* Having concluded that the logistic equation is the best form of sliding scale for the Estuarine Habitat criteria, EPA still needed to determine the appropriate reference period reflected in that logistic equation.

In the Proposed Rule, EPA chose as the reference period the late 1960's to early 1970's. Available information suggested that during this period the estuarine conditions were able to support the designated uses. To describe the conditions in this late 1960's to early 1970's reference period, the Proposed Rule used hydrological and salinity data from 1940 to 1975. This longer period was used because the actual conditions in the late 1960's to early 1970's did not provide representative samples of the possible broad range of precipitation conditions in the estuary.[20] The Proposed Rule suggested that the period 1940–1975 could be considered representative of the late 1960's to early 1970's because the longer period was one of fairly consistent hydrological conditions bracketed by the completion of Shasta Dam on the Sacramento in the early 1940's and by the severe drought of the mid-1970's.

EPA received substantial comment about its choice of an historical reference period to define the targeted level of protection for the Estuarine Habitat criteria. One group of comments criticized the choice of the years included in the reference period. Various other historical periods were discussed by different commenters as alternatives. (Bay Institute 1994, California DWR 1994, and NHI 1994). EPA's specific responses to these comments are in the comment response document included in the record to this rule.

A second set of comments raised a more fundamental problem with the use of an historical reference period. These comments argued that the choice of any particular historical reference period was inherently suspect if it could not account for the changing ''level of development'' (that is, the changing system of dams, diversion facilities, storage reservoirs, etc.) during the 1940 to 1970 period (California DWR 1994). For example, if exactly the same amount of precipitation had fallen in each of 1940 and 1970, the different ''level of development'' in each year would affect how much water actually made its way down the rivers into Suisun Bay. In other words, the level of development, independent of the amount of rainfall, would affect the number of days that the 2 ppt salinity value was attained in Suisun Bay. Without accounting for the level of development, it would be hard to use rainfall data from the 1940's to represent conditions in the late 1960's to early 1970's.

EPA is persuaded that addressing these concerns about the effects of the level of development on resulting salinity criteria is, to a certain extent, appropriate. EPA and others (notably, the CUWA scientific workshops) have presented and discussed methods for accounting for the level of development. The Final Rule includes a straightforward approach to this issue. Standard statistical regression analysis was used to isolate the effects on the number of days of 2 ppt salinity of (1) the level of development, represented by calendar year,[21] and (2) precipitation (Kimmerer 1994b; Ferreira and Meyer

[20] In fact, no dry or critically dry years, and only one above normal year occurred during the late 1960's to early 1970's.

[21] The use of the calendar year as a surrogate for the level of development is reasonable up until the late 1970's, because up until that time there was a fairly consistent increase year-by-year in the number and capacity of diversion and storage facilities, and the significant changes to the salinity regime imposed by the 1978 Delta Plan had not yet taken effect.

1994). This statistical procedure allowed EPA to separate the effects of year-to-year variability in precipitation from the effects of increased levels of upstream development.[22]

The results of these recomputations are shown graphically in Figures 1 and 2. The response surface or curved plane in Figure 2 shows how the number of days of 2 ppt salinity at Roe Island changes with both the precipitation (flow) and the changing level of development over time. Figure 1 shows several ''slices'' of the curved plane in Figure 2. Each of these different slices corresponds to a particular year's level of development (1940, 1958, 1968, and 1975), and show how the number of 2 ppt days would have varied over different hydrological conditions at that year's level of development. Historically, of course, each year experienced only one hydrological scenario; the purpose of the regression equations for these four different years is to show how that particular level of development would have influenced the position of the 2 ppt isohaline over the entire range of possible hydrological conditions.

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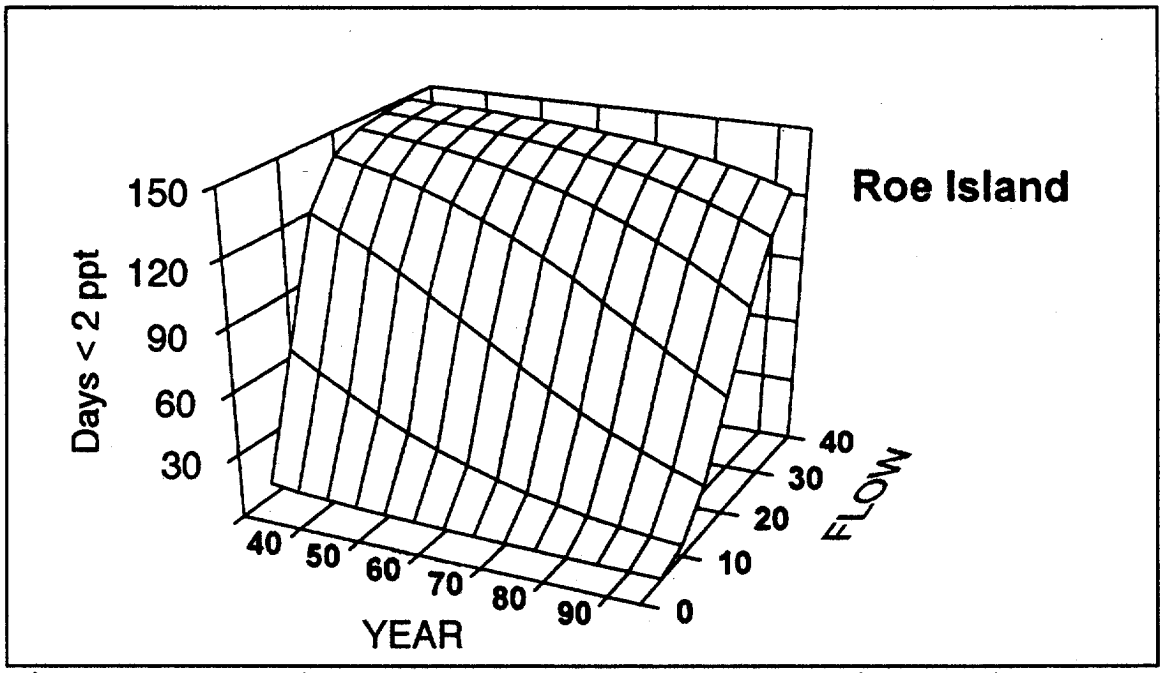

Figure 2. Predicted number of days of compliance with 2 ppt criteria during Feb-Jun period, showing relationship to (1) increasing level of development represented by calendar year and (2) unimpaired flow.

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Having adjusted the historical data to account for the effects of the level of development, EPA must still determine the appropriate reference period for defining the final criteria. The final criteria must adequately reflect conditions in the estuary at a time period during which the estuary attained the designated uses, regardless of the causes of degradation to the waterbody.

In the final rule, EPA is establishing Estuarine Habitat criteria that replicate the ''level of development'' existing in 1968. The intent of these criteria is to protect the Estuarine Habitat designated use to the same degree that these uses would have been protected under the level of development present in 1968.

EPA chose the 1968 level of development because the best available information indicates that at that time, salinity conditions in the Bay/Delta were adequate to protect the estuarine habitat. As explained in the Proposed Rule, EPA, NMFS, and USFWS have called for a level of protection equal to that which existed in the late 1960's and early 1970's. EPA believes that the fish population data summarized in the San Francisco Estuary Project's Status and Trends Report document the precipitous and unreversed decline of the most abundant species beginning in 1970. (Herbold et al. 1992). This downward trend is also apparent in the population data for winter run Chinook salmon. (Herbold et al. 1992).

In choosing a particular year, EPA is not suggesting that the particular hydrological conditions in 1968 are being replicated. Instead, the use of an individual calendar year appears to be a reasonable surrogate for the level of development for that period. As the graph in Figure 2 suggests, there would not be a substantial difference between number of days of meeting the 2 ppt salinity value in 1968 versus 1967 or 1969. EPA has chosen the 1968 value as a reasonable representation of the period in which the estuary was attaining its designated uses.

If the Estuarine Habitat criteria were stated on an annual basis as it was in

[22] In that this statistical procedure allowed the effect of the changing level of development to be controlled, the issue of the proper data set (i.e., group of reference years) to be included in the description of historical hydrological conditions essentially disappears. To take advantage of all appropriate historical data, in performing these computations EPA used data from the years 1930 (when accurate records were first available) to 1978 (when the hydrological conditions in the Delta were first substantially affected by the regulatory measures adopted by the State Board).

the Proposed Rule, the logistic equation corresponding to the 1968 line in Figure 1 would serve as the criteria's sliding scale correlating the number of days of meeting the 2 ppt salinity value with annual unimpaired flow. As described below, however, this annual sliding scale must still be transformed into monthly sliding scales.

(iii) *Moving to Monthly Compliance.*

EPA has also refined the final rule to restate the Estuarine Habitat criteria on a month-by-month basis, rather than as a single number of days of compliance covering the entire February to June period.

EPA received comments suggesting that the number of days of meeting the 2 ppt salinity value at Chipps and Roe Islands should be stated solely, or largely, in reference to the patterns of precipitation that could directly affect estuarine habitat during the period intended for protection. For example, criteria that are designed to protect conditions in the February–June period should reference only the unimpaired flows of February–June (or, possibly, January–June). Including precipitation in months outside of this February–June period could lead to inaccuracies in the criteria for February–June that could unnecessarily affect water project operations or inadequately protect the designated uses. This same problem could exist *within* the February–June period. For example, if in a given year the precipitation in February is substantial, but the following months are very dry, the overall period of February–June would be considered very dry and, using the sliding scale for the entire February–June period, the number of days of compliance with the 2 ppt salinity value at Chipps or Roe Island would be very low. This result may contradict the actual natural hydrological cycle, which under this scenario would have provided at least one high water period for the estuarine habitat uses.

A related issue raised by the comments and in the CUWA scientific workshops was the problem of how to develop compliance strategies for a given year based on a forecast of hydrological conditions expected during the following months. EPA agrees that this forecasting is unreliable, especially for the critical February and March months which are typically the months of most variable precipitation. Sliding scales such as Figure 1 (for Roe Island), which apply to the entire February to June period of protection, still require the project operators to forecast future hydrological conditions to meet the expected number of days of attainment with the 2 ppt criteria. For example, if February and March are wet, project operators have to forecast weather patterns for April to June to determine whether they should operate their projects to meet a substantial number of days of attaining the 2 ppt salinity value at Chipps or Roe Island (forecasting that the whole period will continue to be wet) or a lesser number of days (forecasting that the remaining months will be dry). Thus, the annual or five month approach described above and shown for Roe Island in Figure 1 would not address the issue of unreliable forecasts.

To address this uncertainty in forecasting long range hydrology, and to provide criteria that more closely reflect the natural hydrology actually affecting the estuarine habitat, EPA is in the final rule restating the Estuarine Habitat criteria on a month-by-month basis. That is, the final criteria define the required number of days of compliance for a particular month solely by reference to the hydrological conditions of the previous month. This approach more precisely ties the salinity conditions affecting Estuarine Habitat with natural hydrological cycles reflecting the time when the estuary attained its designated uses, and is therefore consistent with EPA's overall approach to protecting the Estuarine Habitat designated use.

Developing monthly sliding scales. EPA's analysis indicated that the required number of days of compliance with the 2 ppt criteria in a given month could be quite accurately predicted from logistic models using unimpaired flows of any of (a) the current month, (b) the previous month, (c) the previous two months, or (d) the previous and current month. Including the actual unimpaired flows of the current month, however, did not improve model performance and, in practice, the actual unimpaired flow of the current month cannot be known accurately until the month is over. EPA has, therefore, restated the criteria using the logistic equations described above, but only for one month at a time based on the preceding month's unimpaired flow.

For example, the measured unimpaired flow in January would be used to set the number of days of compliance with the 2 ppt criteria at the Chipps and Roe Island locations. Similarly, measured unimpaired flow in February is used to set March's requirement. This approach has been labeled the ''Previous Month's 8-River Index'' (PMI) approach. To make this approach work, the sliding scales exemplified (for Roe Island) in Figure 1 have been transformed into monthly sliding scales. These monthly logistic equations for both Chipps and Roe islands are shown graphically in Figure 3.

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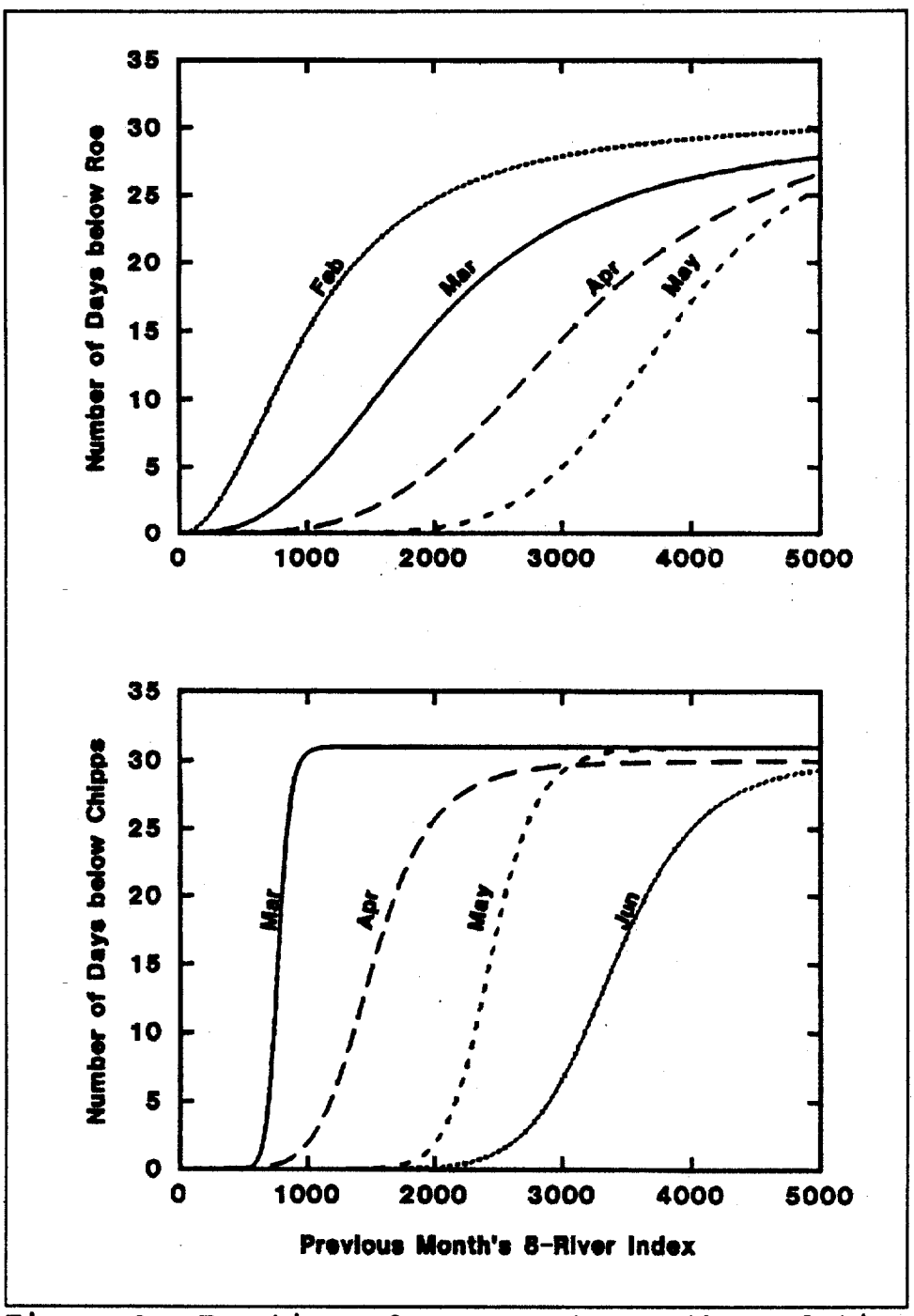

Figure 3 Equations for separate months relating previous month's unimpaired flow to current month requirement.

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Two technical revisions are being made to the criteria values generated by these monthly sliding scale equations. First, to facilitate compliance, the number of days resulting from the monthly equations will be rounded up or down to the nearest whole number. Second, at extremely low flows, the monthly equations include unjustified extrapolations beyond the existing data. For that reason, when the previous month's index is less than 500,000 acre-feet, the number of days of compliance required for the current month shall be zero.

Revising the Roe Island ''trigger'' for monthly compliance. As a result of the above changes to the Estuarine Habitat criteria, the ''trigger'' for the Roe Island location must be restated as a month-to-month trigger. The Proposed Rule stated, in effect, that if the salinity dropped below 2 ppt at Roe Island at any time during the February to June period due to uncontrolled hydrologic conditions, the Roe Island requirements were ''triggered'' for the remainder of the February to June compliance period. In the final rule, the ''trigger'' is evaluated on a monthly basis. If the 14-day moving average salinity at Roe Island falls below 2 ppt on any day during the last 14 days of a month, compliance with the Roe Island criteria would be ''triggered'' for the following month.

For example, assume that the sliding scale of unimpaired flow (PMI) for January indicates that the 2 ppt salinity value shall be attained for 18 days at Roe Island in February, *if* the Roe Island criteria is ''triggered.'' If the 14-day moving average salinity in the last part of January is below 2 ppt at Roe Island, the Roe Island criteria would in fact be triggered for 18 days in February. Assume then that the system is operated to meet the 18 days in February, but that a large storm in mid-February results in the salinities of less than 2 ppt at Roe Island for the entire month of February. This would ''trigger'' the Roe Island criteria in March. If the sliding scale, PMI-based calculation required 31 days of compliance at Roe Island in March in this scenario, compliance for April (for 13 days, for example) would also be triggered, since the 2 ppt would be met during the last 14 days of March. If April is a dry month, the 2 ppt criteria could be met for the required 13 days early in the month, the 14-day moving average salinity in the last half of April would never go below 2 ppt at Roe Island, and the Roe Island criteria would not be triggered for May at all.

Although somewhat complicated, this monthly triggering mechanism is essential to assure that the criteria applicable in a given month reflect the actual distribution of storm events throughout the February to June compliance period. As explained in more detail above, accounting for the natural hydrologic cycles in a manner reflecting the reference period assures protection of the designated uses without unnecessarily affecting water project operations.

(iv) *Alternative Measures of Attaining the Criteria.*

In the Proposed Rule, EPA indicated that it believed a State Board implementation plan that relied on the salinity-flow models, without making additional allowances for ''confidence intervals'', would adequately protect the designated uses. EPA's further review of the comments and continued discussions with the project operators has confirmed this belief.

In addition, EPA believes that the Estuarine Habitat use would be protected if the Estuarine Habitat criteria are directly measured as either a daily salinity value or as a 14-day moving average salinity value. Further, EPA's review of the new CCWD model correlating flow and salinity suggests that the Estuarine Habitat use would be protected at the Chipps and Roe Island monitoring sites if the modeled ''flow equivalent'' of the applicable 2 ppt criteria is provided. According to the CCWD model, the steady state flows that would satisfy these flow equivalent requirements are 29,220 cubic feet per second (cfs) for the Roe Island monitoring site and 11,400 cfs for the Chipps Island monitoring site (Denton, pers. comm.). This ''flow equivalence'' measure of attainment with the criteria would not be available at the Confluence monitoring site because of assumptions in the CCWD model about antecedent conditions in Suisun Bay.[23]

Accordingly, the State Board could adopt an implementation plan providing that project operators would attain the criteria in any one of three ways: (1) the daily salinity value meets the requirement, (2) the 14-day moving average salinity meets the requirement, or (3) at the Chipps and Roe Island monitoring sites, the system is operated on that day so as to meet the ''flow equivalent,'' using the CCWD model, of the stated salinity criteria. EPA notes that the available modeling data indicate that under most circumstances, the most efficient approach (in terms of water usage) to meeting the criteria would be to attain the specified salinity value rather than the alternative flow equivalent.

c. Revised Estuarine Habitat Criteria

Final estuarine habitat criteria reflecting the changes discussed above are shown below at 40 CFR 131.37(a)(1). These revised criteria provide the many equations necessary to define month-by-month sliding scales and, thereby, the applicable criteria.

For illustration purposes only, Table 2 presents representative examples of the required number of days of compliance in different months across a range of possible values of the PMI index of unimpaired flow.

PMI	Chipps Island					Roe Island (if triggered)			
	Feb	Mar	Apr	May	Jun	Feb	Mar	Apr	May
1000	.....	31	2	0	0	13	4	2	0
1250	.....	.....	7	0	0	17	7	4	0
1500	.....	.....	15	0	0	19	10	8	0
1750	.....	.....	21	0	0	21	13	11	0
2000	.....	.....	26	1	0	22	16	15	0
2500	.....	.....	29	16	1	24	20	21	2
3000	.....	.....	29	29	7	25	24	25	5
4000	.....	.....	30	31	25	26	27	28	18
5000	.....	.....	.....	.....	29	27	29	29	26

[23] That is, to make this finding that the ''flow equivalence'' would protect the designated use at the Chipps and Roe Island locations, EPA had to make assumptions in the CCWD model that the 2 ppt salinity value was actually being attained at the Confluence. Given that assumption, EPA cannot find that the ''flow equivalence'' at the Confluence is protective.

PMI	Chipps Island					Roe Island (if triggered)			
	Feb	Mar	Apr	May	Jun	Feb	Mar	Apr	May
6000	.....	.....	.....	.....	30	28	30	30	29

Table 2. Examples of required number of days of compliance for each month across a range of possible values of the 8–River Index for the prior month (PMI).

2. Fish Migration Criteria

a. Overview

(1) Importance of the Fish Migration and Cold Freshwater Habitat Criteria. The State's designated uses for the Bay/Delta include Cold Fresh-Water Habitat ''to sustain aquatic resources associated with a coldwater environment,'' and Fish Migration to ''[p]rovide[ ] a migration route and temporary aquatic environment for anadromous or other fish species.'' (1991 Bay/Delta Plan at 4–1). The migratory fish species associated with the cold fresh-water environment in the Bay/Delta are chinook salmon (Oncorhynchus tshawytscha) and steelhead trout (Oncorhynchus mykiss).[24]

[24] The State Board has designated both of these uses for the Bay/Delta estuary. However, in practice there is substantial overlap between them because many of the factors affecting the Cold Fresh-Water Habitat use also affect those anadromous fishes migrating through the Delta to the ocean. Because of this overlap, this rule will, in protecting Fish Migration, benefit the Cold Fresh-Water Habitat use as well.

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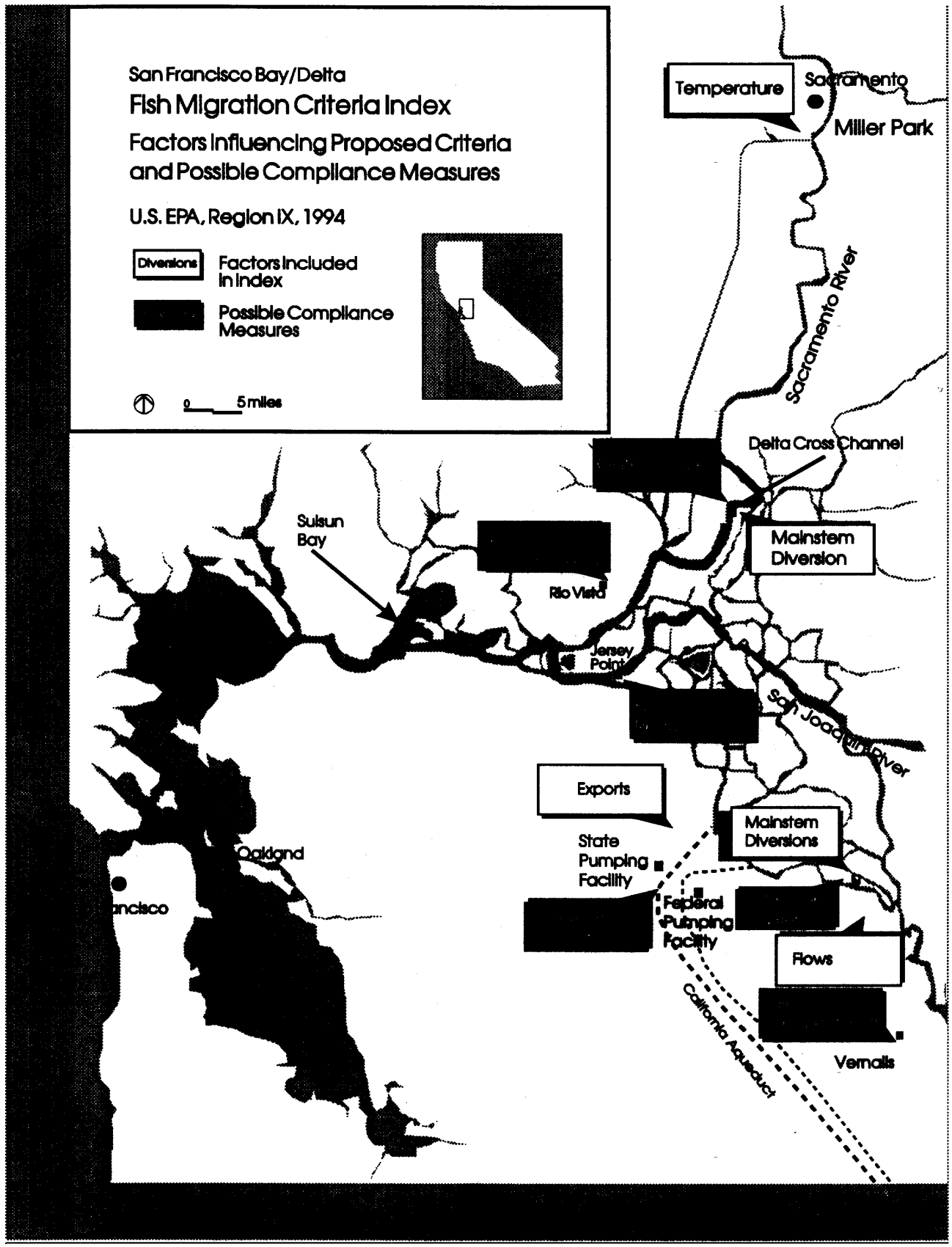

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Currently there are four distinct populations of salmon in the Sacramento/San Joaquin river systems, each named for the season of their migration upstream as adults. The fall-run population is now the most numerous. The San Joaquin River system supports only a fall-run population; the San Joaquin River spring-run became extirpated in the 1940's. The Sacramento River system still supports small winter-run, spring-run and late fall-run populations, but these populations have all declined dramatically in recent years (USFWS 1992a, WRINT–USFWS–7; California DFG 1992a, WRINT–DFG–14). The winter-run population is now listed as threatened under the ESA. The spring-run population has recently reached low enough levels to be recognized as a species of special concern by the State of California, and NMFS has recently included the spring-run in its status review of salmon on the northwest coast of the United States (59 FR 46808 (09/12/94)).

Steelhead trout are also cold fresh-water migratory fish within the Sacramento River System. They have suffered a 90 percent decline since the late 1960's, and are supported largely by hatchery production (CDFG 1992a, WRINT–DFG–14).

Salmon and steelhead migrating through the Delta to the ocean are subject to increased mortality when exposed to high temperatures and low flows and when diverted out of the main channels of the Sacramento and San Joaquin Rivers into less suitable habitat. Those fish diverted from the main river channels into the central and south Delta are also subject to increased mortality because of several factors including higher temperatures, increased predation and increased entrainment at the State and Federal pumping plants in the south Delta (USFWS 1992a).

State and federal legislators have recognized the serious threat to the continued existence of migratory fishes in the Bay/Delta. In 1988, the California State legislature mandated a restoration goal of doubling natural salmon and steelhead production by the year 2000, and required development of a plan to meet this goal. Salmon, Steelhead Trout, and Anadromous Fisheries Program Act; codified at Cal. Fish & Game Code § 6900 et seq. (West 1991). Also, the United States Congress recently enacted the Central Valley Project Improvement Act (CVPIA), which requires that a program be developed and implemented to make ''all reasonable efforts to ensure that * * * natural production of anadromous fish in Central Valley rivers and streams will be sustainable, on a long-term basis, at levels not less than twice the average levels attained during the period 1967–1991. * * *'' Central Valley Project Improvement Act § 3406(b)(1), P.L. 102–575.

(2) Proposed Rule. Many different factors affect the ability of salmon and steelhead to successfully migrate through the Delta to the ocean. These include water temperature, flow rates, diversions, operation of pumping facilities, and gate closures regulating the direction of water flows through the myriad channels and sloughs in the Delta. Clearly, any number of beneficial combinations of these factors could result in conditions that provide for successful migration and protection of the designated use. Accordingly, in formulating its Proposed Rule, EPA concluded that it would state its criteria generally, measuring the success of salmon in migrating through the Delta. That is, EPA would state goals that (1) called for a certain percentage of salmon to be able to survive their passage through the Delta, and (2) that could be achieved by any of a number of different management measures. In this way, the State Board would have maximum latitude to find combinations of management measures that would attain the salmon survival goal.

In order to quantify the success of migrating salmon in passing through the Delta, EPA relied on ''salmon smolt survival models'' developed by the USFWS, one for the Sacramento River and one for the San Joaquin River.[25] These salmon smolt survival models are mathematical equations stating the relationship between specific variables in the Delta (water flow rates, diversions into the central Delta, etc.) and salmon smolt survival.[26] To predict the effect of a particular set of management measures (for example, a specified minimum flow and a specified maximum export flow), EPA inserts the management measures into the model equation. The model equation then generates an ''index value'' representing the relative success of salmon migrating through the Delta while that set of management measures is being implemented.[27]

As its criteria, EPA proposed a set of index values representing successful salmon migration sufficient to protect the designated use. EPA established these target criteria index values by taking a set of USFWS recommendations of management measures that would protect the salmon resource, and translated (using the USFWS model equations) those protective management measures into index values. In other words, the criteria index values represented the level of salmon migration survival through the Delta that would occur if this particular set of protective management measures were adopted. The intent was not to mandate those particular management measures. Rather, it was to set a performance standard—measured by the criteria index value—for salmon survival. To attain the goal, the State Board would use either the specific management measures recommended by USFWS, or any other combination of measures that would yield the same level of survival of migrating salmon.

The Proposed Rule named its criteria index values ''salmon smolt survival index criteria.'' For each of the Sacramento and San Joaquin River systems, the criteria provided a salmon smolt survival index equation (*i.e.* a USFWS model equation) and a set of index values to be attained. The index equation for each river quantified and predicted the survival of salmon smolt migrating through the Delta.

The USFWS equations and EPA's Proposed Rule both ''scaled'' the index values to a scale of 0 to 1. This was done by dividing experimental release results by a constant of 1.8 (the highest release result). In the final rule, EPA is not ''scaling'' its criteria values. It is important to realize that criteria index values in the final rule are not actual survival estimates (such as a percentage of smolt surviving), but indices showing survival relative to other index values.[28]

In the Proposed Rule, the index values contained in the criteria varied according to the standard five water year types—each water year type had a

[25] A ''smolt'' is a salmon in the process of acclimating to the change from a fresh water to a salt water environment. This occurs when young salmon migrate downstream through the Delta to the ocean.

[26] These salmon smolt survival index equations were based in large part on the results of tagged-fish release and recapture experiments designed to measure and compare salmon smolt survival under a number of different physical conditions of varying migration pathways, water temperatures, flow rates, and rates of water exports from the Delta.

[27] There was some disagreement among the commenters on the Proposed Rule as to whether these USFWS models yield index values that are literally ''percentages'' of the salmon smolts surviving through the Delta. All parties appear to agree, however, that these index values do in fact represent the relative survival compared to other index values. This preamble and accompanying rule will generally refer to these values as index values rather than as percentages.

[28] For example, historically, the San Joaquin River index value has reached a number as high as 1.5 (which was attained in an experimental release at Jersey Point). For comparison, the average San Joaquin survival index value during low flow years is 0.09. This 0.09 index value represents approximately 5 smolt recoveries from a release of 50,000 fish at Mossdale, 55 miles upstream of the recovery site at Chipps Island.

particular index value to be attained.[29] 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[33] 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

[29] As stated above, the standard water year categories are wet, above normal, below normal, dry, and critically dry years.

[30] 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.

[31] 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.

[32] 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.

[33] 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 newly-spawned eggs.

release and recapture experiments measuring and comparing salmon smolt survival under a number of different physical conditions of varying migration pathways, water temperatures, flow rates, and rates of water exports from the Delta. On the Sacramento River, over the past 14 years, USFWS has performed a series of studies, releasing coded-wire tagged smolts at Sacramento and using recapture data to estimate an index of their survival to Chipps Island. Similarly, on the San Joaquin River, between 1982 and the present, the USFWS has conducted a series of experimental releases and captures of tagged salmon smolts in the San Joaquin River system, and has used the data collected in these experiments to develop a smolt survival index model for that basin (Brandes 1994).[34] EPA believes that the smolt survival indices from these releases do in fact represent the pattern of smolt survival through the Delta, and this belief was generally confirmed by the scientific workshops sponsored by CUWA (Kimmerer 1994b). As noted above, USFWS and the EPA Proposed Rule both ''scaled'' the index values by dividing experimental release results by 1.8.

In the Proposed Rule, the index values contained in the criteria varied according to the standard five water year types. The proposed criteria index values were stated in tabular form as in Table 3, below. 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 stated 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 flows rates, water diversion into the Upper Old River, and export rates.

The Preamble to the Proposed Rule discussed in detail how the actual criteria index values in Table 3 were determined. To protect the designated uses, the Proposed Rule included index values representing the modeled results of the management measures proposed by USFWS based on the work of the Delta Team of the Five Agency Chinook Salmon Committee, with the exception of certain recommendations regarding the Georgiana Slough. The management measures consisted of export limits, minimum flows, channel gate closures, etc., during critical periods in the year. As explained in the preamble to the Proposed Rule (59 FR 825), EPA was concerned that the Delta Team recommendation to close the Georgiana Slough would have deleterious effects on the Delta smelt and other aquatic life in the central Delta, and possibly on adult salmon returning upstream. Thus, the management measures underlying the recommended criteria index values did not assume that the Slough would be closed. EPA concluded that these management measures, if implemented by the State, would lead to the protection of the designated Fish Migration use.

EPA then evaluated the effects of these management measures on the variables contained in the models, and calculated the criteria index values using the model's equations. The result was criteria index values that reflect effects on survival as a result of implementing the recommended management measures.

Although the criteria index values were set by reference to the protective management measures, 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. The historical index values were developed by the USFWS. *See* USFWS, 1992c (WRINT-USFWS–8); also 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. Both sets of criteria index values represented better protection than the 1956–1970 historical period in drier years, and less protection in wetter years. These proposed criteria index values were intended to reflect more consistent smolt survival and help avoid situations where extraordinary measures would be necessary to preserve runs, particularly in the San Joaquin River tributaries.

TABLE 3.—PROPOSED SALMON SMOLT CRITERIA

Sacramento River		San Joaquin River	
Water year type	Criteria value	Water year type	Criteria value
Wet	.45	Wet	.46
Above Normal.	.38	Above Normal.	.30
Below Normal.	.36	Below Normal.	.26
Dry	.32	Dry	.23
Critical	.29	Critical	.20

Finally, 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. This approach assumed that the criteria index equations included all of the important variables determining smolt survival and correctly stated the interrelationship of those variables, so that actual measurement of attainment would be unnecessary.

The final Fish Migration criteria reflect the following changes from the Proposed Rule: (i) the methodology for establishing the criteria index values has been revised, (ii) the criteria have been restated as sliding scales or continuous functions, and (iii) direct experimental measurements of salmon survival will be used to measure attainment of the criteria.

(i) Revised Method of Selecting Criteria Index Values

As discussed in the materials referenced in EPA's Notice of Availability (59 FR 44095), EPA has revised its approach to stating and developing the criteria index values used in the final criteria. The primary change in the final rule is that EPA has revised the underlying management measures used to generate the criteria index values. On the Sacramento River, available information indicates that closing the Delta Cross Channel during the spring migration period is the most important factor in the protection of the Fish Migration designated use, primarily because closing the Channel prevents migrating fish from being pulled into the inner Delta where survival is significantly lower. Accordingly, the criteria index values were based on tagged-fish release results for migration periods when the Delta Cross Channel was closed. Similarly,

[34] Since the Proposed Rule was published, and as described in the alternative formulation of the Fish Migration criteria made available in EPA's Notice of Availability (59 FR 44095), USFWS has developed a revised version of the San Joaquin River model. This model relates the survival of San Joaquin basin smolts migrating through the Delta to: (1) San Joaquin River flow at Vernalis, (2) proportion of flow diverted from the mainstem San Joaquin River, (3) exports, and (4) temperature at Jersey Point. The revised San Joaquin model structure overall is very similar to that of the Sacramento basin model. This revised model should be more useful than the previous version for analyzing alternative implementation measures.

EPA believes that on the San Joaquin River the management measures recommended by USFWS (with the minor adjustments described below) will protect the designated uses. Accordingly, the criteria index values for the San Joaquin were derived from the modeled values associated with these management measures.

(a) Sacramento River Fish Migration Criteria

On the Sacramento River, the criteria index values vary according to the water temperature at Miller Park at the time of the tagged fish release. ''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 were closed during the critical spring 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.

(I) *Using Temperature as the Independent Variable for the Criteria.* In the Proposed Rule, Sacramento River criteria varied according to water year types reflecting precipitation in the Sacramento River Basin. Using water year type as the ''independent variable'' in the criteria allowed EPA to match criteria index values with the natural variation in precipitation. Further analysis of the USFWS tagged-fish release studies suggests that temperature is a dominant factor influencing salmon smolt survival in the Sacramento River. Temperature at release alone is significantly related to salmon smolt survival (Letter from P. Fox to L. Hoag, California Urban Water Agencies, dated July 13th, 1994).

Because water temperature in the Delta is largely independent of management measures in the Delta (in that it varies naturally with ambient weather conditions), EPA will adopt final Fish Migration criteria that vary based on water temperature. That is, the criteria index values will call for higher smolt survival at lower water temperatures, and lower smolt survival at higher water temperatures. This variation in the criteria index values with temperature follows the pattern of the natural variability of temperature and survival existing on the Sacramento River during periods in which the Fish Migration designated use is attained.

Although it is generally adopting water temperature as the independent variable for the Sacramento River Fish Migration criteria, EPA is modifying the approach in two ways in order to better protect the designated use. First, at very high water temperatures (those above 72° F), measured smolt survival index values approach zero. These high temperature conditions are clearly not consistent with protection of the Fish Migration use. Protective measures should therefore be used to increase survival of smolts throughout this period, even at times of high temperature. To this end, USFWS has recommended additional management measures (primarily export restrictions) to restrict passage of fish into the warm waters of the central Delta and, thus, lower mortality of smolts as they pass through the Delta (USFWS 1992a). It is EPA's judgment that these measures should be used to reduce the serious degradation in migration conditions occurring during high temperature periods. EPA believes, therefore, that a ''floor'' to the Fish Migration criteria is appropriate so as to encourage efforts to protect salmon during these periods of high temperature. EPA has included such a ''floor'' at the 72° F temperature level in its final Sacramento River Fish Migration criteria.

Similarly, at lower temperatures, the smolt survival index values likely approach a maximum at some point. The highest survival index recorded (1.48) coincided with the lowest temperature at release recorded during salmon smolt survival experiments (61°F). Below this temperature, it is unlikely that lower water temperatures would lead to a substantially increased survival. In other words, once water temperature reaches the lower temperatures beneficial to smolt survival, additional decreases in the temperature would not be expected to significantly increase survival. This suggests that the Fish Migration criteria should include a ''ceiling'' value associated with those low temperatures. Otherwise, the criteria would state that continued lowering of water temperature should yield higher and higher survival. This result is unlikely to be valid. EPA is therefore placing a ''ceiling'' on the criteria index values corresponding to the 61°F level.

(II) *Establishing criteria values.* To set the actual criteria values, the final rule relies on the recommendation by USFWS that the Delta Cross Channel be closed at critical times during the spring salmon migration period (USFWS 1992a). Recent investigations by USFWS indicate that closing the Delta Cross Channel is the most important factor in the protection of smolts on the Sacramento River (USFWS 1992b). The historical experimental release results support this hypothesis, in that data points derived from periods when the Cross Channel was closed show a significant and consistent improvement in survival compared to periods when it is open (USFWS 1992b).[35]

Based on this beneficial relationship between survival and the closure of the Delta Cross Channel, EPA has concluded that criteria index values corresponding to a closed Delta Cross Channel (adjusted to provide a floor for high temperature periods) would reflect conditions protecting the Fish Migration designated use on the Sacramento River. Accordingly, the final rule adopts criteria index values, stated (as explained below) as a continuous function or line, to approximate[36] the experimental survival index values observed for Sacramento releases during periods in which the Channel is closed. The continuous function or line for these criteria index values can be stated as a simple linear equation (Index value = 6.96 − .092 * Fahrenheit temperature).

This approach to developing criteria index values addresses some of the concerns about the criteria index equations raised in the public comments and at the CUWA scientific workshops. Some commenters believed that the complexity and structure of the equations resulted in too much uncertainty about their statistical reliability. The revised approach used in the final rule reduces this problem because it sets the criteria index values using observed tagged-fish release results instead of modeled or computed values.

The final criteria index value line described above very closely approximates the line created by doubling the historical survival data measured at times that the Delta Cross Channel is open. These different lines, and the underlying data, are summarized in Figure 4. Although not intentional, the near-coincidence of the final criteria index value line and the doubling line provides an independent policy rationale for adopting this target index, in that the Central Valley Project

[35] This is particularly true for release studies at Sacramento. Release studies at Courtland (downstream of Sacramento) showed less dramatic improvement with the Cross Channel closed, suggesting that other factors such as those included in the USFWS model are also at work.

[36] Approximating this line was done through a standard least squares ''best fit'' computation.

Improvement Act mandates a ''doubling'' goal for anadromous fish.

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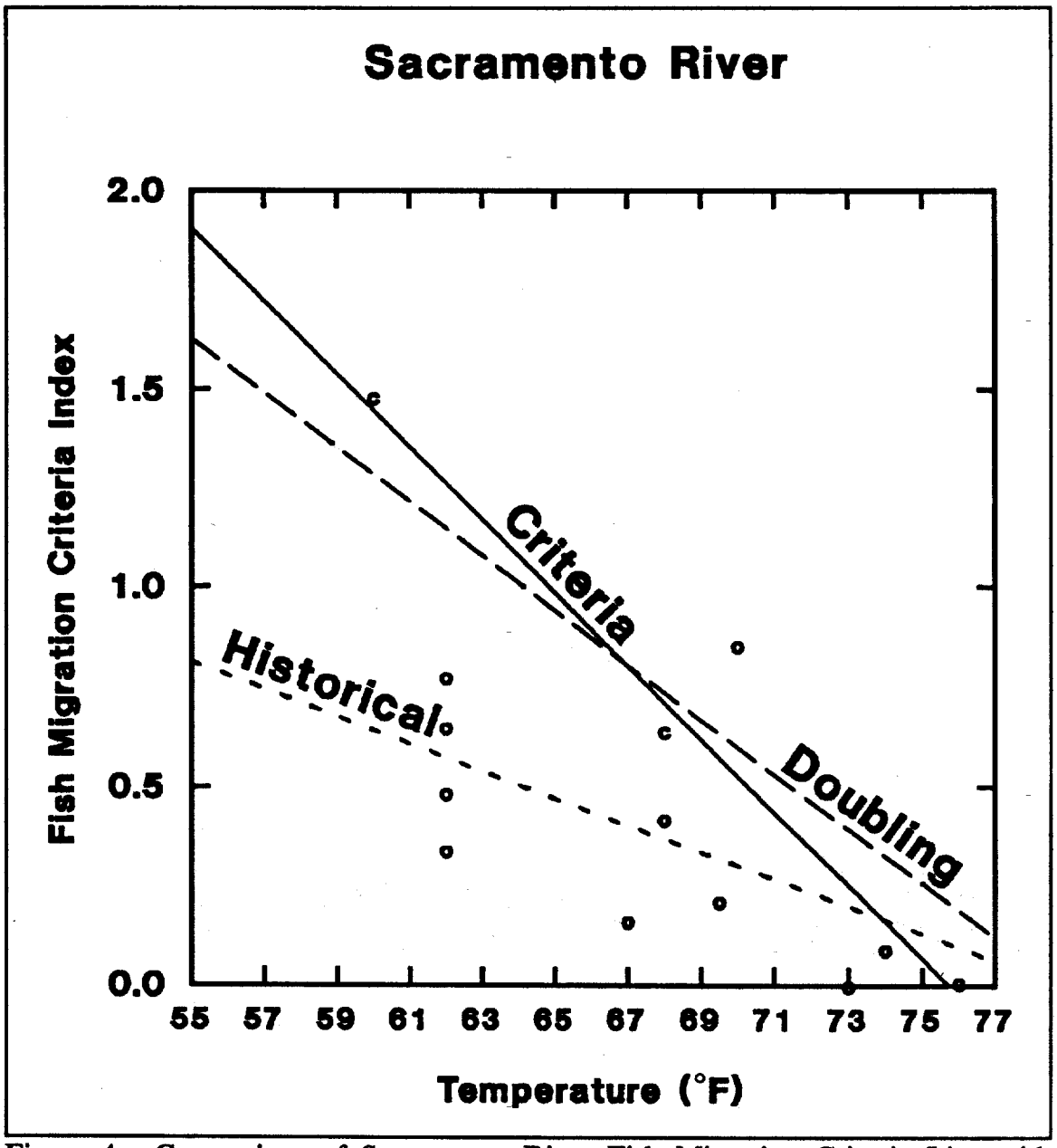

Figure 4: Comparison of Sacramento River Fish Migration Criteria Line with Historical Survival and Doubling of Historical Survival Lines

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Historical information confirms the validity of the final Sacramento River Fish Migration criteria, in that the criteria index values developed in this final rule are consistent with the modeled index values representing conditions in the late 1960's to early 1970's. As stated by EPA in the Proposed Rule, the level of protection on the Sacramento River during this historical period was consistent with the protection of the Fish Migration designated use.

(III) *Revised Sacramento Fish Migration Criteria.* The revised criteria (Sacramento River Fish Migration Criteria or SRFMC) are stated in reference to water temperature. As explained above, use of this linear equation appears inappropriate at both very high and very low temperatures, so the criteria must specify a ceiling on the index values at low temperatures and a floor for high temperatures. Incorporation of these conclusions and comments leads to the following Fish Migration criteria:

At temperatures below 61°F:
SRFMC=1.35

At temperatures between 61°F and 72°F:
SRFMC=6.96 − .092 * Fahrenheit temperature

At temperatures above 72°F:
SRFMC=0.34

In all cases, water temperature is the temperature at release of tagged salmon smolts into the Sacramento River at Miller Park.

These final criteria are shown in Figure 5. Note that the ''ceiling'' and ''floor'' values in the final rule differ somewhat from those included in the documents made available in EPA's Notice of Availability (59 FR 44095). The changes were made to correct computational errors in evaluating the applicable ''continuous function'' values for the 61°F and 72°F ceiling and floor levels.

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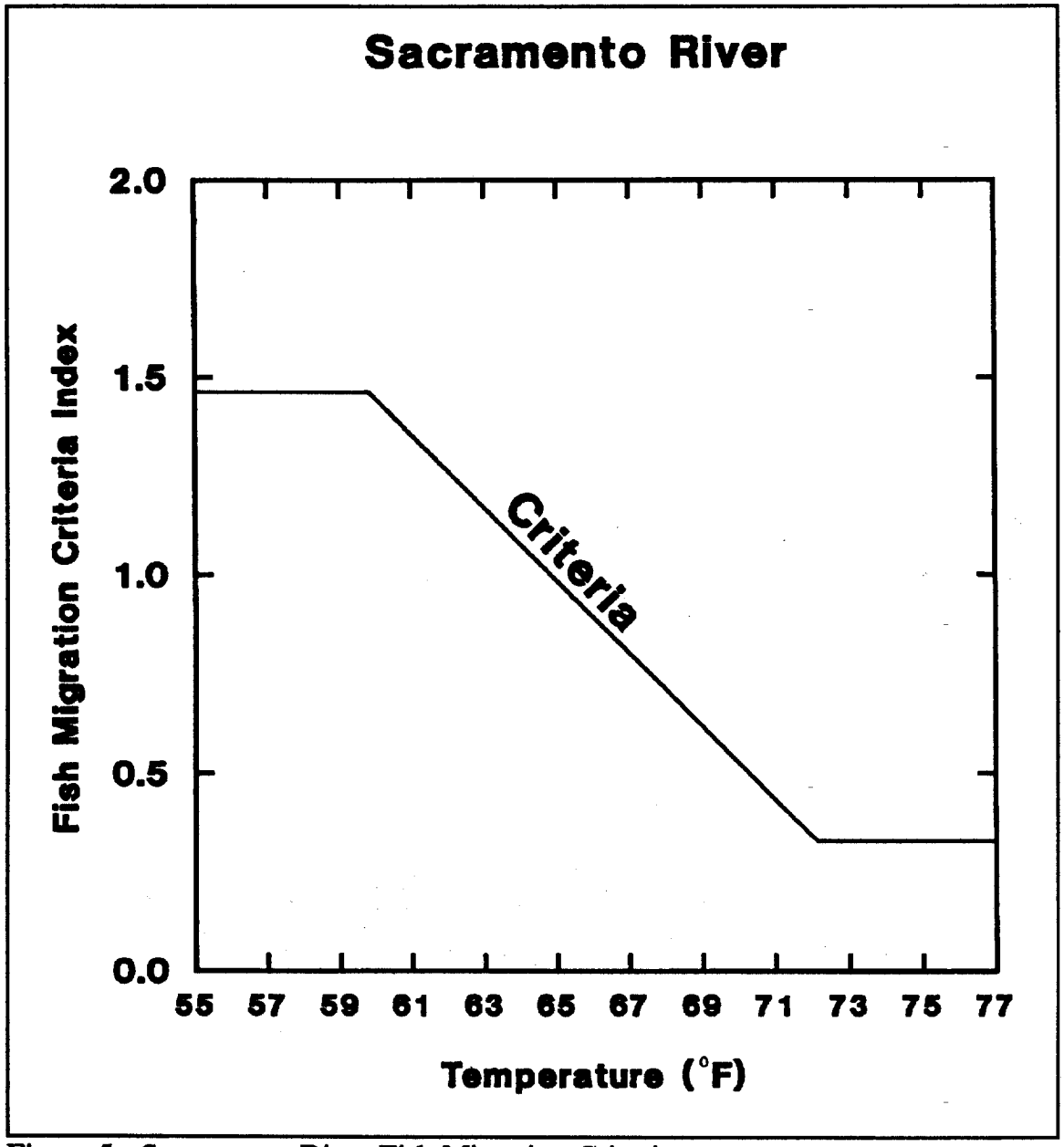

Figure 5: Sacramento River Fish Migration Criteria

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(IV) *Implementation.* On the Sacramento River, the criteria provide survival goals that vary based on the water temperature at the time of release of the tagged salmon smolts. EPA believes that the implementation plan developed by the State Board should provide for a sufficient number of fish releases each year to determine whether the criteria are being attained over a representative range of temperature conditions. EPA recognizes that there may be substantial variation in fish migration criteria values resulting from these experimental releases. Accordingly, the final rule provides that attainment can be measured using a three-year moving average (the current year and two preceding years). Three year periods should provide time to complete sufficient releases to determine whether the implementation measures are, on average, attaining the stated criteria values.

The State Board may consider using the USFWS Sacramento smolt survival model (that is, the model underlying the criteria index equations) to predict measures necessary to attain the criteria. There are a number of base conditions underlying both the tagged-fish release experiments and the USFWS models. For example, USFWS recommended a base Sacramento River flow to ensure that overall conditions do not deteriorate. The State should protect these base conditions as it develops an implementation plan.

Monitoring attainment of these criteria should focus on both within-year measures and across-year comparisons. During each year monitoring of salmon smolt survival should occur throughout the months of April, May and June with particular emphasis during times of temperature change or at times of change in water project operation. It is likely that this monitoring will reveal a large variability in survival at different times and under

different conditions within each year. EPA anticipates that at the time of the next triennial review enough monitoring data over a range of temperatures will be available for a preliminary determination of whether the State's implementation actions attain the criteria.

(b) San Joaquin River Fish Migration Criteria

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 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.

(I) *Using Unimpaired Flow at Vernalis as the Independent Variable for the Criteria.* In the Proposed Rule, San Joaquin River criteria varied according to water year types reflecting precipitation in the San Joaquin River basin. Using the water year type as the ''independent variable'' allowed EPA to match the criteria index values with the natural variation in precipitation. Further analysis has confirmed that water flow at Vernalis shows a significant correlation with survival indices representing total survival through the Delta,[37] suggesting that criteria index values should vary with the natural hydrology. That is, the criteria index values should reflect higher survival during wetter years with more precipitation and lower survival during drier years. This variation replicates the natural hydrological cycles affecting Fish Migration through the estuary.

The Proposed Rule varied criteria index values according to the five water year types, and in that way reflected natural hydrological cycles. In the final rule, however, EPA is using the 60–20–20 unimpaired San Joaquin flow index[38] as a readily-available estimate of natural hydrology. When used in a continuous function (as described below), the 60–20–20 index allows a much more precise statement of the natural hydrology than the five water year categories.

(II) *Establishing Criteria Index Values.* To establish the actual values included in the San Joaquin River Fish Migration criteria, EPA first developed survival values associated with the implementation of management measures proposed by USFWS (USFWS 1992a). These USFWS measures include export limits at certain times, a barrier at Old River during April and May, and minimum flows at Vernalis, and are summarized in Table 5.[39] As indicated in the Proposed Rule, EPA believes that implementation of these management measures would provide conditions protecting the designated Fish Migration use.

Modifying management measures. As explained below, EPA has revised its assessment of some of the USFWS management measures (notably, those involving the Upper Old River barrier). Accordingly, the final rule used the following management measures: (1) A one month (April 15 to May 15), instead of USFWS's two month (April 1 to May 31), requirement for the Upper Old River barrier placement, (2) increased export restrictions (to 1500 cfs) during the time the Old River barrier is in place, (3) increased flow (to an average of 4000 cfs rather than USFWS's 2000 cfs) in critical years when the barrier is in place, and (4) flows and exports varying each year according to the 60–20–20 water year index, rather than using the USFWS proposal to vary measures by water year type. EPA's measures (stated as averages for each water year type) are also shown in Table 4.

EPA revised the management measures recommended by USFWS because recent discussions with USFWS and others, as well as information developed in hydrological modeling for the South Delta Barriers Project (California DWR 1993), raised concerns that an Upper Old River barrier might increase reverse flows in the central Delta. Such an increase has the potential to draw fish into poor habitat and to increase entrainment of fish at the project pumps. This is of particular concern for the threatened Delta smelt. Because the barrier is expected to provide greatly increased protection for migrating salmon smolts, EPA continues to believe, as it expressed in the Proposed Rule, that an Upper Old River barrier is an important implementation measure. However, in order to prevent an increase in detrimental central Delta reverse flows, EPA is revising the USFWS management measures to include only one month with the barrier in place, rather than the two months initially recommended by USFWS.[40]

[37] EPA considered water temperature at release, smolt size at release, and water flow at Vernalis as potential independent variables affecting survival. Based on the studies done to date, it appears that neither water temperature at release nor smolt size show a significant correlation with the smolt survival indices representing smolt survival through the San Joaquin Delta (P. Fox, Data summary presented at CUWA workshop on June 29, 1994). Note that results from upstream site releases (at Snelling and on the lower Stanislaus and Tuolumne Rivers) were included in this correlation between flow and survival index values in order to supplement data from wetter years. This approach assumed that the mortality between the upstream release sites and the downstream Mossdale, Dos Reis and Upper Old River release sites (all close together) is negligible. If incorrect, this assumption may bias the correlation downward, and survival through the Delta may have been better than the index indicates for those releases.

[38] The San Joaquin water year index (denoted the San Joaquin Valley Index in the final rule language) is the commonly-accepted method for assessing the hydrological conditions in the San Joaquin basin. It is also frequently referred to as the 60–20–20 index, reflecting the relative weighting given to the three terms (current year April to July runoff, current year October to March runoff, and the previous year's index) that make up the index.

[39] As explained above, the index values shown in Table 6 (both USFWS and EPA values) have been ''scaled'' by dividing by 1.8. This scaling allows a direct comparison with the Proposed Rule index values, which were also scaled. EPA's final criteria index values have not been scaled, to facilitate measurement of attainment through actual experiments as discussed below.

[40] As in the Proposed Rule, EPA assumed that exports would be reduced to no more than 1500 cfs while the barrier is in place, to help alleviate hydrological problems caused by the barrier. Minimum flows during the time the barrier is in place are assumed to be an average of approximately 4000 cfs during dry and critically dry years to provide an increased ratio of flows to exports in the lower San Joaquin, thereby further reducing potential problems caused by reverse flows. Management measures assumed in developing the criteria values also included export restrictions during the times in April and May when the barrier is not in place. These maximum export rates are: in critically dry years, 2000 cfs; dry years, 3000 cfs; below normal years, 4000 cfs; above normal years, 5000 cfs; and wet years, 6000 cfs.

TABLE 4.—SAN JOAQUIN MANAGEMENT MEASURES COMPARED

Alternative	Max Total CVP/SWP Exports in cfs	Barrier Upper Old River	Vernalis Flow	Index Values on San Joaquin
EPA	4/15 to 5/15 1500 4/1 to 4/15 & 5/16 to 5/31 W[1] 6000 AN 5000 BN 4000 D 3000 C 2000	4/15 to 5/15 All Year Types	4/15 to 5/5 Minimum CFS W 10000 AN 8000 BN 6000 D 4000 C 4000 Other flows from 4/1 to 5/31 same as DWRSIM run used by USFWS for D–1630	W .49[2] AN .35 BN .28 D .22 C .22 Avg = .33
USFWS	4/15 to 5/15 W 6000 AN 5000 BN 4000 D 3000 C 2000	4/1 to 5/31 All Year Types	4/15 to 5/15 Minimum CFS W 10000 AN 8000 BN 6000 D 4000 C 2000 Other flows from 4/1 to 5/31 same as DWRSIM run used by USFWS for D–1630	W .49 AN .41 BN .40 D .35 C .32 Avg = .41

[1] Many of the management measures in Table 4 vary by the water year category. Those categories are wet (W), above normal (AN), below normal (BN), dry (D) and critically dry (C).

[2] For comparison purposes, both EPA and USFWS index values have been scaled by dividing by 1.8. The final EPA criteria have not been scaled.

Criteria index values. Having arrived at this set of management measures that would protect the Fish Migration designated use (and not adversely affect the Delta smelt), EPA used the USFWS survival index equations to develop criteria index values across the potential range of hydrological conditions.[41] Note that, as distinguished from the Proposed Rule, EPA is including only the criteria index *values* as its final Fish Migration criteria. The Proposed Rule had also included the criteria index value *equations* in the criteria. By including only the goal or target index values in the final criteria, EPA is providing greater latitude to the State Board to develop a mix of management measures that attain the stated salmon survival.

Means of these modeled values for each water year type are shown in Table 4. To translate these discrete values into a continuous function (as discussed below), two lines of ''best-fit'' were created, one for the drier years (dry and critically dry) and one for the wetter years (wet, above normal, and below normal). By connecting these two lines, EPA created a continuous function to serve as the criteria index value line on the San Joaquin. This criteria index value line is shown in Figure 6.

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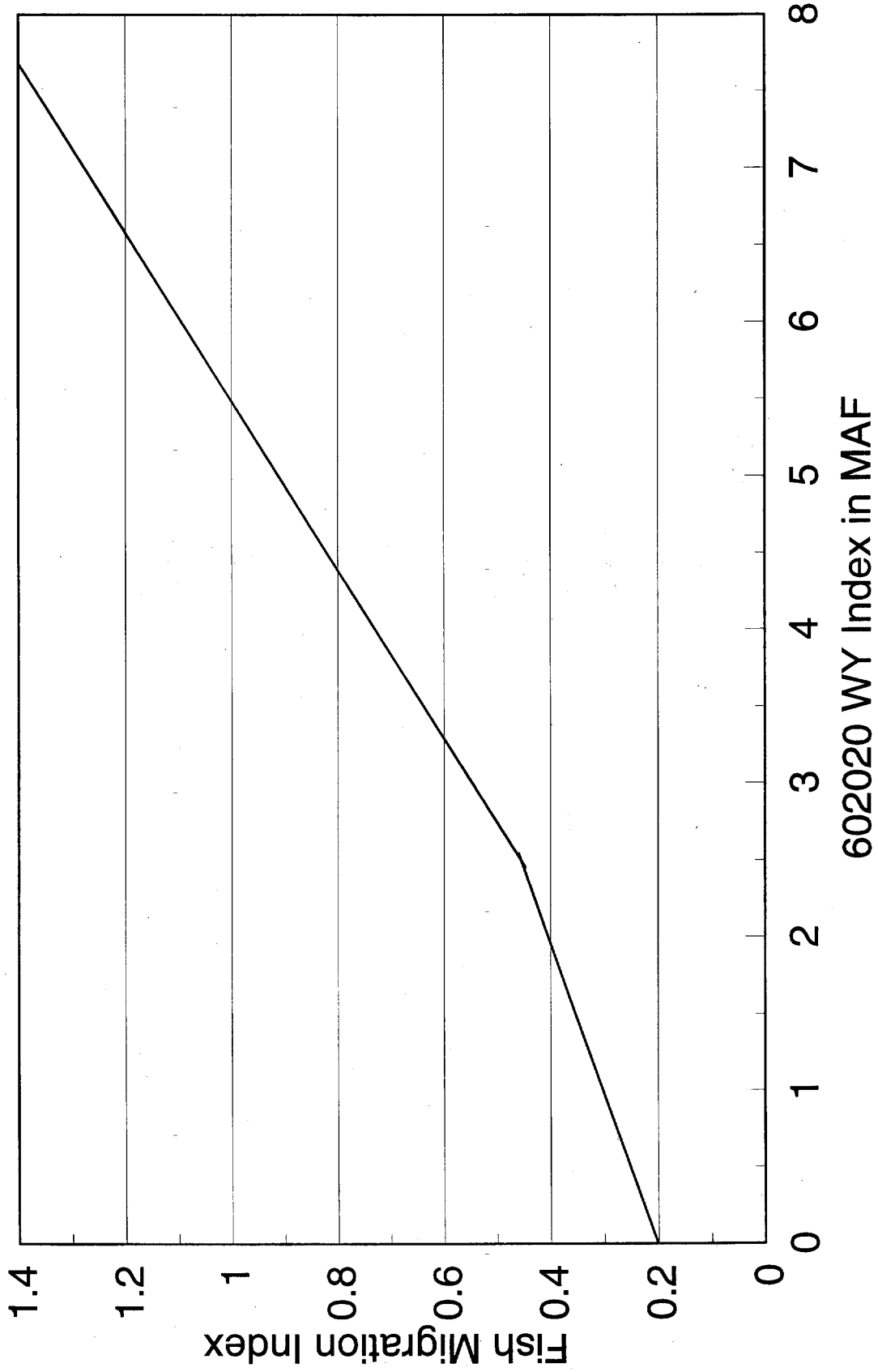
[41] The final Fish Migration criteria on the San Joaquin River do not vary by temperature (as they do for the Sacramento River) because experimental data from releases near the upstream edge of the Delta did not show a significant statistical relationship between survival and temperature at release (P. Fox, Data summary presented at CUWA workshop on June 29, 1994). In other words, on the San Joaquin River, temperature should not be used as the *independent* variable in the criteria. Nevertheless, temperature at Jersey Point is one of the factors included in the revised USFWS San Joaquin River model, and, as described above, that model was used in developing EPA's final criteria to gauge the probable effect of implementation measures on smolt survival. When computing modeled smolt survival, EPA assumed average water temperatures of 60 °F in April and 65 °F in May. These assumed values are averages from a set of temperature data at Jersey Point taken during the late 1950's and 1960's. The recent experimental release temperatures are within the range of this data.

Figure 6. San Joaquin Fish Migration Criteria



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Dry year v. wet year protection. These final criteria index values represent a larger relative increase in survival over current survival rates in dry and critical years (compared to wetter years) so as to protect salmon populations from declining to the critically low levels of recent years. The results from tagged-fish releases on the San Joaquin River show significantly different survival at high versus low flow conditions (USFWS 1992b; Brandes 1994). Most of the release studies have been performed at flows below 5,000 cfs, and it is clear from the relation between survival indices and experimental flow conditions that these conditions are very poor for smolt survival and are inadequate to protect the Fish Migration designated uses. The average survival index for these low flow conditions is 0.09, whereas these index values have attained values as high as 1.5 on the San Joaquin (a Jersey Point release).[42] Although there is less information at higher flows, the experimental results do indicate that survival has been substantially higher under these conditions. The average survival index at these higher flows is 0.48.

To address this relative difference in survival during high and low flow periods, EPA is adopting criteria index values reflecting a relatively larger improvement in survival in low flow years than in high flow years. That is, conditions for migrating fish in drier periods have been relatively worse, so the criteria index values applicable to the drier periods must reflect conditions that are relatively more improved in order to protect the Fish Migration designated use.

Although the final criteria call for relatively higher protection in drier years, it is also particularly important in the San Joaquin basin to protect salmon during periods of higher flow conditions. The years of higher flows have been the only times recently when the Fish Migration use has come close to being attained, and protection in these productive years is important for buffering the salmon population against permanent loss of salmon runs when conditions are poor. To address these special concerns across the spectrum of hydrological conditions, these final criteria index values, on average, increase wet year survival by a factor of 1.8 and critically dry year survival by a factor of 4.

EPA has considered the concerns expressed by some CUWA workshop participants about using the USFWS models to establish criteria index values. The CUWA workshop participants developed a consensus, based not on the USFWS-modeled values but on their independent scientific judgment, that an increase in measured survival index values of two to three times recently observed values would be appropriate in critical years (Kimmerer 1994b). As stated above, the CUWA workshop participants also endorsed relatively higher protection in drier years as opposed to wetter years (Kimmerer 1994b). EPA agrees with these scientific judgments, and believes that measured criteria index values in these ranges must be attained to protect the designated uses on the San Joaquin.

The criteria index values shown as a continuous function in Figure 6, even though developed with the assistance of the USFWS model, are wholly consistent with the findings of the CUWA workshop participants (Kimmerer 1994b). In addition, these target values are, on average, consistent with the historical 1956–70 average survival index for the more protective wetter years of that period (wet, above normal, and below normal water years) as calculated using the USFWS model (Brandes 1994). The target values are also consistent with the CVPIA goal of doubling anadromous fish populations. For comparison, the final criteria index value line is displayed in Figure 7 with the recent historical survival line (based on the tagged fish release results) and a line representing twice the recent historical survival line.

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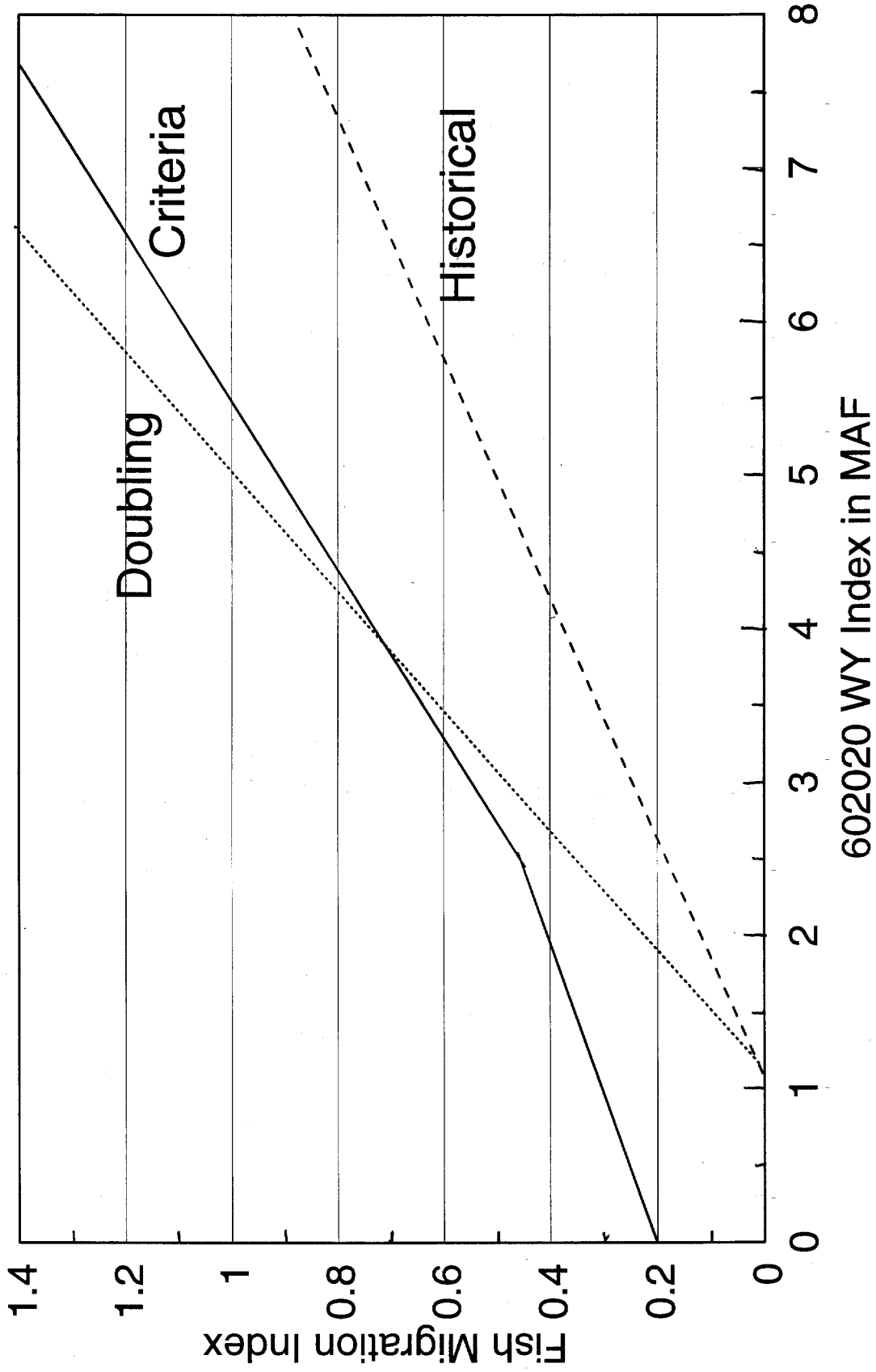
[42] These numbers are not ''scaled'', and are thus indices showing survival relative to other index values. The 0.09 average index value represents approximately 5 recoveries from a release of 50,000 fish at Mossdale, 55 miles upstream of the smolt recovery site at Chipps Island.

Figure 7. San Joaquin Fish Migration Criteria Compared with Historical Experimental Release Results and Release Results Doubled



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(III) Revised San Joaquin Fish Migration Criteria. The criteria index value line is being stated in the final rule as follows:

For years in which the SJVIndex is > 2.5:

SJFMI = (−0.012) + 0.184*SJVIndex

In other years:

SJFMI = 0.205 + 0.0975*SJVIndex

where SJFMI is the San Joaquin Fish Migration index, and SJVIndex is the 60–20–20 San Joaquin water year index in million acre feet (MAF).

These criteria are displayed graphically in Figure 6.

(IV) *Implementation of San Joaquin River Fish Migration Criteria.*

The following discussion is intended to assist the State Board's consideration of the issues involved in implementing these or similar, equally protective, criteria.

The San Joaquin River Fish Migration criteria provide an annual survival goal that varies depending on the 60–20–20 San Joaquin water year index. EPA anticipates that the State Board implementation plan would provide for a sufficient number of tagged fish releases to verify that the applicable criterion is being met in each year. EPA recognizes that there may be substantial variation in fish migration criteria values resulting from these experimental releases. Accordingly, the final rule provides that attainment can be measured using a three-year moving average (the current year and two preceding years). Three year periods should provide time to complete sufficient releases to determine whether the implementation measures are, on average, attaining the stated criteria values.

As stated above, the USFWS model is the best available model of salmon smolt survival through the Delta, and EPA encourages the State Board to use the recently revised USFWS San Joaquin model as guidance for setting implementation measures. Nevertheless, it is important to recognize that there may be constraints on the model's use. Further monitoring and experimental releases under the chosen implementation regime are essential to verify and refine the model, and will ensure that the smolts are actually surviving at the expected level. In addition, it will be particularly important to protect the base conditions assumed in the model, such as flows during the time the Upper Old River barrier is not in place, flows at Jersey Point, and temperature.

The expected criteria index values are unlikely to be achieved if these base conditions deteriorate.

One additional refinement to the implementation measures should be considered on the San Joaquin River. As discussed above, the Sacramento River criteria include a ceiling value on the maximum salmon smolt survival. This was included because there appears to be a point where incrementally lower temperatures do not significantly increase salmon smolt survival. In theory, there may be a similar point on the San Joaquin River where incrementally higher flows in very wet years do not yield significantly higher salmon smolt survival. Nevertheless, the existing data do not allow quantification of what those flow levels are. EPA is supportive of another mechanism for dealing with this issue. It is EPA's judgment that in very wet years (those in which the flows exceed 10,000 cfs during the relevant period) it may be appropriate to meet the flow requirements associated with the targeted Fish Migration criteria index solely through natural storm events and restricted diversions, and not by upstream reservoir releases. In other words, the implementation flows could be provided at these higher flow periods by natural hydrology rather than by reservoir releases. In this way, the natural ''flood events'' that appear to be so beneficial to the salmon would be protected, but the water supply system would not have to bear the water costs of generating artificial flood events through reservoir releases.

(ii) Use of Continuous Function

The second principal difference in the final criteria is to state the criteria as a ''continuous function'' or ''sliding scale.'' As discussed in EPA's alternative formulation of the Fish Migration criteria made available in the Notice of Availability, this approach replaces the Proposed Rule's statement of the criteria as single fixed index values for each of the five water year categories (59 FR 44095). The proposed approach did not account for the substantial differences in hydrological conditions *within* water year types. For example, an ''above normal'' water year type could range from a *wet* ''above normal'' year to a *dry* ''above normal'' year. Given the extreme variation of hydrological conditions in the Bay/Delta, these variations within each of the five standard water year types are substantial, and should be factored into the calculation of the applicable Fish Migration criteria index value. The continuous function approach addresses this problem by transforming the five discrete water year categories into a more precise equation (graphically, a single line or curve) correlating the Fish Migration criteria index value with each year's specific observed hydrological conditions. The continuous function approach provides the same degree of protection for the designated uses as the proposed approach using average survival values. However, the continuous function approach provides a more precise approximation of hydrological conditions and facilitates implementation and compliance. EPA explained the rationale for using the continuous function approach in more detail in the technical documents referenced in the Notice of Availability (59 FR 44095). The derivations of the actual continuous functions for the Sacramento and San Joaquin River systems are explained above.

(iii) Measuring Attainment Through Actual Test Results

The Proposed Rule 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.

Many commenters believed that reliance on the criteria index equations for this purpose was inappropriate because factors other than those implementation measures included in the model may affect smolt survival. To address this concern, in the final criteria, direct experimental measurements of smolt survival through the Delta will be used to estimate attainment of the criteria, instead of relying on modeled estimates. Survival is to be measured through tagged smolt release and recapture studies. This approach assures that factors significantly affecting survival will be reflected in survival measurements, even if they are not well described by the criteria index equations. This more direct approach gives the State greater latitude to develop implementation measures outside of the equation parameters. It also ensures that the implementation measures are actually providing the intended protection for the Fish Migration designated use.

(3) Fish Migration Criteria as Multispecies Protection

The Fish Migration criteria outlined above are based on protection measures required for a single run of salmon, the fall-run Chinook salmon. Some commenters questioned whether this approach conflicts with the habitat or multispecies approach recommended by the Club FED agencies in their

Agreement for Coordination on California Bay/Delta Issues signed September 20, 1993. As noted in the preamble to the Proposed Rule, EPA believes that the implementation measures likely to be adopted to meet the target criteria values in these Fish Migration criteria, when combined with the other Federal actions in the Delta protecting the endangered winter-run Chinook salmon, are fully consistent with the protection of a broad range of anadromous and migratory fishes in the Bay/Delta.

Juvenile spring-run salmon and steelhead move through the Delta during the same period as winter-run and fall-run salmon, and are expected to be protected in the Delta by measures protecting these other runs (CDFG 1990a). Species other than salmon and steelhead seasonally migrate into and out of the Delta for spawning and as juveniles. These species include striped bass, Delta smelt, longfin smelt, white and green sturgeon, American shad and Sacramento splittail. With the exception of temperature, the factors that lead to successful migration of salmon and steelhead smolts are also important for successful migration of the juveniles of these species into the lower embayments. Therefore, EPA's proposed Fish Migration criteria, although specifically addressing fall-run Chinook salmon, will also help protect migration of these other migratory species.

3. Fish Spawning Criteria

a. Proposed Rule

In California, striped bass spawn primarily in the warmer freshwater segments of the Sacramento and San Joaquin Rivers. Protection of spawning in both river systems is important to ensure the genetic diversity of the population as well as to increase the size of the overall striped bass population. The precise location and time of spawning appear to be controlled by temperature and salinity (Turner 1972a; Turner and Chadwick 1972). According to the California DFG, striped bass spawn successfully only in freshwater with electrical conductivities less than 0.44 millimhos[43] per centimeter electroconductivity (mmhos/cm EC), and prefer to spawn in waters with conductivities below 0.33 mmhos/cm. Conductivities greater than 0.55 mmhos/cm appear to block the upstream migration of adult spawners (Radtke and Turner 1967; SWRCB 1988; SWRCB 1991; CDFG 1990b, WQCP–DFG–4). As explained in more detail in the Preamble to the Proposed Rule, salinity does not appear to be a serious limitation on spawning on the Sacramento River. However, in the smaller and shallower San Joaquin River, migrating bass seeking the warmer waters encounter excessive upstream salinity caused primarily by runoff. This salinity can block migration up the San Joaquin River, thereby reducing spawning, and can also reduce survival of eggs (Farley 1966; Radtke 1966; Radtke and Turner 1967; Turner and Farley 1971; Turner 1972a, 1972b).

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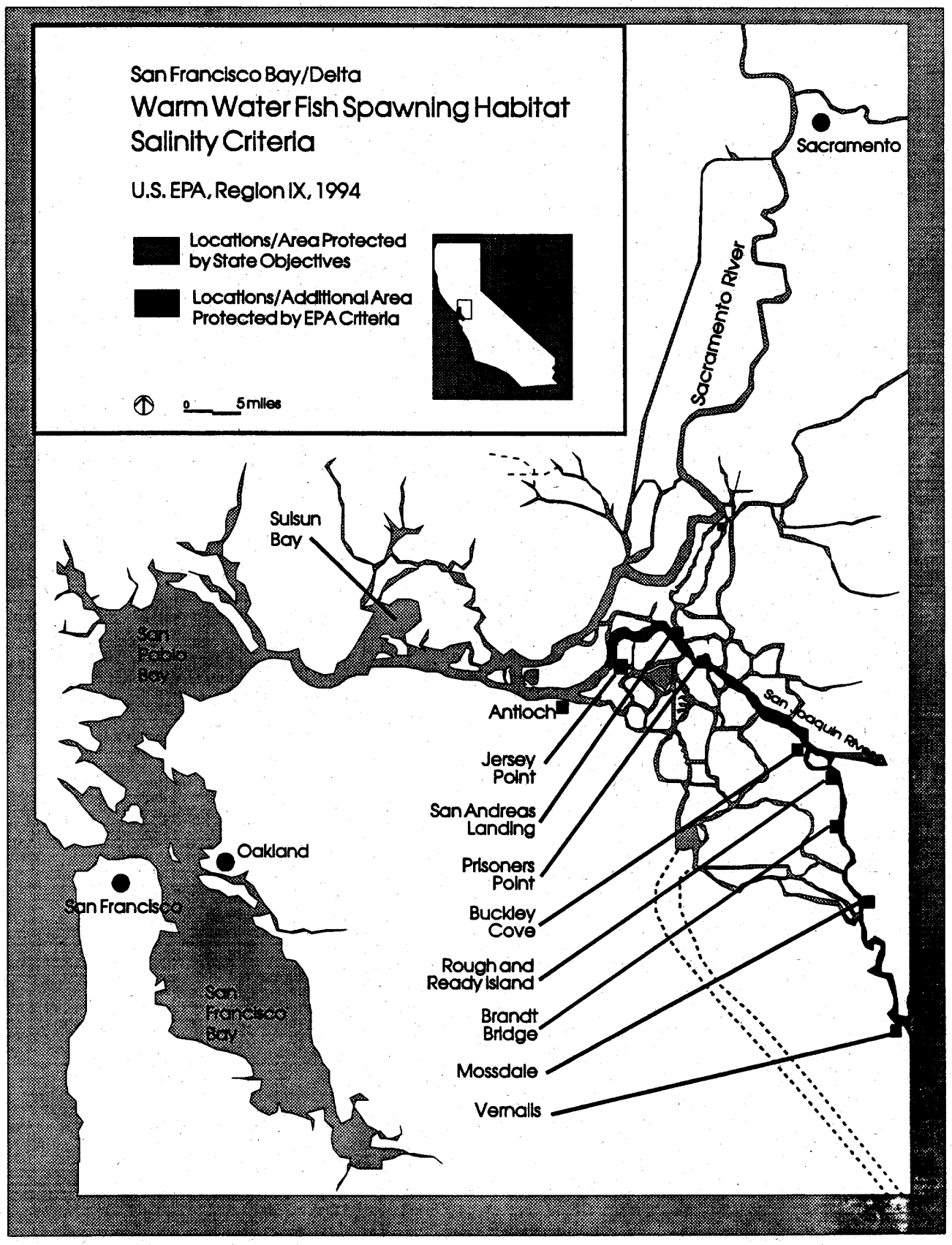
[43] Salinity conditions upstream in freshwater are generally affected by dissolved salts from upstream water runoff. The salinity content of freshwater is traditionally measured by its electroconductivity or specific conductance standardized to 25°C, and is expressed in terms of millimhos per centimeter electroconductivity (''mmhos/cm EC'') or micromhos per centimeter specific conductance. The Proposed Rule stated the Fish Spawning criteria in terms of mmhos/cm EC. In the final rule, EPA will state the criteria in terms of micromhos/cm specific conductance, so as to be consistent with EPA's published guidance. *See* 40 CFR Part 136, Table 1B—List of Approved Inorganic Test Procedures, Parameter 64. The Proposed Rule's term ''0.44 mmhos/cm EC'' is equivalent to the final rule's term ''440 micromhos/cm specific conductance''. EPA will continue using the ''0.44 mmhos/cm EC'' term in this preamble, so as not to confuse the interested public.



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The State Board's 1991 Bay/Delta Plan established objectives of 1.5 mmhos/cm EC at Antioch and 0.44 mmhos/cm EC at Prisoners Point in April and May. EPA disapproved these objectives, in part, because they are not adequate to protect spawning habitat in the reach farther upstream between Prisoners Point and Vernalis. EPA also disapproved the 1991 Bay/Delta Plan spawning criteria because they were not based on sound science. The State Board explained that the 1.5 mmhos/cm EC criteria at Antioch was intended to protect spawning habitat upstream of Antioch (near Jersey Point), not at the Antioch location itself. The State Board acknowledged that ''the use of 1.5 [mmhos/cm] EC at Antioch appears not to be generally appropriate, and proposed that a thorough review of this [criterion] be undertaken at the next triennial review'' (1991 Bay/Delta Plan, p. 5–32). EPA found this unproven approach of setting criteria downstream in hopes of attaining different criteria upstream deficient, and disapproved it.

In the Proposed Rule (40 CFR 131.37(b)), EPA proposed salinity criteria of 0.44 mmhos/cm EC in the lower San Joaquin River in the reach from Jersey Point to Vernalis in wet, above normal, and below normal water years. In dry and critical water years, EPA proposed the 0.44 mmhos/cm criteria for only the reach from Jersey Point to Prisoners Point.

b. Comments on Proposal and Final Criteria

EPA received a number of comments on its proposed Fish Spawning criteria. California DFG was generally supportive of the proposed criteria, but believed that the criteria would need to be supplemented by a range of additional management techniques in order to have any substantial benefit for spawning (California DFG 1994). Several parties noted that striped bass are an introduced predatory species, and that efforts to increase striped bass populations would work at cross-purposes with efforts to enhance other species such as salmon and Delta smelt (City and County of San Francisco Public Utilities Commission 1994; Bay/Delta Urban Coalition 1994; California Farm Bureau Federation 1994). Other commenters raised the possibility that extending the acceptable spawning habitat upstream could result in more striped bass being entrained at the State and Federal water project pumps in the southern Delta. (California DWR 1994). Finally, some commenters believed that emphasizing the striped bass as an individual species was inconsistent with the multiple species approach to habitat protection. (CUWA 1994a).

Although EPA believes there is some merit to each of these comments, EPA is not making any changes to the Fish Spawning criteria in the final rule stated at 40 CFR § 131.37(b). EPA believes there is substantial scientific evidence indicating that increased salinities in the designated reaches of the San Joaquin River do in fact have an adverse effect on fish spawning. This problem of increased salt loadings has been recognized by virtually all the parties (CUWA 1994b; ACWA 1994) and recommendations on how to address it have been developed by, among others, the San Joaquin Valley Drainage Program (SJVDP 1990).

The possibility that healthier populations of predatory fishes such as striped bass would adversely affect other species of concern needs to be considered in the context of the whole range of protective measures being developed for the fishery. The package of project management measures, water quality standards, and implementation programs being developed under the CWA, ESA, CVPIA, and counterpart State authorities are intended to address the entire Bay/Delta ecosystem. For that reason, EPA believes that healthier predatory species populations should not interfere with the protection of other species of concern. EPA further believes that, if the State Board adopts and/or implements these criteria, the State Board can address the impact of entrainment at the pumps in its implementation measures. Finally, EPA believes that salinity problems in the lower San Joaquin affect aquatic species other than the striped bass. Recent research findings of USFWS (Meng 1994) suggest that the spawning habitat for the Sacramento splittail (currently proposed for listing as threatened under the ESA) is also being adversely affected by increased salt loadings in the lower San Joaquin. Accordingly, these criteria are consistent with a multiple species approach.

EPA believes that clearly stating the salinity conditions necessary for protection of the designated fish spawning uses on the lower San Joaquin provides the foundation for implementation plans by the State Board and other regulatory agencies. EPA believes that these implementation plans should build upon the recommendations of the San Joaquin Drainage Program, to the end that compliance with these criteria can be effectively and efficiently achieved.

One change has been made to the final Fish Spawning criteria. In the Proposed Rule, the Fish Spawning criteria were stated with reference to the five standard water year types, with one criterion required for dry and critical dry water years and another criterion required for the remaining water year types. In the final rule, reliance on water year types is eliminated. Instead, deciding which of the two different criteria applies is made by reference to the San Joaquin Valley Index, the standard index of San Joaquin Valley flows. This change merely eliminates the unnecessary middle step of translating the San Joaquin Valley Index into the five water year types.

4. Suisun Marsh Criteria

The tidal wetlands bordering Suisun Bay are characterized as brackish marsh because of their unique combination of species typical of both freshwater wetlands and more saline wetlands. Suisun Marsh itself, bordering Suisun Bay on the north, is the largest contiguous brackish water marsh in the United States. These large tidal marshes are distinct from the approximately 44,000 acres of ''managed'' marshes in the Suisun Bay, which are currently diked and managed for waterfowl use and hunting. Approximately 10,000 acres of marshes, both along channels within Suisun Marsh and bordering Suisun Bay, are still fully tidal (Meiorin et al. 1991).

These tidal marshes provide habitat for a large, highly diverse, and increasingly rare ecological community. The recent ''Status and Trends'' reports published by the SFEP listed 154 wildlife species associated with the brackish marshes surrounding Suisun Bay (Harvey, et al. 1992), including a number of candidates for listing under the ESA. These include the Suisun song sparrow (*Melospiza melodia maxillaris*) and the Suisun ornate shrew (*Sorex ornatus sinuosus*), as well as the plants Suisun slough thistle (*Cirsium hydrophilum* var. *hydrophilum*), Suisun aster (*Aster chilensis* var. *lentus*), delta tule pea (*Lathyrus jepsonii*), Mason's lilaeopsis (*Lilaeopsis masonii*), and soft-haired bird's beak (*Cordylanthus mollis mollis*). These rare species are all found exclusively in tidally inundated marsh.

Recent studies indicate that increases in salinity caused by a combination of upstream diversions and drought have adversely affected the tidal marsh communities (Collins and Foin 1993). As salinity has intruded, brackish marsh plants which depend on soils low in salt content (especially the tules *Scirpus californicus* and *S. acutus*) have died back in both the shoreline marshes and in some interior marsh channel margins of the western half of Suisun Bay. These plants have been replaced by plants

typically growing in saline soils, especially cordgrass (*Spartina foliosa*). This has been associated with erosion of the marsh margins. In addition, tules in the upper intertidal zone have been replaced by the smaller and more salt tolerant alkali bulrush (*Scirpus robustus*). These changes have significantly affected available habitat for a variety of wildlife that nest and feed in these areas, including the Suisun song sparrow, marsh wren, common yellowthroat, black-crowned night heron, and snowy egret (Collins and Foin 1993; Granholm 1987a; 1987b). The loss of habitat for the Suisun song sparrow is of particular concern, since individuals of this species are found only in the already fragmented marshes bordering Suisun Bay, occupy an established territory for their lifetime, and depend on tall tules for successful reproduction and cover from predators (Marshall 1948).

There are currently no salinity criteria protecting the brackish tidal marshes of Suisun Bay, although there is some incidental protection provided by salinity criteria protecting the managed non-tidal marshes. EPA's approval of the 1978 Delta Plan criteria explicitly sought and received assurances from the State Board to develop additional criteria for the brackish tidal marshes and to protect aquatic life in the Suisun Marsh channels and open waters. Because these assurances have not been met, EPA, in its September 3, 1991 letter on the 1991 Bay/Delta Plan, disapproved the standards for Suisun Marsh and stated that the State Board should immediately develop salinity objectives sufficient to protect aquatic life and the brackish tidal wetlands surrounding Suisun Marsh.

In its Proposed Rule, EPA relied on the Estuarine Habitat criteria to protect the tidal wetlands bordering Suisun Bay, and did not propose separate standards in the Suisun Marsh. EPA's proposed criteria were developed to protect aquatic species and to provide salinity conditions similar to those in the late 1960's to early 1970's. Therefore, many of the aquatic species that inhabit the marsh channels would receive increased protection once the Estuarine Habitat criteria are implemented. In addition, the Estuarine Habitat criteria were designed to provide substantially better dry and critically dry year springtime conditions than the recent conditions that have caused adverse effects on the tidal marsh communities bordering Suisun Bay. EPA therefore concluded that these Estuarine Habitat criteria would lead to substantially improved conditions in the marshes.

In its Proposed Rule, EPA solicited comment as to whether the Estuarine Habitat criteria should be supplemented by additional criteria to fully protect the tidal marsh resources. For illustrative purposes, EPA included two possible narrative criteria in the Proposed Rule:

(1) ''water quality conditions sufficient to support high plant diversity and diverse wildlife habitat throughout all elevations of the tidal marshes bordering Suisun Bay''

(2) ''water quality conditions sufficient to assure survival and growth of brackish marsh plants dependent on soils low in salt content (especially *Scirpus californicus* and *Scirpus acutus*) in sufficient numbers to support Suisun song sparrow habitat in shoreline marshes and interior marsh channel margins bordering Suisun Bay.''

EPA received a number of substantive comments on this issue. The State Board and the California DWR opposed additional criteria, believing that any such criteria would be premature pending completion of a biological assessment in the marsh (SWRCB 1994; California DWR 1994). The California DFG recommended adoption of the numeric salinity criteria included in the Suisun Marsh Preservation Agreement signed by California DFG, California DWR, the USBR, and the Suisun Resource Conservation District in 1987 (California DFG 1994). Two environmental organizations, Natural Heritage Institute and the Bay Institute, recommended that additional standards be developed for the Suisun Marsh. Relying primarily on scientific studies that had been prepared and submitted to the State Board's D–1630 hearings (Jocelyn 1992, WRINT–NHI–12; Williams 1992, WRINT–NHI–18), these groups raised questions about whether the EPA Estuarine Habitat criteria would adequately protect the brackish marshes during January and February, or during a multiple year drought, and whether the Estuarine Habitat criteria would adequately protect the interior tidal channels of Suisun Marsh. In its comments, NHI recommended the adoption of numeric salinity criteria (NHI 1994). The Bay Institute recommended adoption of narrative criteria for the Marsh, and offered a detailed suggestion.

EPA believes that the available scientific information points strongly to the need for numeric criteria in the tidal marshes. Nevertheless, EPA does not believe there exists a sufficient scientific basis at this time to support Federal promulgation of numeric criteria for these marshes. EPA is hopeful that the biological studies being prepared at the request of the State Board will be completed soon, and that the State Board will expedite its review of this issue. Given the substantial delays in the completion of these studies, however, EPA does not believe it advisable to delay addressing the serious possibility of adverse impacts to the brackish tidal marshes. For these reasons, EPA is incorporating a narrative criterion applicable to the tidal (i.e., unmanaged) areas of the Suisun Marsh in the final rule.

To be consistent with EPA guidance, narrative criteria should include specific language about conditions that must exist to protect a designated use, and may include specific classes and species of organisms that will occur in waters for a given designation (USEPA 1990). The narrative criterion promulgated below by EPA includes language about important measures of biological integrity specific to Suisun Bay tidal marshes. Specific reference conditions are not included in the criterion; however, it is the intent of this criterion to reflect conditions equalling the level of protection existing in the Suisun Marsh in the late 1960's to early 1970's. As a result of the recent drought and continued high level of freshwater diversion from the estuary, recent conditions have deteriorated in the Suisun Marsh, as indicated by decreased habitat for the Suisun song sparrow and replacement of tules with *Spartina foliosa*.

In implementing this narrative criterion, the State Board should take care to protect the specific classes and species of organisms that are vulnerable to increasing salinity in the Suisun Marsh. Vulnerable species include those species that are presently listed under the Federal Endangered Species Act, including the salt-marsh harvest mouse *(Reithrodontomys raviventris)* and the California clapper rail *(Rallus longirostris obsoletus)*. Vulnerable species also include both those rare plants that are candidates for listing under the Federal Endangered Species Act (including Mason's *lilaeopsis (Lilaeopsis masonii)*, delta tule pea *(Lathyrus jepsonii)*, Suisun slough thistle *(Cirsium hydrophilum var. hydrophilum)*, Suisun aster *(Aster chilensis var. lentus)*, soft-haired bird's beak *(Cordylanthus mollis ssp mollis)*) and dominant plant species such as the tules *Scirpus acutus* and *S. californicus*, and the bulrush S. robustus. Animal species include Federal candidate species Suisun song sparrow *(Melospiza melodia maxillaris)*, California black rail *(Laterallus jamaicensis coturniculus)*, tri-colored blackbird *(Agelaius tricolor)*, saltmarsh common yellowthroat *(Geothylpis trichos sinuosa)*, Suisun

ornate shrew *(Sorex ornatus sinuosus)* and southwestern pond turtle *(Clemmys marmorata pallida).* Other vulnerable species include river otter *(Lutra canadensis),* beaver *(Castor canadensis),* nesting snowy egret *(Egretta thula),* nesting black-crowned night-heron *(Nycticorax ncyticorax),* ducklings of breeding ducks such as mallard *(Anas platyrhynchos),* gadwall *(Anas strepera)* and cinnamon teal *(Anas cyanoptera),* marsh wren *(Cistothorus palustris),* American bittern *(Botaurus lentiginosus),* Virginia rail *(Rallus limicola),* sora *(Porzana carolina),* and common moorhen *(Gallinula chloropus).*

EPA hopes that the measures taken to implement the Estuarine Habitat criteria will be sufficient to protect the fish and wildlife designated uses targeted by this narrative criterion. Nevertheless, in the event that continuing substantial adverse impacts on the brackish marsh habitat become evident before any possible revisions to the State's numeric criteria, this narrative criterion will provide a basis for State Board measures to address those adverse impacts.

D. Public Comments

Public hearings on the Proposed Rule were held in Fresno, California on February 23, 1994; in Sacramento, California on February 24, 1994; in San Francisco, California on February 25, 1994; and in Los Angeles, California on February 28, 1994. Over 120 people spoke at these four hearings. The public comment period closed on March 11, 1994. EPA received over 225 written comments on the Proposed Rule.[44]

Responses to the public comments have been prepared and are a part of the administrative record to this rulemaking. The public may inspect this administrative record at the place and time described above.

E. Executive Order 12866

Under Executive Order 12866 (58 FR 51735, October 4, 1993), the Agency must determine whether the regulatory action is ''significant'' and therefore subject to Office of Management and Budget (OMB) review and the requirements of the Executive Order. The Order defines ''significant regulatory action'' as one that is likely to result in a rule that may:

(1) Have an annual effect on the economy of $100 million or more or adversely affect in a material way the economy, a sector of the economy, productivity, competition, jobs, the environment, public health or safety, or State, local, or tribal governments or communities;

(2) Create a serious inconsistency or otherwise interfere with an action taken or planned by another agency;

(3) Materially alter the budgetary impact of entitlements, grants, user fees, or loan programs or the rights and obligations of recipients thereof; or

(4) Raise novel legal or policy issues arising out of legal mandates, the President's priorities, or the principles set forth in the Executive Order.

Pursuant to the terms of Executive Order 12866, it has been determined that this rule is a ''significant regulatory action'' because it raises novel policy issues arising out of the Federal coordination effort described above. This coordination effort, which calls for the integration of several Federal agencies and several different Federal statutes, is a unique and precedential approach to the implementation of Federal natural resources policy. As such, this action was submitted to OMB for review. Changes made in response to OMB suggestions or recommendations will be documented in the public record.

The following is a summary of the regulatory impact assessment (RIA) that has been prepared in compliance with Executive Order 12866. The full RIA is part of the administrative record to this rule, and is available for public review as described above.

Executive Order 12866 requires Federal agencies to assess the costs and benefits of each significant regulatory action they promulgate. The RIA addresses two interrelated regulatory actions. The first is the promulgation by EPA of water quality criteria for the Bay/Delta estuary under the CWA. The second is the USFWS designation of critical habitat for the Delta smelt under the ESA.

Need for Regulation

The Bay/Delta is the largest estuarine environment on the west coast of the Americas, encompassing 1,600 square miles and draining more than 40% of the water in California.

- The Bay/Delta estuary supports more than 120 species of fish and is a waterfowl migration and wintering area of international significance.
- The estuary supports 108 known species of fish, birds, mammals, reptiles, amphibians, invertebrates, and plants imperiled by habitat loss, including 25 species that are listed or are candidates for listing under the Endangered Species Act (ESA).
- The estuary is composed of numerous habitats valued for their recreational, scientific, educational, aesthetic, and ecological aspects; designated uses defined by the California State Water Resources Control Board include estuarine habitat, coldwater and warmwater habitat, fish migration, fish spawning, ocean commercial and sport fishing, preservation of rare and endangered species, shellfish harvesting, and wildlife habitat.
- As a result of habitat change and other human-induced impacts, the estuary's ability to support a diverse ecosystem with large populations of important commercial, recreational, and heritage species has declined. The 1980's and 1990's brought the number of indigenous species to extremely low levels. Declines in aquatic resources have led to curtailed fishing seasons, petitions for listing species under the ESA, and general concern about the health of the estuarine ecosystem.
- The principal benefit expected to result from this rulemaking is an increase in ecosystem health. A healthy Bay/Delta ecosystem will maintain aquatic species in populations of sufficient sizes to sustain recreational and commercial fisheries, as well as the uniqueness and diversity still present in the estuary.

The Bay/Delta estuary is also the hub of California's two major water distribution systems, the SWP operated by California DWR and the CVP operated by the USBR. Most of the water stored and transported by the CVP is used for agriculture; the CVP also supplies municipal and industrial water to portions of the Central Valley and San Francisco Bay Area. SWP water is primarily used for municipal and industrial uses and the production of agricultural crops. Development and operation of the water projects have contributed to losses in biological productivity in the Bay/Delta estuary by substantially altering the flow and salinity conditions to which the indigenous organisms are adapted.

The Bay/Delta estuary is subject to the water quality control jurisdiction of the State Board and two regional boards. Pursuant to requirements of the CWA, the State Board in 1991 adopted and submitted to EPA the 1991 Bay/Delta Plan containing water quality standards for the Bay/Delta estuary. EPA, finding that the 1991 plan did not provide for adequate protection of the designated fish and wildlife uses of the Bay/Delta estuary, disapproved provisions of the plan. In response to State Board's failure to revise the disapproved criteria, EPA published the proposed rule for

[44] The Bay Institute submitted identical comment letters generally supporting adoption of protective standards in the Bay/Delta from approximately 1,500 people. The total number of comments stated in the text counts these comments as a single comment.

establishing revised water quality criteria; these EPA criteria are the primary subject of the RIA.

Approach

The RIA analyzes a final rule that establishes four sets of federal criteria to protect the designated uses of the Bay/Delta estuary. The analysis focuses on the two sets of criteria with measurable water costs to Delta exporters:

- Salinity criteria protecting the estuarine habitat, and
- Fish migration criteria to protect fish migration in the estuary.

The other two criteria; salinity criteria to protect fish-spawning habitat on the lower San Joaquin river and narrative criteria to protect tidal wetlands surrounding Suisun Marsh, are not expected to result in actions that generate additional economic costs.

The primary method for implementing the criteria is to increase Delta outflow, and the analysis focuses on the effects of this approach. EPA recognizes that the State of California has sole authority to reallocate water rights in implementing these criteria. However, because the State has not yet developed a plan for implementation of the criteria, EPA considered the water supply and delivery impacts of the criteria using the following three implementation approaches that represent the range of options available to the State:

- Project Exporters-Only Approach:

—Generally represents implementation of D–1485, under which the SWP and CVP exporters are solely responsible for providing sufficient water supplies to attain the water quality criteria.

—Because of priority systems within the SWP and CVP, would concentrate responsibility for meeting the standards on water districts with junior water rights, which also bear responsibility for meeting requirements associated with the ESA. Municipal and industrial (M&I) users are priority users within the SWP system. In the CVP priority system, users of 27% of diversions are responsible for meeting 100% of the ESA requirements and water quality standards.

—Could result in effects on San Joaquin Valley agricultural water users, primarily in western Fresno and portions of Kern County and the urban areas supplied by Metropolitan Water District of Southern California (MWD) and Santa Clara Valley Water District (SCVWD).

- Sharing Approach:

—Would spread water supply impacts to more or potentially all of the water districts that divert water from the Sacramento and San Joaquin River systems, including areas of the Sacramento Valley, eastside San Joaquin Valley and urban areas of San Francisco and East Bay.

—Could be based on formulas using many criteria in assigning responsibility, such as diversions, depletions, damage caused by diversions, seniority and priority of water rights, beneficial and reasonable use, and economics.

—For the analysis, an illustrative formula was used where nonproject diverters and non-exporter CVP users share 20% of responsibility for meeting flow requirements necessary to achieve compliance with the criteria.

- Other Innovative Approaches:

—Could include combining shared implementation responsibility with a system of mitigation credits, a water supply cap, and a fund or fee system for purchasing water for environmental uses; policies for promoting a water market and/or a water bank are crucial.

Water Supply and Delivery Impacts

Short-term (1995) and longer term (2010) impacts of the Project Exporters-Only and Sharing Approaches were analyzed through comparison with baseline conditions consisting of current conditions that exist in the absence of the criteria, estimated for a range of hydrological conditions represented in the 71-year hydrologic record for the Delta. Water supply costs are commonly reported using two conventions: the average of 71 years and the ''critical period'', which represents conditions experienced in the drought period of the 1930s.

The analysis estimated the incremental (i.e. new) water supply and delivery impacts of the criteria over those associated with D–1485 and the recent (1992–1994) winter-run salmon requirements. These impacts reflect the effects of a package of federal actions under several laws designed to comprehensively protect the Bay/Delta ecosystem. The entire package of actions and requirements have been extensively coordinated to achieve significant improvements in the Bay/Delta ecosystem.

Both the incremental water supply impacts, as well as the recent Endangered Species Act impacts can be illustrated in the following table:

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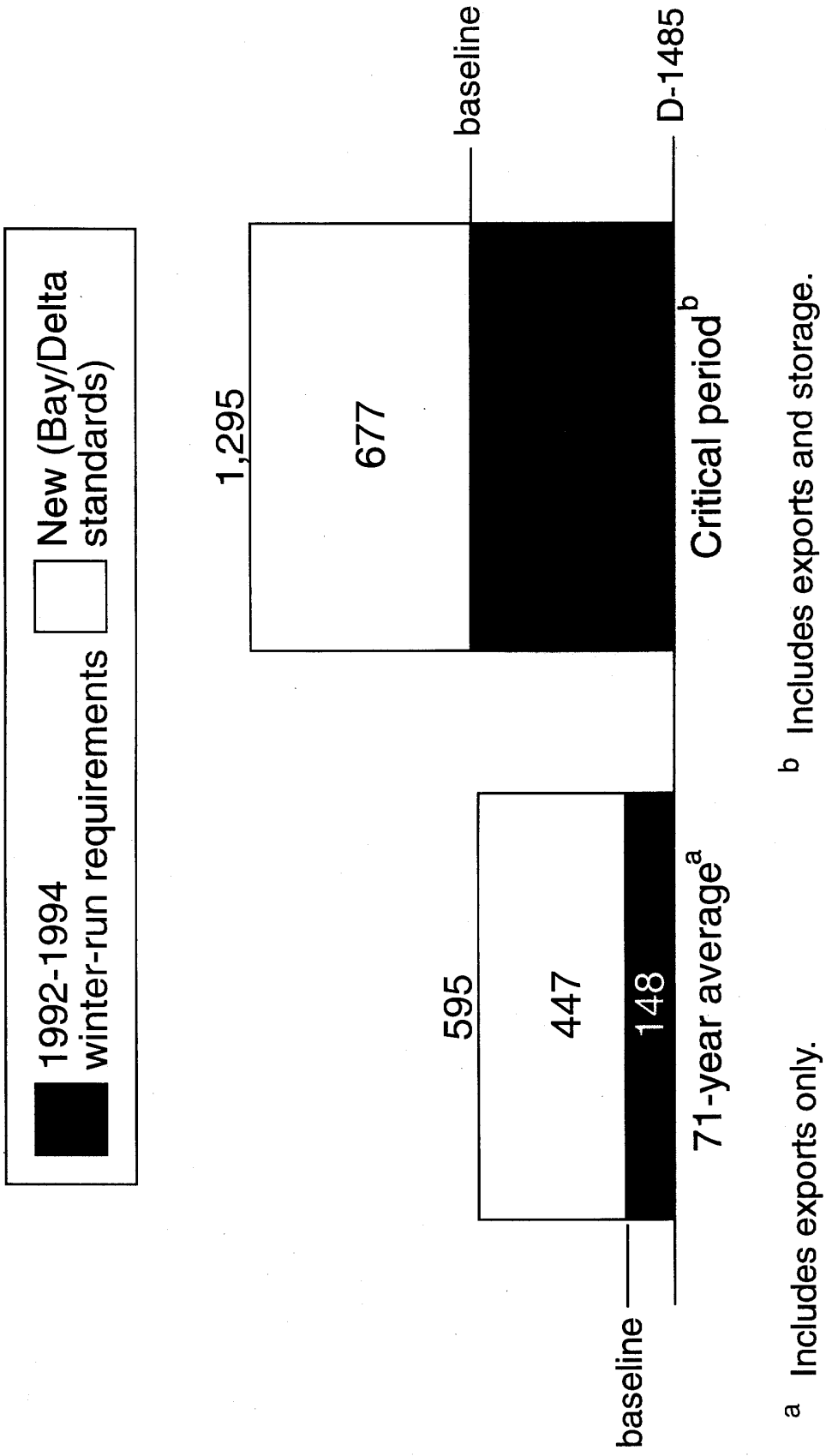
RIA TABLE 1

Water Supply (TAF)



[a] Includes exports only.

[b] Includes exports and storage.

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Water delivery impacts are the changes in water volumes available to different users and depend on seniority of water rights and priority systems within affected water delivery systems, such as the SWP and the CVP.

Costs

The State's implementation plan will substantially affect the magnitude and distribution of the costs of regulatory actions. In the agricultural sector, economic welfare costs would consist primarily of changes in producers' surplus (net operating revenues accruing to farmers). In the urban sector, economic welfare costs would take the form of consumers' surplus losses to the residential sector resulting from developing higher cost replacement supplies and consumer costs of water supply shortages. The following are key results of the cost analysis:

• Water transfers can greatly reduce impacts on affected agricultural and urban areas. Water transfers to urban areas through waterbank programs are common and considered likely in the short-run. Although, increased agriculture-to-agriculture water transfers are not expected in the short-run, they can theoretically decrease impacts considerably.

• Urban project contractors water supplies would not be affected in most years, even without sharing.

—MWD's supplies are affected in 11% of years, SCVWD supplies are affected in 25% of years.

• With water transfers available in dry years, the cost associated with the regulations is estimated to be $4.3 million on average and $15.8 million during dry water years for the Project-Exporters Only scenario. Without water transfers or waterbanks, costs increase significantly; the combined cost of water shortages and replacement water supplies to project users is estimated to be $28.3 million on average years and $165.3 million during dry years.

• Agricultural impacts would be small relative to agricultural value in the Central Valley but would be concentrated in agricultural areas with low-seniority water rights in portions of Fresno and Kern counties.

—Under the Project-Exporters Only scenario and assuming no increase in water transfers, economic welfare losses to agriculture are estimated to average $27 million annually, weighted over all hydrological conditions. However, impacts in the driest 10% of years account for economic costs of $43 million.

—If the State's implementation plan is based solely on seniority of water rights and existing contractual arrangements, impacts will be concentrated in geographic subareas of Fresno and Kern counties. Cumulative impacts are an important consideration in these areas—the impacts of environmental requirements associated with the ESA and the CVPIA are already concentrated in these subareas. However, the State's implementation plan may be based on many criteria, including economics.

• The Sharing Approach would have an important cost-reducing effect, especially in dry years if transfers are limited, in comparison with the Project Exporters-Only Approach.

—Economic welfare costs to agriculture would be reduced by sharing the responsibility of environmental requirements with all diverters. Overall, economic welfare losses would be reduced by approximately $0.5 million for average years and more than $5.5 million in dry years.

—A net gain in economic welfare to urban areas would also result from sharing. Overall economic losses would be reduced by approximately $10.5 million in average years and $54.0 million in dry years when transfers are limited.

• Over the long term, costs are not estimated to substantially increase, even with increasing demand resulting from population growth and decreased groundwater availability.

A summary of these costs is shown below in RIA Table 2.

RIA TABLE 2.—SUMMARY OF ECONOMIC WELFARE COSTS

[In millions of dollars]

	Average expected value	Dry Years
Agriculture: [1]		
• No increase in water transfers	28	43
• Sharing/no increase in transfers	27	37
• Increased transfers	10–18	NA
Urban: [2]		
• Dry year transfer	4	16
• No dry year transfer	28	165
• Sharing/no dry year transfer	18	111

Note: Total impacts are less than the sum of agricultural and urban impacts in the case of agricultural-to-urban transfers. In cases in which there are no agricultural-to-urban transfer, total impacts equal the sum of agricultural and urban impacts.

[1] Transfers are from agriculture to agriculture.

[2] Transfers are from agriculture to urban users.

Benefits

Important benefits of the water quality regulations include the following:

• Biological productivity and health for many estuarine species are expected to increase.

• The decline of species is expected to be reversed and the existence of species unique to the Bay/Delta, such as Delta smelt, winter-run chinook salmon, longfin smelt, and Sacramento splittail, will be protected.

• Populations of a variety of estuarine species are expected to increase; although the extent of the population increases has not been determined for all species, the increases are anticipated to benefit the recreational and commercial fisheries.

• Costs associated with further declines in the estuary will be avoided. The most important avoided cost is associated with further declines in the recreational and commercial fisheries industry including further closures affecting the 200 million dollar industry, with possible future actions needed to protect species from extinction. Other avoided costs include government costs associated with crop deficiency payments; agricultural drainage costs; and costs associated with potential reductions in property values.

The ecological benefits of improved Bay/Delta estuary conditions are expected to generate approximately $2–21 million annually in net economic benefits to commercial and recreational fisheries and have associated employment gains of an estimated 145–1,585 full-time equivalent jobs annually. The federal package of actions to protect the estuary, of which EPA's criteria are a part, will also produce the benefit of increased certainty regarding water supplies from the delta; this allows for more informed water management planning and investments.

Conclusions

The following general conclusions can be drawn regarding the results of the RIA:

• Although urban water supplies are are not affected in most years, however, minimizing urban costs largely depend on the availability of water through transfers and a drought water bank.

• Under the Project-Exporters Only approach to implementation (i.e., status-quo), agricultural impacts are concentrated only in certain areas of Fresno and Kern Counties. This concentration of impacts is magnified by these areas bearing the responsibility for Endangered Species requirements. This concentration of impacts is the

result of historic water rights arrangements and may be attenuated through the water rights phase.

- Benefits of ecosystem protection, which could not be estimated in the analysis, are expected to substantially exceed the use benefits to commercial and recreational fisheries. These nonuse or intrinsic values, which include benefits to the public for improved ecosystem health and for avoiding the extinction of species and closures of fisheries, are difficult to estimate accurately because they are nonmarginal.
- Substantial reductions in economic costs—for the same level of benefits—resulted from the sharing scenario analysis, particularly when transfers are limited. For urban areas, the economic benefits of dry year transfers are large, even when compared to the benefits of sharing.
- Although a fully developed water market is not likely, it could theoretically reduce economic costs to very low levels. Innovative implementation plans (purchase funds, fees, tradeable responsibility) that take advantage of these potential efficiencies may be the most cost-effective solution.

Given both the monetary estimates and the information on ecological benefits that is not calculated in monetary terms, EPA believes that the benefits are commensurate with the costs. Cost-effective implementation of the criteria will result in a healthy ecosystem and fisheries resources coexisting with a strong agricultural sector.

F. Regulatory Flexibility Act

Under the Regulatory Flexibility Act (5 U.S.C. 601 et seq.) (RFA) EPA generally is required to conduct a final regulatory flexibility analysis (FRFA) describing the impact of the regulatory action on small entities as part of a final rulemaking. However, under section 605(b) of the RFA, if EPA certifies that the rule will not have a significant economic impact on a substantial number of small entities, EPA is not required to prepare a FRFA. Although EPA is providing the certification here, it is nevertheless including a discussion for public information of possible effects to small entities that could result from State Board implementation of today's rule.

Today's rule establishes ambient water quality criteria that are unique in that implementation of these criteria is solely dependent upon actions by agencies other than EPA. Until actions are taken to implement today's criteria (or equally protective state criteria meeting the requirements of the CWA), there will be no economic effect of this rule on any entities—large or small. For that reason, and pursuant to section 605(b) of the Regulatory Flexibility Act, 5 U.S.C. 605(b), I hereby certify that this rule itself will not have a significant economic impact on a substantial number of small entities.

Discussion

Although EPA is certifying that this rule will not have a significant economic impact on a substantial number of small entities, and therefore is not required to prepare a FRFA, it is nevertheless presenting this discussion to inform the public of possible economic effects of state implementation of the criteria promulgated today on small entities. By so doing, EPA intends to inform the public about how such entities might be affected by the State's implementation. The focus of the discussion is on small farms, and our analysis shows that there will be no significant economic effect on a substantial number of them. Additionally, as described elsewhere in the RIA, impacts on the urban sector, while speculative, are expected to be limited. Accordingly, EPA believes there will be no significant economic impact on a substantial number of small entities as a result of the State's implementation of these criteria.

This discussion first provides a profile of small entities—in this case small farms—to determine whether or not they will be affected by State Board actions designed to attain the criteria set forth in this rulemaking. EPA investigated information by geographic area using the U.S. Small Business Administration's definition. Information used includes acreage and gross value per acre.

Small entities that may be primarily affected by the State's implementation of EPA's rule are small farms (as discussed in the RIA, the primary economic impacts of implementation of these criteria are expected to fall on the agricultural sector; impacts on the urban sector are expected to be limited). Small farms are defined by the U.S. Small Business Administration as farms with annual sales of less than $500,000. Small farms account for 93% of all farms and 53% of all cropland (including unharvested pastureland) in California. The remaining 7% of California farms, which have annual sales of more than $500,000, account for 74% of the value of farm products sold (Jolly 1993). Unfortunately, no survey information is available by subgeographic area and value per operator to assist in determining whether or not State Board action implementing this rulemaking could affect small farms. As discussed in the RIA, impacts may be concentrated in the subgeographic areas of the San Joaquin Valley—particularly the westside of Fresno County, including Westlands Water District and Kern County. This analysis uses the worst case scenarios from the RIA in assuming concentrated and, possibly, not insignificant impacts in these areas. These assumptions include: no increase in water transfers and the most status-quo implementation plan selected by the State of California. As discussed in the RIA, innovative implementation plans could reduce all agricultural impacts.

Due to the lack of survey information, two commonly reported measures—gross value per acre and acreage per farm—were used to develop an indication of whether or not these subgeographic areas contain small farms, by the SBA definition. The first commonly reported indicator of farm size is acreage.

EPA used two measures of farm size by acreage in the San Joaquin Valley, derived from the 1987 Census of Agriculture. The first measure, average farmland per operator, includes the average amounts of cropland; rangeland; wooded lands; and lands in buildings, roads, and ponds managed by each farm operator in the San Joaquin Valley. The average amount of farmland per operator in the San Joaquin Valley is 341 acres, varying from 266 acres in non-westside areas to 1,834 acres in the Westlands Water District. The second measure of farm size, irrigated land per operator, includes the average amount of cropland, excluding rangelands and wooded lands, managed by each farm operator. The average amount of irrigated land per operator in the San Joaquin Valley is 165 acres, ranging from 114 acres in non-westside areas to 1,113 acres in the Westlands Water District. These data suggest that some agricultural districts contain very few small farms, while others are largely composed of smaller farms.

These measures of farm size may be distorted by characteristics of the data compiled in the 1987 Census of Agriculture. Because of the way farm operators are defined and counted within the census, the number of truly separate farm operations within the San Joaquin Valley may be lower than the census reports. Thus, the amount of farmland and irrigated land per separate farm operation is probably higher than reported. Additionally, farming is not the principal occupation for many farm operators. In the San Joaquin Valley, 44% of the operators included in the census reported that farming was not

their principal occupation (Archibald 1990). These operations, which could include hobby farms, are probably much smaller than commercial operations. Therefore, the average size of commercial operations is likely much larger than reported. These data limitations make it difficult to assess the true proportion of the farm industry represented by small commercial farms.

The other measure used to develop an indication of whether or not small farms are affected is average gross revenue per acre. This information was obtained from the USBR and the same data is used in the RIA. As discussed previously, the areas where impacts may be concentrated are primarily the westside of the San Joaquin Valley, especially Westlands Water District and Kern County. Values of $1100–$2300 an acre are indicated by this data. These estimates are further confirmed by the average value of $1413 an acre found in a recent University of California report (Carter 1992.) Thus using the range of values for gross revenue per acre and the more conservative definition of irrigated land per acre for the Westside, farms average approximately $600,000 –$1,120,000. This does not meet the SBA definition. In addition, average farm size in the Westlands Water District is much larger, leading to average estimates over $1 million per operator. In Kern County, however, gross revenue per acre averages $1863 and therefore to meet the SBA definition a farm would have to be unusually small (under 270 acres.) These estimates indicate that a substantial number of small entities would not be substantially affected.

The farms in the CVP area (westside Fresno County) are subject to the U.S. Department of Interior 960-acre limitation on farm size for the receipt of subsidized water. Although the degree of compliance with this limitation is in question, a recent legal settlement by the U.S. Department of Interior will increase the enforcement of this acreage limitation. Using the measures of average gross revenue per acre, farms that approach the acreage limitation are not considered small farms using the SBA definition.

Type of small farm by crop type was also investigated to provide another indication of farms potentially affected by State Board action. As discussed in the RIA, State Board action consistent with this rulemaking would likely result primarily in field and forage crop displacement. In 1987, small farms produced 40% of all irrigated hay and field crops harvested and 30% of all nonfeedlot cattle sales in the state (U.S. Dept. of Commerce 1989). Approximately 80% of the irrigated hay and field crops and 50% of nonfeedlot cattle are raised in the Sacramento Valley and San Joaquin Valley counties (U.S. Dept. of Commerce 1989). Such cattle production is the principal use of irrigated pasture in California. These percentages are substantially lower than the overall percentage of cropland in small farms. In other words, large farms (i.e., farms with annual sales exceeding $500,000) account for a disproportionate share of the production of the crops and livestock that might be displaced by the projected water supply reductions.

While these measures indicate that the State's implementation of the criteria in this rule will not affect a substantial number of small farms, given that the measure was developed from averages, there will exist in every irrigation district some small farms. Westlands Water District reports that 125 farms are 320 acres or less (a 320 acre farm grossing $1400-$1500 an acre would meet the SBA definition of a small farm.) Thus, without survey information, we cannot completely conclude that all small farms would not be affected by State Board action.

The RIA conducted for this rulemaking indicates that if previous implementation procedures are followed, impacts may be concentrated in geographic subareas. The State does have implementation flexibility to spread the impacts to a greater geographic area. This would have two offsetting impacts in relationship to farm size. First, the impacts overall will be decreased so that impacts would be less concentrated in subregions, possibly to insignificant levels. Second, however, in spreading the impacts more broadly, the State will be spreading it to areas with small farms.

Within irrigation districts with project water, junior water rights and little access to groundwater, even the State may have little implementation authority to assess or minimize impacts by farm size. A Stanford University study explains:

Most farmers receive their water from a local district (generally an irrigation, water, or water storage district) or from a mutual water company * * * local districts have considerable discretion over the acquisition, allocation and pricing of water. The nature and limits of the discretion, however, vary among districts depending on the laws under which the district was formed, any special legislation unique to a district, and a district's local rules and regulations. (Center for Economic Policy Research 1992.)

G. Enhancing the Intergovernmental Partnership Under Executive Order 12875

In compliance with Executive Order 12875, 58 FR 58093 (October 28, 1993), we have involved state, local, and tribal governments in the development of this rule. In addition to the substantial participation by state and local governments and local agricultural and municipal water districts in the public commenting process, several activities have been carried out since the publication of the Proposed Rule. These include:

(1) The State of California and the Federal government (represented by the EPA, the Department of the Interior, and the Department of Commerce) have negotiated and this past summer signed a Framework Agreement laying out the institutional processes and mechanisms to be used to coordinate state and Federal activities affecting water quality and water development in the Bay/Delta. The Framework Agreement specifically included (a) a process for Federal and state adoption of water quality standards meeting the requirements of state and Federal law, (b) a structure and process for technical coordination of the state and Federal regulatory activities affecting operation of the state and Federal water projects in the Bay/Delta (the SWP and the CVP), and (c) a process for developing a Federal-state partnership for long term planning for water resources in California. Many of the steps envisioned in the Framework Agreement have already been accomplished. The Framework Agreement explicitly called for the final Federal promulgation of a water quality rule, which is being accomplished in this rulemaking.

(2) EPA has held a number of workshops with representatives of the municipal and agricultural water districts to discuss the Proposed Rule and the accompanying draft economic analysis. Further, EPA has participated in additional workshops sponsored by the California Urban Water Agencies (CUWA) to discuss CUWA's scientific comments on the Proposed Rule.

(3) As envisioned by the Framework Agreement, the State Board has held a series of workshops to assist in developing revised State water quality standards meeting the requirements of the CWA. EPA has participated in these workshops and, in accordance with the State Board's processes, has presented the State Board options for possible standards that would meet the requirements of the CWA.

(4) EPA has worked closely with the California DWR to ascertain the

probable water supply impacts of its Proposed Rule, and has continued to work with California DWR to explore mechanisms for reducing water supply impacts of protective standards. As explained in the Preamble to the final rule, many of these mechanisms have been incorporated into EPA's final rule.

(5) EPA has worked closely with representatives of a coalition of CUWA and of agricultural water agencies to consider alternative standards and measures that would meet the requirements of the CWA.

(6) EPA has continued to meet with the State Board and other State officials, both at the staff and policy levels, to discuss ways to attain protection of the Bay/Delta resources in a way that meets the requirements of the CWA and is consistent with the State's roles in water quality and water development planning.

H. Paperwork Reduction Act

This rule places no information collection activities on the State of California and, therefore, no information collection request (ICR) will be submitted to the Office of Management and Budget (OMB) for review in compliance with the Paperwork Reduction Act, 44 U.S.C. 3501 et seq.

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List of Subjects in 40 CFR Part 131

Environmental protection, Indians—lands, Intergovernmental relations, Reporting and recordkeeping requirements, Water pollution control, Water quality standards, Water quality criteria.

Dated: December 14, 1994.

Carol M. Browner,

Administrator.

40 CFR part 131 is amended as follows:

PART 131—[AMENDED]

1. The authority citation for part 131 continues to read as follows:

Authority: 33 U.S.C. 1251 *et seq.*

2. Section 131.37 is added to read as follows:

§ 131.37 California.

(a) *Additional criteria.* The following criteria are applicable to waters specified in the Water Quality Control Plan for Salinity for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary, adopted by the California State Water Resources Control Board in State Board Resolution No. 91–34 on May 1, 1991:

(1) *Estuarine habitat criteria.* (i) *General rule.* (A) Salinity (measured at the surface) shall not exceed 2640 micromhos/centimeter specific conductance at 25 °C (measured as a 14-day moving average) at the Confluence of the Sacramento and San Joaquin Rivers throughout the period each year from February 1 through June 30, and shall not exceed 2640 micromhos/centimeter specific conductance at 25 °C (measured as a 14-day moving average) at the specific locations noted in Table 1 near Roe Island and Chipps Island for the number of days each month in the February 1 to June 30 period computed by reference to the following formula:

Number of days required in Month X = Total number of days in Month X * $(1-1/(1+e^{K})$

where K = A + (B*natural logarithm of the previous month's 8-River Index);

A and B are determined by reference to Table 1 for the Roe Island and Chipps Island locations;

x is the calendar month in the February 1 to June 30 period;

and e is the base of the natural (or Napierian) logarithm.

Where the number of days computed in this equation in paragraph (a)(1)(i)(A) of this section shall be rounded to the nearest whole number of days. When the previous month's 8-River Index is less than 500,000 acre-feet, the number of days required for the current month shall be zero.

Table 1. Constants applicable to each of the monthly equations to determine monthly requirements described.

Month X	Chipps Island		Roe Island (if triggered)	
	A	B	A	B
Feb	–[1]	–[1]	–14.36	+2.068
Mar	–105.16	+15.943	–20.79	+2.741
Apr	–47.17	+6.441	–28.73	+3.783
May	–94.93	+13.662	–54.22	+6.571
June	–81.00	+9.961	–92.584	+10.699

[1] Coefficients for A and B are not provided at Chipps Island for February, because the 2640 micromhos/cm specific conductance criteria must be maintained at Chipps Island throughout February under all historical 8-River Index values for January.

(B) The Roe Island criteria apply at the salinity measuring station maintained by the U.S. Bureau of Reclamation at Port Chicago (km 64). The Chipps Island criteria apply at the Mallard Slough Monitoring Site, Station

D–10 (RKI RSAC–075) maintained by the California Department of Water Resources. The Confluence criteria apply at the Collinsville Continuous Monitoring Station C–2 (RKI RSAC–081) maintained by the California Department of Water Resources.

(ii) *Exception.* The criteria at Roe Island shall be required for any given month only if the 14-day moving average salinity at Roe Island falls below 2640 micromhos/centimeter specific conductance on any of the last 14 days of the previous month.

(2) *Fish migration criteria.* (i) *General rule.*

(A) *Sacramento River.* Measured Fish Migration criteria values for the Sacramento River shall be at least the following:

At temperatures less than below 61°F: SRFMC = 1.35

At temperatures between 61°F and 72 °F: SRFMC = 6.96–.092 * Fahrenheit temperature

At temperatures greater than 72 °F: SRFMC = 0.34

where SRFMC is the Sacramento River Fish Migration criteria value. Temperature shall be the water temperature at release of tagged salmon smolts into the Sacramento River at Miller Park.

(B) *San Joaquin River.* Measured Fish Migration criteria values on the San Joaquin River shall be at least the following:

For years in which the SJVIndex is > 2.5: SJFMC = (−0.012) + 0.184*SJVIndex

In other years: SJFMC = 0.205 + 0.0975*SJVIndex

where SJFMC is the San Joaquin River Fish Migration criteria value, and SJVIndex is the San Joaquin Valley Index in million acre feet (MAF)

(ii) *Computing fish migration criteria values for Sacramento River.* In order to assess fish migration criteria values for the Sacramento River, tagged fall-run salmon smolts will be released into the Sacramento River at Miller Park and captured at Chipps Island, or alternatively released at Miller Park and Port Chicago and recovered from the ocean fishery, using the methodology described in this paragraph (a)(2)(ii). An alternative methodology for computing fish migration criteria values can be used so long as the revised methodology is calibrated with the methodology described in this paragraph (a)(2)(ii) so as to maintain the validity of the relative index values. Sufficient releases shall be made each year to provide a statistically reliable verification of compliance with the criteria. These criteria will be considered attained when the sum of the differences between the measured experimental value and the stated criteria value (i.e., measured value minus stated value) for each experimental release conducted over a three year period (the current year and the previous two years) shall be greater than or equal to zero. Fish for release are to be tagged at the hatchery with coded-wire tags, and fin clipped. Approximately 50,000 to 100,000 fish of smolt size (size greater than 75 mm) are released for each survival index estimate, depending on expected mortality. As a control for the ocean recovery survival index, one or two groups per season are released at Benecia or Pt. Chicago. From each upstream release of tagged fish, fish are to be caught over a period of one to two weeks at Chipps Island. Daylight sampling at Chipps Island with a 9.1 by 7.9 m, 3.2 mm cod end, midwater trawl is begun 2 to 3 days after release. When the first fish is caught, full-time trawling 7 days a week should begin. Each day's trawling consists of ten 20 minute tows generally made against the current, and distributed equally across the channel.

(A) The Chipps Island smolt survival index is calculated as:

$SSI=R\div MT(0.007692)$

where R=number of recaptures of tagged fish

M=number of marked (tagged) fish released

T=proportion of time sampled vs total time tagged fish were passing the site (i.e. time between first and last tagged fish recovery)

Where the value 0.007692 is the proportion of the channel width fished by the trawl, and is calculated as trawl width/channel width.

(B) Recoveries of tagged fish from the ocean salmon fishery two to four years after release are also used to calculate a survival index for each release. Smolt survival indices from ocean recoveries are calculated as:

$OSI=R_1/M_1\div R_2/M_2$

where R_1=number of tagged adults recovered from the upstream release

M_1=number released upstream

R_2=number of tagged adults recovered from the Port Chicago release

M_2=number released at Port Chicago

(*1*) The number of tagged adults recovered from the ocean fishery is provided by the Pacific States Marine Fisheries Commission, which maintains a port sampling program.

(*2*) [*Reserved*]

(iii) *Computing fish migration criteria values for San Joaquin River.* In order to assess annual fish migration criteria values for the San Joaquin River, tagged salmon smolts will be released into the San Joaquin River at Mossdale and captured at Chipps Island, or alternatively released at Mossdale and Port Chicago and recovered from the ocean fishery, using the methodology described in paragraph (a)(2)(iii). An alternative methodology for computing fish migration criteria values can be used so long as the revised methodology is calibrated with the methodology described below so as to maintain the validity of the relative index values. Sufficient releases shall be made each year to provide a statistically reliable estimate of the SJFMC for the year. These criteria will be considered attained when the sum of the differences between the measured experimental value and the stated criteria value (i.e., measured value minus stated value) for each experimental release conducted over a three year period (the current year and the previous two years) shall be greater than or equal to zero.

(A) Fish for release are to be tagged at the hatchery with coded-wire tags, and fin clipped. Approximately 50,000 to 100,000 fish of smolt size (size greater than 75 mm) are released for each survival index estimate, depending on expected mortality. As a control for the ocean recovery survival index, one or two groups per season are released at Benicia or Pt. Chicago. From each upstream release of tagged fish, fish are to be caught over a period of one to two weeks at Chipps Island. Daylight sampling at Chipps Island with a 9.1 by 7.9 m, 3.2 mm cod end, midwater trawl is begun 2 to 3 days after release. When the first fish is caught, full-time trawling 7 days a week should begin. Each day's trawling consists of ten 20 minute tows generally made against the current, and distributed equally across the channel.

(B) The Chipps Island smolt survival index is calculated as:

$SSI=R\div MT(0.007692)$

where R=number of recaptures of tagged fish

M=number of marked (tagged) fish released

T=proportion of time sampled vs total time tagged fish were passing the site (i.e. time between first and last tagged fish recovery)

Where the value 0.007692 is the proportion of the channel width fished by the trawl, and is calculated as trawl width/channel width.

(C) Recoveries of tagged fish from the ocean salmon fishery two to four years after release are also used to calculate a survival index for each release. Smolt survival indices from ocean recoveries are calculated as:

$OSI=R_1/M_1 \div R_2/M_2$
where R_1=number of tagged adults recovered from the upstream release
M_1=number released upstream
R_2=number of tagged adults recovered from the Port Chicago release
M_2=number released at Port Chicago

(*1*) The number of tagged adults recovered from the ocean fishery is provided by the Pacific States Marine Fisheries Commission, which maintains a port sampling program.

(*2*) [*Reserved*]

(3) *Suisun marsh criteria.* (i) Water quality conditions sufficient to support a natural gradient in species composition and wildlife habitat characteristic of a brackish marsh throughout all elevations of the tidal marshes bordering Suisun Bay shall be maintained. Water quality conditions shall be maintained so that none of the following occurs: Loss of diversity; conversion of brackish marsh to salt marsh; for animals, decreased population abundance of those species vulnerable to increased mortality and loss of habitat from increased water salinity; or for plants, significant reduction in stature or percent cover from increased water or soil salinity or other water quality parameters.

(ii) [Reserved]

(b) *Revised criteria.* The following criteria are applicable to state waters specified in Table 1–1, at Section (C)(3) (''Striped Bass—Salinity : 3. Prisoners Point—Spawning) of the Water Quality Control Plan for Salinity for the San Francisco Bay—Sacramento/San Joaquin Delta Estuary, adopted by the California State Water Resources Control Board in State Board Resolution No. 91–34 on May 1, 1991:

Location	Sampling site Nos (I–-A/RKI)	Parameter	Description	Index type	San Joaquin Valley Index	Dates	Values
San Joaquin River at Jersey Point, San Andreas Landing, Prisoners Point, Buckley Cove, Rough and Ready Island, Brandt Bridge, Mossdale, and Vernalis.	D15/RSAN018, C4/RSAN032, D29/RSAN038, P8/RSAN056, -/RSAN062, C6/RSAN073, C7/RSAN087, C10/RSAN112	Specific Conductance @ 25 °C	14-day running average of mean daily for the period not more than value shown, in mmhos.	Not Applicable	>2.5 MAF	April 1 to May 31.	0.44 micromhos.
San Joaquin River at Jersey Point, San Andreas Landing and Prisoners Point.	D15/RSAN018, C4/RSAN032, D29/RSAN038	Specific Conductance.	14-day running average of mean daily for the period not more than value shown, in mmhos.	Not Applicable	≤2.5 MAF	April 1 to May 31.	0.44 micromhos.

(c) *Definitions.* Terms used in paragraphs (a) and (b) of this section, shall be defined as follows:

(1) *Water year.* A water year is the twelve calendar months beginning October 1.

(2) *8-River Index.* The flow determinations are made and are published by the California Department of Water Resources in Bulletin 120. The 8-River Index shall be computed as the sum of flows at the following stations:

(i) Sacramento River at Band Bridge, near Red Bluff;

(ii) Feather River, total inflow to Oroville Reservoir;

(iii) Yuba River at Smartville;

(iv) American River, total inflow to Folsom Reservoir;

(v) Stanislaus River, total inflow to New Melones Reservoir;

(vi) Tuolumne River, total inflow to Don Pedro Reservoir;

(vii) Merced River, total inflow to Exchequer Reservoir; and

(viii) San Joaquin River, total inflow to Millerton Lake.

(3) *San Joaquin Valley Index.* (i) The San Joaquin Valley Index is computed according to the following formula:

$I_{SJ}=0.6X+0.2Y$ and $0.2Z$
where I_{SJ}=San Joaquin Valley Index
X=Current year's April–July San Joaquin Valley unimpaired runoff
Y=Current year's October–March San Joaquin Valley unimpaired runoff
Z=Previous year's index in MAF, not to exceed 0.9 MAF

(ii) *Measuring San Joaquin Valley unimpaired runoff.* San Joaquin Valley unimpaired runoff for the current water year is a forecast of the sum of the following locations: Stanislaus River, total flow to New Melones Reservoir; Tuolumne River, total inflow to Don Pedro Reservoir; Merced River, total flow to Exchequer Reservoir; San Joaquin River, total inflow to Millerton Lake.

(4) *Salinity.* Salinity is the total concentration of dissolved ions in water. It shall be measured by specific conductance in accordance with the procedures set forth in 40 CFR 136.3, Table 1B, Parameter 64.

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