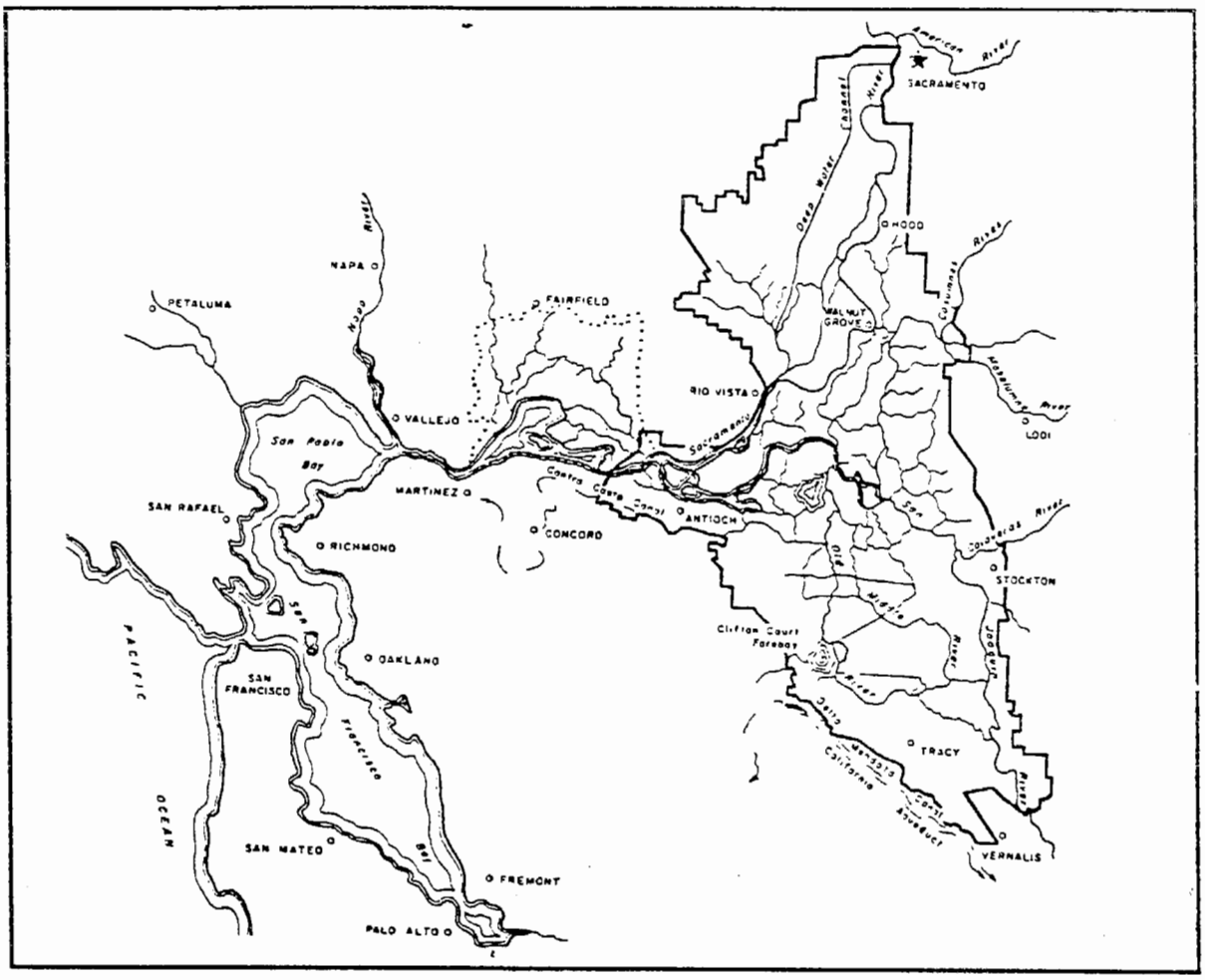



# WATER QUALITY CONTROL PLAN FOR SALINITY

## San Francisco Bay/ Sacramento - San Joaquin Delta Estuary

**91-15WR**

**May 1991**

**WATER RESOURCES CONTROL BOARD**
**STATE OF CALIFORNIA**

# WATER QUALITY CONTROL PLAN FOR SALINITY

San Francisco Bay/
Sacramento - San Joaquin
Delta Estuary

Report Number, 91-15 WR

May 1991

Prepared by the Bay-Delta Section
Division of Water Rights
WATER RESOURCES CONTROL BOARD
STATE OF CALIFORNIA

STATE WATER RESOURCES CONTROL BOARD
RESOLUTION NO. 91-34

ADOPTION OF THE WATER QUALITY CONTROL PLAN FOR SALINITY --
SAN FRANCISCO BAY/SACRAMENTO-SAN JOAQUIN DELTA ESTUARY

WHEREAS:

1. The State Water Resources Control Board is responsible for the regulation of activities and factors which affect or may affect the quality of the waters of the State (Water Code Section 13001).

2. The State Board has undertaken a process, under its water quality authority, to develop a set of water quality objectives for salinity, temperature, and dissolved oxygen to protect beneficial uses of the Estuary.

3. The State Board has conducted 60 days of evidentiary hearing initiated on July 7, 1987, and concluded on August 23, 1990, in accordance with the Federal Clean Water Act (33 U.S.C.A. Sections 1251 to 1387) and the California Water Code, and has considered the evidence introduced at the hearing.

4. A draft Water Quality Control Plan for Salinity -- San Francisco/Sacramento-San Joaquin Delta Estuary was formulated and submitted for public review on January 18, 1991.

5. The State Board conducted a public hearing on the draft water quality control plan on March 11, 1991, after notice to all interested parties, in accordance with Federal and State requirements and has considered the oral and written comments submitted.

6. The Water Quality Control Plan, consisting of the Water Quality Control Plan for Salinity -- San Francisco/Sacramento-San Joaquin Delta Estuary, accompanying Technical Appendix, and the comments and responses thereto, has been revised to incorporate appropriate comments received from the interested parties.

7. The water quality objectives in the Water Quality Control Plan--San Francisco Bay/Sacramento-San Joaquin Delta Estuary will be reviewed at least once every three years.

8. The Water Quality Control Plan is an adjunct to the Basin Plans; together with the Basin Plans, it includes all necessary elements of water quality control plans in accordance with Sections 13241 and 13242 of the California Water Code and Federal requirements.

9. The State Board has prepared the Water Quality Control Plan under a certified program as a substitute document for an environmental impact report under Section 21080.5 of the California Public Resources Code (California Environmental Quality Act).

THEREFORE BE IT RESOLVED:

1. That the State Board adopts the Water Quality Control Plan--San Francisco Bay/Sacramento-San Joaquin Delta Estuary (Plan) in accordance with Section 13170 of the Water Code.

2. That the Executive Director is directed to forward copies of the Beneficial Use Designation and Water Quality Objectives portions of the Plan to the United States Environmental Protection Agency for review and approval in accordance with requirements of the Federal Clean Water Act [33 U.S.C.A. Section 1313(c)].

CERTIFICATION

The undersigned, Administrative Assistant to the Board, does hereby certify that the foregoing is a full, true, and correct copy of a resolution duly and regularly adopted at a meeting of the State Water Resources Control Board held on May 1, 1991.

Maureen Marché
Administrative Assistant to the Board

# FOREWORD

## Introduction

Consider water in California and you face a complex brew of physical, technical, political and cultural elements. Most of the State's water supply falls as rain and snow in the north, in the wintertime. Most of the consumptive use occurs south of the Sacramento-San Joaquin Delta, in the summer.

During the past century, the challenge was how best to capture, redistribute and safeguard this resource. As a consequence, pioneering projects dot the landscape with reservoirs and water transport canals which lace together the northern and southern parts of the State.

The current challenge is how to balance the redistribution of water to ensure maximum benefit to all of California, its people, its agriculture, its industry and its environment, including how best to protect its quality so that it serves our needs.

Balancing this redistribution is a major function of the State Water Resources Control Board.

## Comprehensive Protection for the State's Waters

In California, the use of water must be planned within the framework of source availability, current as well as future needs and principles embodied in State law. California needs a water supply of sufficient quality to meet all reasonable uses. Although there exist sufficient water sources to meet all reasonable needs, these sources are insufficiently managed and/or developed to provide a reliable supply for all needs.

The Bay-Delta water system is a major source of supply to the State, providing more than half of all water used in California. Therefore, comprehensive planning for the ongoing protection, development and management of this unparalleled resource is needed.

The State Board has major planning and regulatory responsibilities for the State's water resources, and specifically the Bay-Delta system. The State Board is uniquely designed for this task: it has the dual responsibility of protecting the State's water resources as well as allocating the State's existing water supply.

The Basin Plans prepared by the Central Valley and San Francisco Regional Boards establish water quality objectives to protect beneficial uses of Bay-Delta waters. To supplement those efforts, in 1987, the State Board embarked on a major comprehensive program to protect the waters of the Bay-Delta system. That program is composed of five interrelated components. Each of the components is important and builds on the others.

The five components are: the California Water Quality Assessment, adopted in April, 1990; the Pollutant Policy Document, adopted in June 1990; the Inland Waters Plan and the Enclosed Bays and Estuaries Plan, adopted in April, 1991; the Water Quality Control Plan for Salinity for the Bay-Delta, adopted May 1991; and the Scoping and Water Right phases of the Bay-Delta proceedings (the Scoping Phase of which began in March, 1991).

Viewed in the context of these other Plans and actions, the Water Quality Control Plan for Temperature and Salinity represents but one step in a coordinated five-point program.

Genesis of the Bay-Delta Plan

In 1978, the Board issued several comprehensive reports on the uses and protections of the Delta. The proceedings were limited to current and near-term conditions in the Delta. When the original Delta Plan and accompanying Water Right Decision (D-1485) were issued, the Board realized that the Delta's importance would require another examination. The State Board committed itself to review the Delta Plan in about ten years.

This commitment as well as applicable court decisions have resulted in the current proceedings and have expanded the scope of the proceeding.

In 1986, the State Court of Appeal issued a decision, also known as the Racanelli or Delta Water Cases decision, addressing legal challenges to the Delta Plan and D-1485. The Court directed the State Board to take a global view toward its dual responsibilities to the State's water resources. According to the Court, the State Board's duty in its water quality role is to provide reasonable protection for beneficial uses, considering all demands made on the water. Moreover, the State Board's water allocation role is not confined to the consideration of existing water rights. The Court also recognized that a program to implement protections for the system would be lengthy and complex; the program would involve entities over which the State Board has little or no control, whose actions, however, affect the waterscape.

Content of the Current Bay-Delta Plan: Use of Water Quality Objectives for the Bay-Delta Waters

The current Plan is primarily concerned with salinity and temperature factors.

Numerous water quality objectives, protecting water quality and the beneficial uses of Bay-Delta waters (see Table 1-1), have been established for:

- Salinity at municipal and industrial intakes,
- Salinity levels to protect Delta agriculture,
- Salinity levels to protect export agriculture,
- Salinity for fish and wildlife resources in the Estuary.

Water quality objectives have also been established to provide:

- Expansion of the period of protection for striped bass spawning, and
- Temperature and dissolved oxygen levels for fisheries in the Delta.

Most importantly, this Plan sets the stage for the real heart of the Bay-Delta proceedings -- determining reasonable protection for all uses, and determining who will share responsibility for meeting the established water quality objectives.

The Scoping and Water Right Phases of the Proceedings

Immediately after adoption of this Plan, the State Board will conduct scoping hearings on other actions necessary to protect beneficial uses, including flow requirements.

The flow issue is critical to the State Board's final decision. Flow requirements yet to be established will ultimately determine how much water can be exported for consumptive use, as well as how much water is needed to protect fish and wildlife.

Central to all these issues is the question of what amount of water is available and who is required to manage it.

Currently, two major water systems, one State and one Federal, export Delta water to other areas in California. These systems -- the State Water Project (SWP), operated by the California Department of Water Resources (DWR), and the Central Valley Project (CVP), operated by the U.S. Bureau of Reclamation (Bureau) -- are responsible for meeting salinity objectives in the Bay-Delta. There are, however, approximately 7,000 parties which divert Delta water for usage throughout the State.

In order to establish an equitable means of water supply and distribution as embodied in Racanelli, the State Board has determined that other parties diverting Delta water, not only the CVP and SWP, should be required to meet water quality objectives in the Delta.

A primary task, among many others, of the Scoping and Water Right phases of the proceedings therefore will be the identification of appropriate requirements and of the parties responsible for providing for these needs. Initially, the State Board will review the operations of Sacramento and San Joaquin Valley reservoirs of 100,000 acre-feet and larger, as well as those of major direct water diverters, to determine how responsibility will be allocated for meeting the Bay-Delta Estuary's water quality and quantity needs. The extent to which smaller projects will be included will be considered during the Scoping Phase.

To complete the Scoping and Water Right phases, consideration will also be given to these issues:

- The record to date, plus the continuation of low runoff and depleted storage, clearly show that there are insufficiently managed fresh water flows to protect fully all beneficial uses during dry and critical years, and perhaps in subnormal years. Consequently, decisions are needed regarding new facilities, agreements on how to mitigate adverse impacts, modifications on water use and possibly new directives from the Legislature.

- At the end of the current proceedings (that is, after adopting a water right decision), the State Board will incorporate in a revised Plan of Implementation that will:

  - establish a time table to carry out best practicable management of the resources and uses thereof;
  - identify potential new facilities and time schedules for planning and construction to achieve best practicable management;
  - outline suitable mitigation measures based on negotiated agreements to offset losses if some specified beneficial uses are not reasonably protected by direct requirements;
  - establish requirements to modify uses to reasonably balance the allocation of fresh water resources and the beneficial uses; and
  - propose potential new legislative directives.

In addition, the State Board must evaluate new major facilities, and consider other actions that are already in the planning stages or under public discussion. These include but are not limited to:

| | |
|---|---|
| Upstream from Delta | Auburn Dam and reservoir (could modify water right terms); additional fish hatcheries for salmon and steelhead. |
| In Delta | Delta island storage (permit terms and conditions) enlarge channels; isolated conveyance. |
| In Export Areas | Los Banos Grandes and Los Vaqueros reservoirs (permit terms and conditions); conjunctive use of ground water basins; southern California surface reservoirs. |
| Mitigation | Wetlands additions; improve fish hatchery outputs; improve planting of fish; improve aquatic habitat; reduce infestations of injurious phytoplankton, clams, etc. |
| Water Use Modification | Improve irrigation efficiencies; increase artificial ground water recharge; increase waste water reclamation. |

| | |
|---|---|
| Potential Legislation | Set priorities for types of beneficial uses; explore and propose agricultural land retirement where corrective drainage costs are excessive (similar to buy out of environmentally sensitive lands at Lake Tahoe). |

Completion of the water right process will be a complex task. The most difficult decisions lie ahead. Scoping has already begun in March. As we move into the Water Right Phase, the State Board needs the guidance of all parties on the appropriate range of alternatives that should be evaluated -- toward the goal of having a balanced water right decision adopted in late 1992.

# WATER QUALITY CONTROL PLAN
## CONTENTS

## APPENDICES



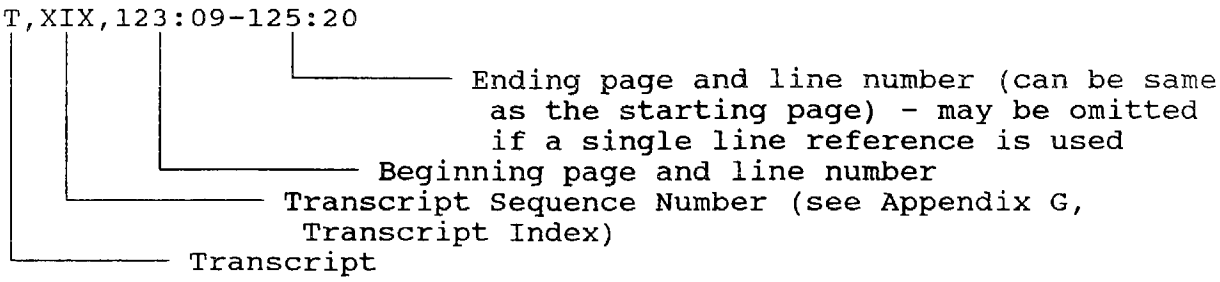
## TECHNICAL APPENDICES
(Available Upon Request)

# FIGURES

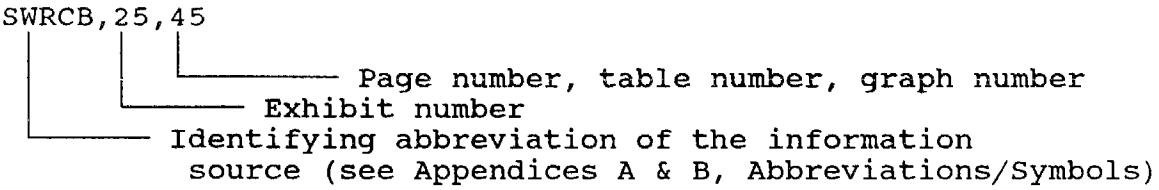
# CITING INFORMATION

When citing evidence in the hearing record, the following conventions have been adopted:

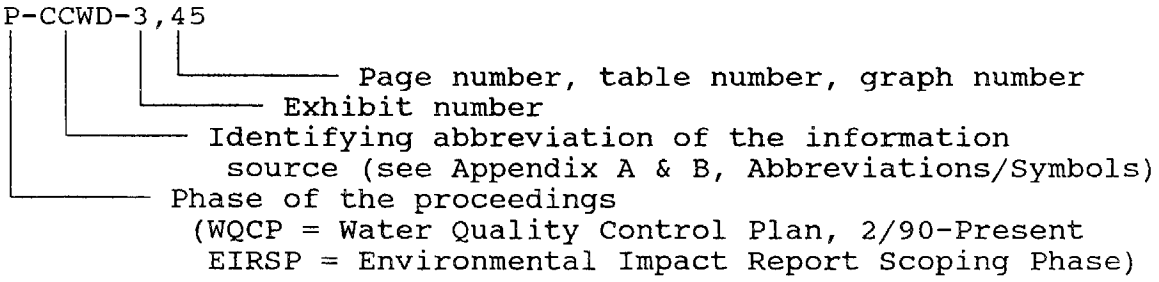
Information derived from the TRANSCRIPT:




Information derived from an EXHIBIT SUBMITTED DURING PHASE I:

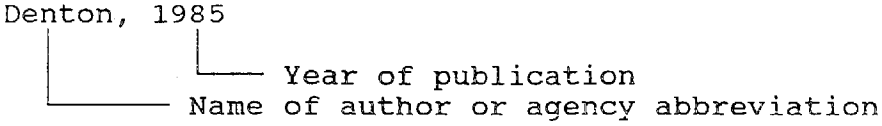



Information derived from an EXHIBIT SUBMITTED AFTER PHASE I:




When citing REFERENCES from outside of the hearing record, the following conventions have been adopted:

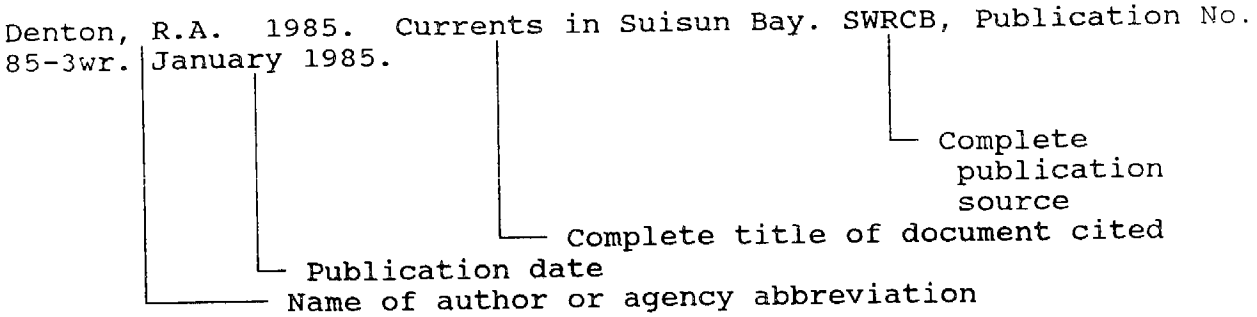
Information derived from published documents,
(a) in the text of the Plan:



TABLES

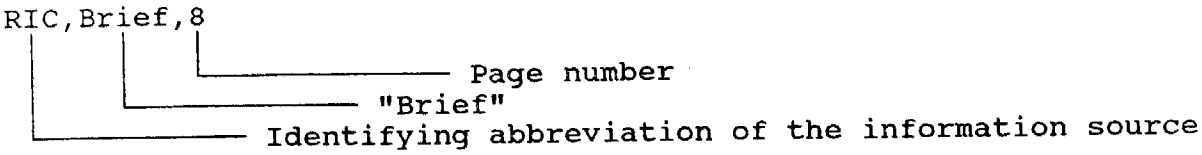
CITING INFORMATION (Continued)

(b) at the end of the appropriate Plan Chapter:




Information derived from Phase I closing BRIEFS:

(a) in the text of the Plan:




(b) at the end of the appropriate Plan Chapter:

Brief of the Rice Industry Committee on Pollutants in the Bay-Delta Estuary, pg. 8.

For a complete list of the abbreviations for information sources, citations and symbols used in this document, see Appendix A and B.

Appendix C is a Glossary of Terms; Appendix G is a Index of Transcripts listing Transcript Sequence Numbers.

# 1.0 EXECUTIVE SUMMARY

## 1.1 Background

The San Francisco Bay and Sacramento-San Joaquin Delta Estuary (Bay-Delta Estuary) includes the Sacramento-San Joaquin Delta (Delta), Suisun Marsh and the embayments upstream of the Golden Gate. The Delta and Suisun Marsh are located where California's two major river systems, the Sacramento and San Joaquin rivers, converge to flow westward to where they meet incoming seawater tides flowing through the San Francisco Bay. The beneficial uses of the waters in this system are set forth within the water quality control plans adopted by the San Francisco and the Central Valley Regional Water Quality Control Boards. The beneficial uses of Delta waters encompass almost all uses of water imaginable. The watershed of the Bay-Delta Estuary provides drinking water to two-thirds of the State's population and water for a multitude of other urban uses; it supplies some of the State's most productive agricultural areas both inside and outside the Delta; it is one of the largest systems for fish and waterfowl habitat and production in the United States. The Sacramento-San Joaquin Delta serves as a critical link for projects which transfer water from surplus to deficient areas.

Two major water distribution systems divert water from the Delta: the State Water Project (SWP) operated by the California Department of Water Resources (DWR) and the Central Valley Project (CVP) operated by the United States Bureau of Reclamation (USBR). Numerous other water diversion and management efforts influence the inflows into, flows through, and outflows from the Bay-Delta estuary.

## 1.2 Procedural Setting

In July 1987, the State Water Resources Control Board (State Board) opened a public proceeding consistent with direction from the California Court of Appeal in U.S. v. State Water Resources Control Board, 182 Cal.App.3d 82, 227 Cal.Rptr.161 (1986). To provide a comprehensive approach to water quality management, the Board has reviewed and approved amendments to the two relevant regional basin plans, and has adopted a separate Pollutant Policy Document (PPD), the Enclosed Bays and Estuaries and Inland Surface Water Plans, and a Water Quality Assessment.

This Water Quality Control Plan for Salinity, San Francisco Bay/Sacramento-San Joaquin Delta Estuary (Plan), supersedes the regional water quality control plans for the Bay and Delta to the extent of any conflict. This document supersedes the 1978 Delta Plan to the extent that the 1978 Plan addresses the water quality parameters which are the subject of this Plan. In addition to setting water quality objectives for salinity, the 1978 Delta Plan established Delta outflow standards and operational constraints implemented through Water Right Decision 1485 (D-1485). These flow requirements are established for the purpose of assuring flows consistent with the reasonable protection of beneficial uses. The Board has determined that modification of these flow requirements is premature until the Water Right Phase of these proceedings is completed. Because changes

to these flow requirements are not being proposed as part of the Water Quality Phase of these proceedings, the flow requirements and operational constraints in the 1978 Delta Plan will remain in effect until the conclusion of the Water Right Phase.[1]

Further, this document is a substitute for an environmental document, consistent with the process certified under Public Resources Code Section 21080.5.

After adoption of this Plan, the Board will commence comprehensive scoping hearings consistent with the California Environmental Quality Act. The purpose of the scoping hearings is to receive evidence from participants to: (1) develop specific alternatives for reasonable levels of protection for beneficial uses; (2) identify the current and potential role that proposed physical facilities, negotiated settlements, legislative action, and the actions of other agencies should play in the protection of beneficial uses of Bay-Delta waters; (3) draft a matrix of alternatives (to include flow amounts as appropriate); (4) assess implementation of the alternatives; and (5) compile a draft EIR.

Following the public review of the draft EIR prepared by the State Board, a hearing will be held on the draft EIR and on water right matters to which it applies. This Water Right Phase will be conducted as a quasi-adjudicative proceeding at several locations throughout the state. It will conclude with the adoption of a final EIR and a water right decision.

The product of the current Water Quality Phase of the planning process will be updated to reflect findings and conclusions at the end of the Water Right Phase and periodically, thereafter, whenever sufficient new information is received.

As set forth above, it is important to note that water quality objectives and water right permit terms for the Delta exist today. They were recognized by the court in U.S. v. State Water Resources Control Board. Current permit conditions which seek to protect the Delta are in effect and enforceable pending completion of these full proceedings.

In regard to the Suisun Marsh, the water quality objectives for Suisun Marsh are unchanged from the 1978 Delta Plan. The implementation vehicle, Water Right Decision 1485 (D-1485), was amended in 1985 to change (or delete) some monitoring stations and to revise the schedule for implementation. The DWR, USBR, DFG, and Suisun Resource Conservation District (SRCD) have signed and adopted a set of three agreements concerning the Suisun Marsh. These are the Suisun Marsh Preservation Agreement (SMPA), the Monitoring Agreement, and the Mitigation Agreement.

---

*1/ The flow requirements established in the 1978 Delta Plan are implemented in the Board's Decision 1485 and will be enforced by the Board pursuant to its water rights authority until new terms and conditions are adopted in the Water Rights Phase of these proceedings. At the end of the Water Right Phase, this document will also be updated. At that point the Board will have evaluated all of the requirements of the 1978 Delta Plan, and will have retained or modified those requirements, as appropriate. It will no longer be necessary for any provision of the 1978 Delta Plan to remain in effect, except where the Board has decided to adopt that provision, with appropriate modifications, in the Water Quality or Water Right Phase of these proceedings.*

The SMPA contains water quality standards for the managed marshes of Suisun Marsh which the four signatories would like the State Board to adopt as water quality objectives. The SMPA also describes the physical facilities that the four signatories have agreed would serve the managed marshes in order to maintain production of preferred waterfowl food plants. The facilities built so far, including the Suisun Marsh Salinity Control Gates (previously called the Montezuma Slough Control Structure), have changed the physical regime in the Marsh.

Revised water quality objectives incorporating the SMPA (with any modifications necessitated by the biological assessment) will be adopted by the State Board after the biological assessment (discussed in Section 7.4.2.6) is completed. Until that time, the water quality standards in the amended D-1485 will continue to be implemented; see Table 1-2 for a summary of these standards.

## 1.3 Scope of the Plan

This Plan is the product of extensive hearings. In this Plan, we make a distinction between thermal loadings and salinity effects caused by man's traditional land use and waste water additions to the waters of the state and those influences directly related to and resulting from the allocation of water for use through water control and diversion. This distinction is premised upon the different way federal and state laws treat waste discharges and the allocation of water for beneficial use. Waste dischargers are governed by both state and federal law. The appropriate regional boards adopt basin plans designed to regulate thermal loadings and salinity effects, as well as other pollutant components, of waste discharges. These plans are submitted to the Environmental Protection Agency in accordance with the provisions of the Clean Water Act. The allocation of water recognizes both the intended and unintended results of water control and diversion such as those resulting in salinity variations within the Estuary.

This Plan primarily addresses temperature and salinity objectives (for a complete listing, see Table 1-1). Water rights proceedings and other actions will follow in order to implement these objectives and others which can best be addressed in the allocation process. Initially, the State Board will be reviewing operations of Sacramento and San Joaquin Valley reservoirs of 100,000 acre-feet and larger, and major direct diverters, to determine how responsibility will be allocated for meeting the Bay-Delta Estuary's water quality and quantity needs. The extent to which small projects will be included will be considered during the Scoping Phase. The need for determining the specific responsibilities of other water right holders will be analyzed as we proceed. When the process is completed, the combination of water quality planning and the amended water right permits will provide the statutorily mandated reasonable protection of the beneficial uses.

## 1.4 General Comments

* State Water Planning Programs and the Federal Act

This Plan fully complies with the State's water quality statutes and with applicable federal law. The State's water quality planning is consistent with the federal Water Pollution Control Act as amended by the Clean Water Act Amendments of 1987. California's water planning program is more broad-based than the federal act, and encompasses planning and implementation powers affecting: determinations of waste and unreasonable use, allocations of water use through water rights decisions, review and approval of changes in the manner, timing and location of water use, and sources of pollution.

* Fish Migration

In the course of these proceedings, evidence was introduced that significant impacts to the fishery are due to the location, method and timing of diversions of water from and upstream of the Delta and are not related to the quality of the water. The impacts to the fishery are due in part to such factors as:

- direct entrainment losses at the points of diversion from the Delta;
- diversion of fish through the Delta Cross Channel into the interior Delta;
- reverse flows in various reaches of the San Joaquin River, Old River, Middle River and other Delta channels, caused by the CVP, SWP, CCC and local agricultural diversion pumps; and
- the lack of flows in some water years to either hold the entrapment zone in the proper location to provide a nursery area for young striped bass or to move (flush) the young striped bass into Suisun Bay where habitat conditions should be better than in the Delta.

These flow-related issues will be addressed by the State Board in the Scoping and Water Right phases of these proceedings. The State Board retains the option of setting flow objectives, if appropriate. However, in an effort to expand the Board's, and others', understanding of the potential benefits to the fishery and the cost in terms of reductions of available offstream water supply, operational information will be needed addressing the above issues. The study needs are discussed in more detail in Chapter 7. Such studies will permit the Board to evaluate a full range of social and economic benefits and costs, and to identify management options that could be implemented to reasonably protect the fishery resources.

* Fish versus People

During the proceedings an issue was raised and described as "fish v. people". Some parties wanted the Board to assign value or weight to people's needs for the water versus fish needs if the circumstances so required. The State Board must ensure reasonable protection of beneficial uses. In this case, municipal and industrial uses and aquatic life are the two beneficial uses to be protected. The court in U.S. v SWRCB directed

that the Board was to equitably distribute the dry year shortages as well as the wet year benefits. Such balancing and distribution is the essence of allocation and will be undertaken during the Water Rights Phase of these proceedings. In establishing the reasonable objectives and goals of this Plan, there is no need to choose one beneficial use over the other. All beneficial uses are being reviewed for the reasonable protection of each use, and then for the reasonable protection of all uses as they relate to each other.

* Location and Operation of the Pumps and Cross Channel Facilities

The location and operation of the diversion pumps and cross channel facilities within the Delta have direct impacts upon uses in and out of the Delta. Evidence was submitted which dealt with the hydraulic effects of the state and federal diversions and their impacts on fishery resources. The record contains evidence that one of the chief impacts upon fishery beneficial uses is the operation of the diversion pumps, cross channel facilities and other physical facilities within the Delta, during critical times of migration and spawning. The record also reflects the serious potential impacts inherent in the location of the pumps to the beneficial uses of drinking water. The existence of disinfection by-products, caused by the treatment of water containing organic materials that result from decomposition of peat soils, may present a risk to drinking water supplies both in and out of the Delta.

In addressing both the fishery and drinking water impacts, it is necessary to understand their profound implications to uses throughout the state. These are examples of where it is necessary to protect the same resource for two equally important beneficial uses. Any attempt to set numeric objectives or to single out any one permanent implementation condition without a full balancing of the impacts to all uses in and out of the Delta would result in numerous and widespread inequities within California's water supply system.

The Board has broad powers to address these impacts and will also do so in the Scoping and Water Right phases. In light of the impacts to the fishery and to drinking water supplies, a solution may be to relocate the existing points of diversion for the projects. Therefore, the parties should provide necessary information within the Scoping Phase to enable the State Board to weigh alternatives to the existing places of diversion.

* Role of Fish Hatcheries as a Mitigation Measure

There is evidence of economic, social and resource benefits and impacts from the use of fish hatcheries and growout facilities as resource management tools. Potential negative impacts include disease transmissions and genetic effects on fish. Further evaluation of the influences and impacts of those management tools is required within the scoping and subsequent implementation stages of this process.

* Flow Requirements for the Bay

Requests have been made for the Plan to contain requirements for more flows to protect the Bay (downstream of Carquinez Straits). To have meaning the concept of "more flows" must include such factors as water year types, time

of year, tidal influences, the relationship of demand to water availability, etc. There must be a demonstrated connection between flow and the reasonable protection of beneficial uses. Although data were presented on this topic, the Board finds the information inconclusive. The Board will consider Bay flow requirements during the Scoping and Water Right phases of these proceedings and may decide to set flow objectives.

The State Board is supporting a program to produce information about the Bay-Delta system that would be relevant to management decisions (e.g., what appropriate water quality objectives should the State Board set to reasonably protect beneficial uses being made of waters within the Bay-Delta Estuary complex). The program should:

1. Identify the activities that have an effect on the Bay and Delta and that can be managed (i.e., differentiate between natural phenomena and man-induced activities having an impact on the Bay-Delta);

2. Identify responsibilities for developing studies to allow resources agencies to better manage the Bay-Delta system.

3. Develop a stable funding mechanism for the needed studies through fees on point dischargers, nonpoint dischargers and upstream water users.

4. Develop time schedules and oversight committees to ensure timely implementation and coordination.

Since planning and executing studies of the Estuary require DFG to work closely with the other member agencies of the IESP, more stable and consistent funding of all IESP programs is required to achieve maximum benefits from these studies and to achieve effective Estuary management.

* Pulsing/Seasonal Flows

There was testimony given that the Board should establish pulsing/seasonal flows in order to improve stratification within the south Bay. Because the physical and biological importance of stratification is largely unknown, further information is needed and should be developed to determine if and how stratification influences or impacts beneficial uses. Further, there appears to be a need to examine stratification, or the ability to influence stratification, through operation of control and diversion facilities. Therefore, the Board believes that pulsing/seasonal flows should be further analyzed by the Operations Workgroup, with a progress report to be provided during the Scoping and Water Right phases of these proceedings.

* Exclusion of Unimpaired Flows

In an examination of the record and review of existing objectives, the Board determined that unimpaired flows are not a feasible alternative to the existing operations. Therefore they are not an appropriate basis for examining, evaluating and balancing the protection of beneficial uses. The Board has considered the existing facilities, reviewed operational data, analyzed relevant management tools and deliberated upon all submitted economic information. There are sufficient data available to support a partial evaluation of existing conditions. Such an evaluation is necessary

to establish objectives and to ultimately refine these objectives after completion of the next portions of these proceedings. Unimpaired flows continue to be used as a basis for estimating available water supply and for determining year types.

* Limitations Upon Existing Supplies

Water supplies to southern California have been restricted by court decree and physical circumstance. California's supply from the Colorado River is limited and except for unusual circumstances fixed. Water available to Los Angeles from the Owens Valley and the Mono Lake Basin has been reduced by judicial decree. Various ground water basins within areas using Delta water supplies are facing serious limitations due to pollution or salt water intrusion. The record reflects that substantial increases in population are expected within all areas making use of water from the Delta.

* Water Resources Management

While the general public perception of reasonable conservation efforts includes such measures as odd-even watering days, low flush toilets, flow restrictors, and reasonable use of water by agriculture, much more needs to be done to expand conservation among all water users. Any determination of the reasonable use of water must be prefaced upon a demonstration that reasonable conservation efforts are being undertaken. The showing is the obligation of all users and advocates for the uses. This obligation extends to public trust uses. Temporary changes in fishery harvest regulations should be considered as part of an overall short-term approach to improve the situation until longer-term measures may be instituted. The Board does not believe that such measures should substitute for its own responsibilities to provide suitable habitat. Other public trust management activities may conserve water while maintaining the value of the resource.

Another measure that may be required is the use of water meters throughout the state. Meters draw attention to the fact that conservation is so fundamental that it requires recognition of the individual's impacts upon water use and demand. Coupled with the need to heighten each individual's understanding of his or her impact upon water use and demand is the need to heighten understanding of the impacts of individual loadings of waste and pollution into our water systems. Source controls, waste minimization and pollution prevention are necessary conservation measures to be planned for and implemented by all those using the resource.

Along with heightened awareness of conservation must come an understanding and full acceptance of the potential for reclaimed water. While many understand the need to protect the environment through recycling of aluminum, glass and paper, too few appreciate the waste that occurs whenever water is used once and then treated and dumped into the ocean. A good illustration of reclamation occurs in the Santa Ana River Basin. The need to maximize the beneficial use of all water, particularly that which can be reasonably treated and reused, must become part of the demonstration that reasonable conservation efforts are being undertaken.

A process being called Urban Water Conservation Best Management Practices (BMP) is being developed by urban water suppliers, environmental organizations, and other public interest groups statewide. The BMP process represents a consensus among the above groups on the issue of urban water conservation for the Bay-Delta hearing. The State Water Resources Control Board encourages such consensus recommendations.

During the course of the proceedings a number of effective urban and agricultural conservation and reclamation measures were demonstrated. Yet, concerns, attitudes and apprehensions were expressed about the following aspects of conservation, including:

* Apprehension that water users who were already exercising effective conservation measures would be penalized if sufficient credit wasn't given for voluntary or existing effort. While the obligation to prove such pre-existing conservation measures remains the burden of those seeking credit for conservation measures, any entity capable of showing historic or existing practices would receive credit in the balancing equation. Additional measures will be required only if they are feasible and reasonable.

* Concern that agricultural users are not conserving as much as they could. Some contend that if agriculture would retire marginal land from production and alter the kinds of crops grown to less water intensive crops, there would be enough water for all present and foreseeable future needs. All parties agreed that there is more that all sectors of California could do to conserve. But, conservation alone will not be the answer to the State's supply needs. Further, conservation imposed upon one sector of users based solely upon the amount used by that sector is not a demonstration of the balancing and integration of California's complex water needs. The parties should include more complete data during the Scoping Phase with respect to the potential for conservation by agriculture. During subsequent phases of the proceedings, the State Board will give significant consideration to the Interagency Report of the San Joaquin Valley Drainage Program.

1.5 General Conclusions
(With references to chapter and section, where appropriate)

o The State Board has a major but not all-inclusive role in the allocation and protection of water resources. Its decisions are a dynamic part of the total management and protection program affecting water resources.

o Reasonable protection of beneficial uses means that the Board considers available evidence and strikes a balance between the benefit of a water quality objective and the achievability of that objective. A partial, nonprioritized listing of factors considered in the balancing of benefit and achievability includes:

- Agreements and accords offered by participating parties for the protection and management of the Bay-Delta Estuary, and reviewed by the Board as to their reasonableness;
- Intrinsic values of the beneficial use in addition to quantitative data;

- Legal requirements to protect rare, threatened and endangered species;
- Present and future water supplies and demands;
- Social and economic values (including impacts to housing and agriculture);
- Alternatives to achieve comparable protection; and
- Existing water quality and water allocation laws.

**WATER YEAR TYPES** (Chapter 3)

- o The Bay-Delta Estuary is a dynamic system characterized by wide annual, seasonal, and daily fluctuations in fresh water inflows and ocean derived salinities.

- o Defining water year types is an essential tool in evaluating the amount of water available.

- o Water availability is an essential factor in establishing reasonable objectives for ocean derived salts.

- o The Board adopts the "40-30-30 Water Year Index" for the Sacramento River Basin as proposed by the Operational Studies Workgroup. In subsequent phases of the proceedings, the Board wishes to examine critically the use of the "subnormal snowmelt" and "year following dry or critical year" provisions which allow alterations of objectives.

- o Changes to water year types will include development and refinement of an appropriate index before it can be implemented for the San Joaquin River Basin.

**CURRENT AND FUTURE WATER SUPPLY CONDITIONS**

- o On the average, precipitation supplies about 193 MAF per year in California with another 6 MAF coming from out-of-state sources. About 58 percent of this water is used by native vegetation and unirrigated lands; about 25 percent flows to the sea, to salt sinks, or to Nevada; about 14 percent is diverted for offstream uses; and about 3 percent goes to the natural recharge of ground water basins.

- o The watershed of the Bay-Delta is a major source of supply critical in satisfying the water needs of the entire State.

- o The Bay-Delta watershed is influenced by water diversion and control. On the average about 40 percent of the flow entering the Delta is unmanaged. However, in dry years less than five percent is unmanaged.

- o As California's population grows to over thirty-six million people by 2010, the currently developed water supplies will be inadequate to meet the needs of a growing population, expanding economy, and the aquatic environment.

- o There are about 9.2 million acres of irrigated agricultural land in California, of which approximately 7.3 million are in the Central Valley.

- Agricultural acreage is currently not expected to increase.

- Agricultural demands are partially being met by groundwater overdraft in the San Joaquin Valley.

- The Final Report of the Interagency San Joaquin Valley Drainage Program addresses various aspects of agricultural conservation. The State Board will consider this and any additional submitted information concerning these matters.

- Planning for municipal and industrial water needs must focus on the primary requirements of a reliable supply of high quality drinking water at an affordable cost.

- Reductions in reliable water supplies could have adverse impacts on the economy and the environment of the state.

- Conservation, reclamation and conjunctive use of local ground water basins are important components of reliable water supplies.

- California water supplies have been affected by recent court decisions. The state's dependable share of water from the Colorado River has been reduced to 4.4 MAF per year. Interim court decisions have reduced the City of Los Angeles' water supply from tributaries in the Mono Lake Basin by 50 to 65 TAF. Also, court decisions have limited export of ground water from the Owens Valley Basin to levels lower than originally anticipated by the City of Los Angeles.

- Water conservation by the Imperial Irrigation District consistent with State Board Order 88-20 could make water available for use in other parts of the state by 100 TAF in the early 1990s, with a goal of about 368 TAF.

- Ground water is a diminishing resource upon which the state relies. Factors limiting the availability of that resource include toxics, overdraft, salt water intrusion, land use practices and lack of recharge and coordinated administrative practices.

## WATER QUALITY OBJECTIVES

- There are numerous influences on the Estuary's beneficial uses. Some are not fully defined, including the impacts of commercial and sport fishing (legal and illegal), the adverse effects of accidentally introduced species (e.g., the clam Potamocorbula amurensis), and the potential problems with genetic alteration in fish resulting from reliance on hatcheries. There are also known harmful effects from toxic materials, dredging, structures, and others, on the health of the aquatic habitats in the Bay-Delta Estuary.(See 5.0)

Salinity Requirements for Municipal and Industrial Water Use

- There is a need for water from the best available sources to meet the drinking water need of all Californians. There is a need to design and implement a comprehensive trihalomethane formation potential (THMFP) monitoring program, and to develop best management practices, or other appropriate means, to control discharges of THMFP.

- For all municipal and industrial intakes within the Bay-Delta Estuary, the Board adopts the 250 mg/l chloride (salinity) objective which is the secondary standard for aesthetics (taste) and corrosion established by the Department of Health Services. However, additional salinity protection may be needed in some areas to protect drinking water supplies from disinfection by-products (DBPs).(5.1)

- The D-1485 objective of 150 mg/l chloride at the Contra Costa Water District's Rock Slough intake protects the municipal and industrial beneficial uses in Contra Costa County and provides benefits to the municipal supplies exported from the Delta. If and when additional storage capacity is built or other information is developed, this objective and its monitoring location will be reviewed. Meanwhile, deleting the 150 mg/l chloride objective in D-1485 at the Rock Slough Intake could result in increased bromide concentrations and increased salinity and consumer complaints due to the salty taste in the water.(5.1)

- Delta water at times contains bromides (often measured via correlations with chlorides) and organic substances which, upon disinfection, increase the risk of forming by-products (including trihalomethanes (THMs)) that are human health concerns.(5.2)

- In the Delta THM precursors come from organic carbon in Delta peat soils and from the watershed upstream. Bromides which naturally occur in ocean water and connate water exacerbate the formation of THMs upon disinfection.(5.2)

- Existing drinking water standards are being met through a combination of source water controls and current drinking water treatment processes.(5.2)

- If drinking water standards on DBPs are revised, the State Board will consider modifying existing salinity objectives.(5.2)

- In the future the Board will review and weigh all factors that might result in more stringent salinity objectives for drinking water after disinfection. This includes alternative water disinfection methods.(5.2)

- Due to the concerns with DBPs in treated water from the Delta and in keeping with the goal (not objective) of obtaining the best available drinking water, the Board finds that, whenever feasible, municipal water supply agencies should strive to obtain bromide levels of 0.15 mg/l or less (about 50 mg/l chloride in the Delta). Appropriate actions by these supply agencies include encouraging DWR and USBR to work with the SWRCB to ensure development of facilities to make maximum use of uncontrolled flows through off-stream storage, encouraging those agencies to move water supply intakes to better locations, working with the State and Regional Boards to eliminate problem discharges within the Delta, and continuing the development of alternative water treatment technologies.(5.2)

Western and Interior Delta Agriculture (5.3)

- To reasonably protect crops grown in the western and interior Delta, water quality objectives were developed using corn as the representative salt-sensitive crop.

- Assuming improved leaching practices are used, salinities up to 1.5 mmhos/cm EC could be allowed during the irrigation season without affecting crop yield. However, the economic costs of these practices are not in the record.

- Until adequate economic data are available on leaching costs, the Board will maintain the existing salinity objectives.

Southern Delta Agriculture (5.3)

- To reasonably protect crops grown in the southern Delta, water quality objectives were developed using beans and alfalfa as representative salt-sensitive crops.

- The objective of 0.7 mmhos/cm EC in the southern Delta protects beans during the summer irrigation season and the objective of 1.0 mmhos/cm EC protects alfalfa during the winter irrigation season. These or other adequately protective objectives at specified locations will be implemented over time.

Exported Water for Agriculture (5.17)

- Water is exported from the Delta for agricultural use in the San Joaquin Valley and southern California.

- To reasonably protect crops grown in the export areas, water quality objectives were developed using almond orchards as the representative salt-sensitive crop.

- The Board finds that the objective of 1.0 mmhos/cm EC reasonably protects salt-sensitive crops grown in the San Joaquin Valley and southern California.

Estuarine Habitat (5.4)

Fisheries: (Beneficial uses - Warm, Cold, Migration, Spawning, Rare)

- The State Board supports the natural perpetuation of species affected by water and water quality. It is the policy of the State to significantly increase the natural production of salmon by the end of this century.

- Because of the amounts of data, past practices and public interest, striped bass and Central Valley Chinook salmon will be given separate consideration in the development of water quality objectives.

- Fish hatcheries for some species are a management tool that will be evaluated for their benefit and operation within the watershed during subsequent phases of the Bay-Delta proceedings.

- With respect to temperature and salinity, the objectives set in this Plan protect selected estuarine habitat beneficial uses. There is insufficient information in the record to set specific salinity and temperature objectives for the protection of Delta smelt, American shad, benthos, resident fish or marine habitat outside the Estuary.

Chinook Salmon in the Central Valley (5.5)

- The Estuary is a migratory corridor and rearing area for Chinook salmon.
- Hatchery production has kept the total number of fall-run salmon relatively stable.
- The diversity of the gene pool from naturally produced salmon is desirable.
- The Sacramento River winter-run of the Chinook salmon has been listed as an endangered species and will receive additional consideration in the final phases of these proceedings.
- The Board finds that salinity is not a factor affecting salmon as they migrate through the Estuary.
- Elevated temperature is one of the factors which can affect Chinook salmon during their migration through the Delta.
- Temperatures no greater than 68°F during the periods of April through June and September through November at Freeport on the Sacramento River and Vernalis on the San Joaquin River should be achieved by controllable factors, such as waste discharge controls, increases in riparian canopy, and bypass of warming areas (e.g., Thermalito Afterbay).
- Controllable water quality factors are those actions, conditions, or circumstances resulting from human activities that may influence the quality of the water of the State, that are subject to the authority of the State Board, or the Regional Board, and that may be reasonably controlled. Based on the record in these proceedings, controlling temperature in the Delta utilizing reservoir releases does not appear to be reasonable, due to the distance of the Delta downstream of reservoirs, and uncontrollable factors such as ambient air temperature, water temperatures in the reservoir releases, etc. For these reasons, the State Board considers reservoir releases to control water temperatures in the Delta a waste of water; therefore, the State Board will require a test of reasonableness before consideration of reservoir releases for such a purpose.
- No temperature requirements were submitted for winter-run Chinook salmon. To provide some protection for this endangered species, the more conservative temperature objective of 66°F (developed for the fall-run) is provided for the winter-run. This objective should be achieved by controllable factors, as noted above, during the period January through March at Freeport on the Sacramento River.

Striped Bass (5.6)

- Studies over many years indicate that there are numerous factors affecting striped bass abundance, including diversions from the Delta, reduced Delta outflow, flow patterns in the interior Delta, fewer adults, toxic effects, changes in the food chain due to introduced species, recreational angler harvest, and illegal poaching.
- Studies should be continued and additional water operation tests should be conducted to determine the effects on striped bass and the best means for their protection.

- In light of various impacts on the fishery, particularly of the export pumps, it is necessary to examine existing points of water diversion. Within the Scoping Phase, the Board will consider alternatives to the existing points of diversion.

Striped Bass - Spawning Habitat from Prisoners Point to Vernalis

- Review of the evidence indicates that it may be desirable to expand existing spawning habitat for striped bass in the Delta. However, the State Board concludes that the most significant factor in the decline of striped bass is entrainment[1] due to pumping. The State Board will consider actions to be taken concerning entrainment losses during the Scoping and Water Right phases of the proceedings. Upon examination of the results of these actions, the State Board will consider the issue of expansion of spawning habitat.

Striped Bass - Spawning Habitat from Antioch to Prisoners Point

- The major spawning areas for striped bass are the Sacramento River above the Delta and the San Joaquin River area between Antioch and Prisoners Point.

- The Board finds benefits for the resource in maintaining spawning habitat in this reach by establishing boundary salinities at Antioch of 1.5 and at Prisoners Point of 0.44 mmhos/cm EC from April 15 through May 31. The end date of May 31 may be shortened if data indicate that spawning has ceased.

- Deficiencies in firm supplies and the level of protection afforded by the striped bass spawning objective should be correlated.

- The Board needs better information than is currently available to consider the complete economic relationship between improvements in striped bass spawning habitat and water availability.

Marshes

- The Board believes that the managed portions of Suisun Marsh are currently being protected by D-1485 as amended in 1985. The protections, including the operation of the Suisun Marsh Salinity Control Gate, are being used and evaluated.(5.10)

- A biological assessment is needed to assess the water quality requirements of the rare, threatened and endangered plants and animals (and their habitats) in the wetlands surrounding Suisun Bay to determine reasonably necessary amendments and additions to the Suisun Marsh objectives. The results will likely not be available in time for inclusion in the final Bay-Delta Environmental Impact Report or water right decision in 1992. When the bioassessment is completed the water quality objectives will be evaluated and incorporated as warranted.(5.10)

- Water quality objectives for San Pablo Bay exist in the Statewide Water Quality Plan for Enclosed Bays and Estuaries of California and in the Water Quality Control Plan for Region 2.(5.11)

---

*1/ Entrainment means primarily the effects of project operations, such as operation of the Delta Cross Channel gates, export pumping, and reverse and low river flows, plus local non-project diversions.*

## 1.6 Summary of Implementation Requirements

### Water Year Classification (see 7.5.3.1)

- The current Sacramento River Water Year Classification approximates annual conditions of water availability with five distinct categories. DWR has proposed the addition of a sliding scale to the classification to smooth the transitions between categories. There is a need for the parties to study this proposal, and submit the results for review during the Scoping Phase of the proceedings.

- Due to a previous lack of analytical tools, the San Joaquin River Basin classification needs refinement. The State Board requests the parties to develop a San Joaquin River Basin classification with similar methodology as used for the Sacramento River Basin and submit the results for review during the Scoping Phase of the proceedings. This system, together with the Sacramento River classification, will be used during the Scoping and Water Right Phases to determine how the responsibilities of meeting water quality objectives should be distributed.

### Municipal and Industrial

- There is a need for water from the best available sources to meet the drinking water needs of all Californians. The parties should advise the State Board during the Scoping Phase on their plans and programs to obtain high quality drinking water through the year 2010.(7.2.2.1)

- An Interagency Program led by DWR has been formed to continue the work conducted by the Delta Health Effects Study and the Delta M&I Workgroup. The primary task of the new workgroup is to investigate conditions that adversely affect drinking water. The State Board requests this workgroup to design and implement a comprehensive THMFP monitoring program for the Delta by June 1991, and to present annual progress reports to the State Board commencing in January 1992.(7.4.2.1)

- Additional information is required to assess adequately the impact of Delta agricultural drains on THM formation. There is a need to conduct appropriate, comprehensive monitoring of agricultural discharges. The Central Valley Regional Board shall require the development and implementation of best management practices or other means to appropriately control these discharges. This task should begin in the Rock Slough area.(7.4.2.1)

### Western and Interior Delta Agriculture (7.4.2.2)

- The Corn Study provides important information on the sensitivity of corn. A leaching study was recently begun to evaluate its effectiveness, practicality, and costs. This information is needed before a new objective can be set to protect the western and interior Delta agriculture. This study should be completed and the results submitted during the Water Right Phase of the proceedings.

Salt-Load Reduction (7.2.2.2)

- Upon adoption of this Plan, the State Board will request the Central Valley Regional Board to develop an initial salt-load reduction program. The goal of this initial program will be to reduce annual salt-loads discharged to the San Joaquin River by at least 10 percent and to adjust the timing of salt discharges from low flow to high flow periods. During the Water Right Phase of these proceedings, the Regional Board should discuss how it intends to implement this program (for example, drainage operation plans and best management practices).

Modeling Needs (7.4.3.2)

- The Board recognizes the need to develop its own water right modeling capability which will assist in the consideration of water transfers, new water rights, review of existing water rights and future alterations of Delta water quality and flow requirements.

- The three-dimensional model currently being developed by USGS for evaluating hydraulic and biological processes in the various embayments of the San Francisco Bay should be finalized.

- An Interagency Modeling Development and Use Committee should be formed to:

  - Facilitate exchange of modeling information and to reduce duplication,
  - Improve access of information by all interested parties
  - Simulate operation of major reservoirs in addition to the CVP and SWP,
  - Consider effects of antecedent conditions,
  - Improve temperature modeling for the Sacramento and San Joaquin River basins,
  - Improve Delta channel depletion estimates in DAYFLOW,
  - Improve both water quality and flow modeling for the San Joaquin River basin,
  - Update hydrology to reflect current land use and groundwater/surface water interactions.

Monitoring

- There is a need to develop, with the State Board's assistance, a coordinated monitoring program plan to ensure compliance with the water quality objectives contained in this Plan, and to identify meaningful changes in any significant water quality parameters potentially related to implementation of this Plan. The programs specified in Chapter 7 of the Plan should be carried out.

Special Temperature Considerations

- Analysis is needed of the effectiveness of various means to control factors which will help maintain cooler waters in the Sacramento and San Joaquin rivers and their tributaries for the protection of all runs of Chinook salmon.

- The parties maintaining the continuous temperature gauges at Freeport on the Sacramento River and at Vernalis on the San Joaquin River should develop data related to the 68°F temperature objective for protection of salmon. The State Board directs DWR to continue the dissolved oxygen monitoring in the lower San Joaquin River between Turner Cut and Stockton to protect salmon migration.

Special Salinity Monitoring (7.4.2.4)

- Continuous EC and temperature monitoring equipment should be installed at various locations in the San Joaquin River between Antioch and Vernalis to obtain data on salinity conditions for striped bass spawning.

- The temperature data collected are to be submitted to the State Board which will then make a determination whether controllable factors should be controlled.

Estuarine Habitat (7.4)

- Past studies of the estuarine habitat have been extensive. Relatively few investigators have been able to specifically quantify the lower level of conditions that protect the beneficial uses. The studies discussed below should lead to interim actions that can be implemented to protect these uses more effectively.

Salmon (7.4.2.3)

- Identify the critical factors influencing smolt survival, including evaluation and implementation of the studies indicated in Chapter 7 of this Plan.

Marshes around Suisun Bay (7.4.2.6)

- A comprehensive biological assessment is being prepared for the rare, threatened and endangered species (and their habitat) of the managed and unmanaged wetlands around Suisun Bay. Studies are needed to determine the relationship between channel water salinity and soil water salinity in the unmanaged tidal wetlands around Suisun Bay.

Scoping and Water Right Issues (7.5)

- Only a few parties are currently responsible for meeting water quality and flow requirements and for compliance monitoring activities within the Delta. The Board requests that information be developed on how these burdens should be distributed over more water right holders and waste dischargers. This information will be considered and used by the Board during the Scoping and Water Right phases of the proceedings.

- For the development of alternatives to existing points of diversion and for the coordination of preparedness planning by other agencies, information should be presented during the Scoping Phase on the impact of flood control measures, levee conditions, dredging, channel deepening, barriers and seismic activities.

Striped bass (7.5.2.4)

- The direct entrainment losses of striped bass and other fish at the major diversions in the Delta are well documented. The Bureau of Reclamation and the Contra Costa Water District should each negotiate a fishery agreement with the Department of Fish and Game that would provide for mitigation of the direct entrainment losses at the Tracy Pumping Plant and Contra Costa Pumping Plant No. 1. These agreements should be completed prior to the conclusion of the Water Right Phase. Direct entrainment losses at Delta agricultural diversions are not well documented. The parties should evaluate such losses and identify corrective measures.

- A real-time monitoring program should be developed and used to assess the daily densities of striped bass eggs and larvae in the Sacramento River during the spring and initiate periodic closure of the Delta Cross Channel to reduce diversion of striped bass into interior Delta channels. Closure of the Delta Cross Channel should be coordinated with short duration pulsed flows in the Sacramento River, in combination with short term reductions in export pumping and reduced reverse flows, to transport striped bass eggs and larvae into the Suisun Bay.

- There is the need to initiate a detailed investigation and evaluation of alternative sites for establishing facilities for rearing juvenile striped bass salvaged from the SWP and CVP facilities for subsequent release to the Bay-Delta system.

- A detailed review and evaluation of alternative recreational angler harvest management options including, but not limited to, specific area and seasonal closures, alternative size limits including initiation of a slot limit, and restrictions on fishing gear such as use of single barbless hooks should be conducted. In addition, the impacts of poaching on the striped bass population should be evaluated, funding sources for expanded enforcement should be sought, and the unrestricted sale of striped bass in California should be eliminated. Temporary changes in fishery harvest regulations should be considered as part of an overall short-term approach to improve the situation until longer-term measures may be instituted. The Board does not believe such measures should substitute for its own responsibilities to provide suitable habitat.

- Additional water project operation tests should be conducted in the Delta to better determine the effects of diverting water from and upstream of the Delta on striped bass.

Other Aquatic Species (7.5.3)

- Additional means should be developed to assess the general health of the Estuary and serve as a basis for determining the impacts of new projects, physical and operational changes, introduced species, etc. DFG should develop a priority list of tasks to be performed. Consideration should be given to specific components, such as American shad, Delta smelt, and the benthos. Also, use of biocriteria should be considered.

San Francisco Bay (7.5.3)

- There is a need to examine further the impacts of San Francisco Bay inflows on fish, invertebrates, and other public trust resources, particularly as these inflows, including pulse flows, affect the distribution, abundance, and reproductive success of species inside the Estuary. Studies are also needed to provide the linkage, if any, between phytoplankton and higher trophic levels.

Entrapment Zone (7.5.3.3)

- Studies are needed to provide the degree of linkage between the location and productivity of the entrapment zone and the effects on the population levels of important fish species.

The State Board retains the option of setting flow objectives if appropriate.

1.7 Water Quality Objectives

To protect beneficial uses of the Bay-Delta Estuary, the State Board adopts the salinity, temperature and dissolved oxygen objectives listed in Table 1-1.

# TABLE 1-1 WATER QUALITY OBJECTIVES

## A) MUNICIPAL AND INDUSTRIAL

| LOCATION | SAMPLING SITE NOs. (I-A/RKI) | PARAMETER | DESCRIPTION | INDEX TYPE | YEAR TYPE | DATES | VALUES |
|---|---|---|---|---|---|---|---|
| *Contra Costa Canal at Pumping Plant #1* | *C-5 CHCCC06* | *Chloride (Cl-)* | *Maximum mean daily, in mg/l* | *Not Applicable* | *All* | *Oct-Sep* | *250* |
| *Contra Costa Canal at Pumping Plant #1* - or - *San Joaquin River at Antioch Water Works Intake* | *C-5 CHCCC06* / *D-12(near) RSAN007* | *Chloride (Cl-)* | *Maximum mean daily 150 mg/l chloride for at least the number of days shown during the Calendar Year. Must be provided in intervals of not less than two weeks duration. (% of Calendar Year shown in parenthesis)* | *Sac R 40-30-30* / *Sac R 40-30-30* | *W* / *AN* / *BN* / *D* / *C* | | *No. of days each Cal. Year < 150 mg/l Cl-* *240 (66%)* / *190 (52%)* / *175 (48%)* / *165 (45%)* / *155 (42%)* |
| *West Canal at mouth of Clifton Court Forebay* | *C-9 CHWST0* | *Chloride (Cl-)* | *Maximum mean daily, in mg/l* | *Not Applicable* | *All* | *Oct-Sep* | *250* |
| *Delta Mendota Canal at Tracy Pumping Plant* | *DMC-1 CHDMC004* | *Chloride (Cl-)* | *Maximum mean daily, in mg/l* | *Not Applicable* | *All* | *Oct-Sep* | *250* |
| *Cache Slough at City of Vallejo Intake [1]* and/or *Barker Slough at North Bay Aqueduct Intake* | *C-19 SLCCH16* / *- SLBAR3* | *Chloride (Cl-)* | *Maximum mean daily, in mg/l* | *Not Applicable* | *All* | *Oct-Sep* | *250* |

# TABLE 1 - 1 (cont.) WATER QUALITY OBJECTIVES

## B) AGRICULTURAL

### AREA

| LOCATION | SAMPLING SITE NOs. (I-A/RKI) | PARAMETER | DESCRIPTION | INDEX TYPE | YEAR TYPE | DATES | VALUES |
|---|---|---|---|---|---|---|---|
| **1) WESTERN DELTA** | | | | | | | |
| *Sacramento River at Emmaton* | *D-22 RSAC092* | *Electrical Conductivity (EC)* | *Maximum 14-day running average of mean daily, in mmhos/cm (mmhos)* | *Sac R 40-30-30* | | *0.45 EC April 1 to Date Shown* | *EC from Date Shown to Aug. 15 [2]* |
| | | | | | *W* | *Aug. 15* | -- |
| | | | | | *AN* | *July 1* | *0.63* |
| | | | | | *BN* | *June 20* | *1.14* |
| | | | | | *D* | *June 15* | *1.67* |
| | | | | | *C* | -- | *2.78* |
| *San Joaquin River at Jersey Point* | *D-15 RSAN018* | *Electrical Conductivity (EC)* | *Maximum 14-day running average of mean daily, in mmhos* | *Sac R 40-30-30* | | *0.45 EC April 1 to Date Shown* | *EC from Date Shown to Aug. 15 [2]* |
| | | | | | *W* | *Aug. 15* | -- |
| | | | | | *AN* | *Aug. 15* | -- |
| | | | | | *BN* | *June 20* | *0.74* |
| | | | | | *D* | *June 15* | *1.35* |
| | | | | | *C* | -- | *2.20* |

# TABLE 1 - 1 (cont.) WATER QUALITY OBJECTIVES

## B) AGRICULTURAL

### AREA

| LOCATION | SAMPLING SITE NOs. (I-A/RKI) | PARAMETER | DESCRIPTION | INDEX TYPE | YEAR TYPE | DATES | VALUES |
|---|---|---|---|---|---|---|---|
| **2) INTERIOR DELTA** | | | | | | | |
| *South Fork Mokelumne River at Terminous* | *C-13 RSMKL08* | *Electrical Conductivity (EC)* | *Maximum 14-day running average of mean daily, in mmhos* | *Sac R 40-30-30* | | *0.45 EC April 1 to Date Shown* | *EC from Date Shown to Aug. 15 [2]* |
| | | | | | *W* | *Aug. 15* | -- |
| | | | | | *AN* | *Aug. 15* | -- |
| | | | | | *BN* | *Aug. 15* | -- |
| | | | | | *D* | *Aug. 15* | -- |
| | | | | | *C* | -- | *0.54* |
| *San Joaquin River at San Andreas Landing* | *C-4 RSAN032* | *Electrical Conductivity (EC)* | *Maximum 14-day running average of mean daily, in mmhos* | *Sac R 40-30-30* | | *0.45 EC April 1 to Date Shown* | *EC from Date Shown to Aug. 15 [2]* |
| | | | | | *W* | *Aug. 15* | -- |
| | | | | | *AN* | *Aug. 15* | -- |
| | | | | | *BN* | *Aug. 15* | -- |
| | | | | | *D* | *Jun. 25* | *0.58* |
| | | | | | *C* | -- | *0.87* |

# TABLE 1 - 1 (cont.) WATER QUALITY OBJECTIVES

## B) AGRICULTURAL

### AREA

| LOCATION | SAMPLING SITE NOs. (I-A/RKI) | PARAMETER | DESCRIPTION | INDEX TYPE | YEAR TYPE | DATES | VALUES |
|---|---|---|---|---|---|---|---|
| (To be implemented by 1996) [3] | | **3) SOUTH DELTA** | | | | | |
| *San Joaquin River at Airport Way Bridge, Vernalis* | *C-10 RSAN112* | *Electrical Conductivity (EC)* | *Maximum 30-day running average of mean daily EC, in mmhos* | *Not Applicable* | *All* | *Apr 1-Aug 31* | *0.7* |
| | | | | | | *Sep 1-Mar 31* | *1.0* |
| *Old River near Middle River* | *C-8 ROLD69* | | | | | *or* | |
| *Old River at Tracy Road Bridge* | *P-12 ROLD59* | | | *If a three-party contract has been implemented among DWR, USBR and the SDWA, that contract will be reviewed prior to implementation of the above and, after also considering the needs of other beneficial uses, revisions will be made to the objectives and compliance/monitoring locations noted above, as appropriate.* | | | |
| *San Joaquin River at Brandt Bridge [site]* | *C-6 RSAN073* | | | | | | |
| | | **4) EXPORT** | | | | | |
| *West Canal at mouth of Clifton Court Forebay -and- Delta Mendota Canal at Tracy Pumping Plant* | *C-9 CHWST0 DMC-1 CHDMC004* | *Electrical Conductivity (EC)* | *Maximum monthly average of mean daily EC, in mmhos* | *Not Applicable* | *All* | *Oct-Sep* | *1.0* |

# TABLE 1-1 (cont.) WATER QUALITY OBJECTIVES

## C) FISH AND WILDLIFE

### HABITAT/SPECIES

| LOCATION | SAMPLING SITE NOs. (I-A/RKI) | PARAMETER | DESCRIPTION | INDEX TYPE | YEAR TYPE | DATES | VALUES |
|---|---|---|---|---|---|---|---|
| **CHINOOK SALMON** | | | | | | | |
| DISSOLVED OXYGEN | | | | | | | |
| *San Joaquin River between Turner Cut & Stockton* | *RSAN050-RSAN061* | *Dissolved Oxygen (DO)* | *Minimum dissolved oxygen, in mg/l* | *Not Applicable* | *All* | *Sep 1-Nov 30* | *6.0* |
| TEMPERATURE | | | | | | | |
| *Sacramento River at Freeport and* | *RSAC155* | *Temperature* | *Narrative Objective* | *Not Applicable* | *All* | *"The daily average water temperature shall not be elevated by controllable factors above 68 deg. F from the I Street Bridge to Freeport on the Sacramento River, and at Vernalis on the San Joaquin River between April 1 through June 30 and September 1 through November 30 in all water year types." [4]* | |
| *San Joaquin River at Airport Way Bridge, Vernalis* | *C-10 RSAN112* | *Temperature* | *Narrative Objective* | *Not Applicable* | *All* | | |
| *Sacramento River at Freeport* | *RSAC155* | *Temperature* | *Narrative Objective* | *Not Applicable* | *All* | *"The daily average water temperature shall not be elevated by controllable factors above 66 deg. F from the I Street Bridge to Freeport on the Sacramento River between January 1 through March 31." [4]* | |

# TABLE 1-1 (cont.) WATER QUALITY OBJECTIVES

## C) FISH AND WILDLIFE

### HABITAT/SPECIES

| LOCATION | SAMPLING SITE NOs. (I-A/RKI) | PARAMETER | DESCRIPTION | INDEX TYPE | YEAR TYPE | DATES | VALUES |
|---|---|---|---|---|---|---|---|
| **STRIPED BASS-SALINITY.1 ANTIOCH-SPAWNING** | | | | | | | |
| *Sacramento River at Chipps Island* | *D-10 RSAC075* | *Delta outflow Index (DOI)* | *Average for the period not less than the value shown, in cfs* | *Not Applicable* | *All* | *Apr 1-Apr 14* | *6,700* |
| *San Joaquin River at Antioch Water Works Intake* | *D-12 (near) RSAN007* | *Electrical Conductivity (EC)* | *14-day running average of mean daily for the period not more than value shown, in mmhos* | *Not Applicable* | *All* | *Apr 15-May 31 (or until spawning has ended)* | *1.5* |
| **STRIPED BASS-SALINITY.2 ANTIOCH-SPAWNING-RELAXATION PROVISION** | | | | | | | |
| *San Joaquin River at Antioch Water Works Intake* | *D-12 (near) RSAN007* | *Electrical Conductivity (EC)* | *14-day running average of mean daily not more than value shown corresponding to deficiencies in firm supplies declared by a set of water projects representative of the Sacramento River and San Joaquin River watersheds, for the period shown, or until spawning has ended. The specific representative projects and amounts of deficiencies will be defined in subsequent phases of the proceedings.* | *Total Annual Imposed Deficiency (MAF)* | | *Apr 1-May 31 EC in mmhos* | |
| | | | | | | *Dry* | *Critical* |
| *This relaxation provision replaces the above Antioch & Chipps Island standard whenever the projects impose deficiencies in firm supplies.* | | | | *0.0* | | *1.5* | *1.5* |
| | | | | *0.5* | | *1.8* | *1.9* |
| | | | | *1.0* | | *1.8* | *2.5* |
| | | | | *1.5* | | *1.8* | *3.4* |
| | | | | *2.0* | *or more* | *1.8* | *3.7* |
| | | | | *Linear interpolation is to be used to determine values between those shown.* | | | |
| **STRIPED BASS-SALINITY.3 PRISONERS POINT-SPAWNING** | | | | | | | |
| *San Joaquin River at: Prisoners Point* | *D-29 RSAN038* | *Electrical Conductivity (EC)* | *14-day running average of mean daily for the period not more than value shown, in mmhos* | *Not Applicable* | *All* | *Apr 1-May 31 (or until spawning has ended)* | *0.44* |

# TABLE 1-1 (cont.) WATER QUALITY OBJECTIVES

## C) FISH AND WILDLIFE

### HABITAT/SPECIES

| LOCATION | SAMPLING SITE NOs. (I-A/RKI) | PARAMETER | DESCRIPTION | INDEX TYPE | YEAR TYPE | DATES | VALUES |
|---|---|---|---|---|---|---|---|
| **STRIPED BASS-SALINITY: 4. PRISONERS POINT-SPAWNING-RELAXATION PROVISION** | | | | | | | |
| | | *When the relaxation provision for Antioch spawning protection is in effect:* | | | | | |
| *San Joaquin River at: Prisoners Point* | *D-29 RSAN038* | *Electrical Conductivity (EC)* | *14-day running average of mean daily for the period not more than the value shown, in mmhos* | *Not Applicable* | *D&C* | *Apr 1-May 31 (or until spawning has ended)* | *0.55* |

### SUISUN MARSH

*In regard to the Suisun Marsh, the water quality objectives for Suisun Marsh are unchanged from the 1978 Delta Plan. The implementation vehicle, Water Right Decision 1485 (D-1485), was amended in 1985 to change (or delete) some monitoring stations and to revise the schedule for implementation. The DWR, USBR, DFG, and Suisun Resource Conservation District (SRCD) have signed and adopted a set of three agreements concerning the Suisun Marsh. These are the Suisun Marsh Preservation Agreement (SMPA), the Monitoring Agreement, and the Mitigation Agreement. The SMPA contains water quality standards for the managed marshes of Suisun Marsh which the four signatories would like the State Board to adopt as water quality objectives. The SMPA also describes the physical facilities that the four signatories have agreed would serve the managed marshes in order to maintain production of preferred waterfowl food plants. The facilities built so far, including the Suisun Marsh Salinity Control Gates (previously called the Montezuma Slough Control Structure), have changed the physical regime in the Marsh.*

*Revised water quality objectives incorporating the SMPA (with any modifications necessitated by the biological assessment) will be adopted by the State Board after the biological assessment (discussed in Section 7.4.2.6 of the plan) is completed. Until that time, the water quality standards in the amended D-1485 will continue to be implemented; see Table 1-2 for a summary of these standards.*

## FOOTNOTES:

[1] The Cache Slough objective to be effective only when water is being diverted from this location.

[2] When no date is shown, EC limit continues from April 1.

[3] South Delta Agriculture objectives will be implemented in stages: two interim stages and one final stage. The first interim stage will be implemented with the adoption of the WQCP, the second interim stage by 1994, and the final stage by 1996. Interim Stage 1 -- 500 mg/l mean monthly TDS all year at Vernalis. Interim Stage 2 -- (to be implemented no later than 1994) 0.7 mmhos/cm EC April 1 to August 31, 1.0 mmhos/cm EC September 1 to March 31, 30-day running average, at Vernalis and Brandt Bridge; with water quality monitored at three current interior stations -- Mossdale, Old River, near Middle River and Tracy Road Bridge, and an additional interior monitoring station on Middle River at Howard Road Bridge. Final Stage -- (to be implemented no later than 1996) 0.7 mmhos/cm EC April 1 to August 31, 1.0 mmhos/cm EC September 1 to March 31, 30-day running average, at Vernalis and Brandt Bridge on the San Joaquin River; with two interior stations at Old River Near Middle River and Old River at Tracy Road Bridge. Monitoring stations will be at Mossdale at head of Old river and Middle River at Howard Road Bridge.

OR

If a three-party contract has been implemented among DWR, USBR and the SDWA, that contract will be reviewed prior to implementation of the above and, after also considering the needs of other beneficial uses, revisions will be made to the objectives and compliance/montioring locations noted above, as appropriate.

[4] Controllable water quality factors are those actions, conditions, or circumstances resulting from human activities that may influence the quality of the waters of the State, that are subject to the authority of the State Board, or the Regional Board, and that may be reasonably controlled. Based on the record in these proceedings, controlling temperature in the Delta utilizing reservoir releases does not appear to be reasonable, due to the distance of the Delta downstream of reservoirs and uncontrollable factors such as ambient air temperature, water temperatures in the reservoir releases, etc. For these reasons, the State Board considers reservoir releases to control water temperatures in the Delta a waste of water; therefore, the State Board will require a test of reasonableness before consideration of reservoir releases for such a purpose.

# TABLE 1-2 IMPLEMENTATION REQUIREMENTS FOR SUISUN MARSH

| LOCATION | SAMPLING SITE NOs. (I-A/RKI) | PARAMETER | DESCRIPTION | EFFECTIVE DATES | MONTHS | VALUES |
|---|---|---|---|---|---|---|
| *Sacramento River at Collinsville* | *C-2 RSAC081* | *Electrical Conductivity (EC)* | *Monthly average of both daily high tide values not to exceed the values shown, in mmhos/cm (or demonstrate that equivalent or better protection will be provided at the location)* | *Oct 1,1988* | *Oct* | *19.0* |
| | | | | | *Nov* | *15.5* |
| | | | | | *Dec* | *15.5* |
| *Montezuma Slough at National Steel* | *S-64(new) SLMZU25* | | | | *Jan* | *12.5* |
| | | | | | *Feb* | *8.0* |
| | | | | | *Mar* | *8.0* |
| *Montezuma Slough near Beldon Landing* | *S-49 SLMZU11* | | | | *Apr* | *11.0* |
| | | | | | *May* | *11.0* |
| *Chadbourne Slough at Chadbourne Road (proposed) and Cordelia Slough 500 ft west of S.P.R.R. crossing at Cygnus* | *S-21(prop.) SLCBN1 S-33 SLCRD04* | | | *Oct 1,1991* | | |
| *-or-* | | | | *or* | | |
| *Chadbourne Slough at Chadbourne Road (proposed) and Cordelia Slough at Cordelia Goodyear Ditch (proposed)* | *S-21(prop.) SLCBN1 S-97(prop.) SLCRD06* | | | *Oct 1,1993* | | |
| *Goodyear Slough at Morrow Island Clubhouse* | *S-35(new) SLGYR03* | | | *Oct 1,1991* | | |
| *-or-* | | | | *or* | | |
| *Goodyear Slough, 1.3 mi south of Morrow Island [Drainage] Ditch at Pierce* | *S-75 SLGYR04* | | | *Oct 1,1994* | | |
| *Suisun Slough, 300 ft south of Volanti Slough* | *S-42 SLSUS12* | | | *Oct 1,1997* | | |
| *Water Supply Intakes for Waterfowl Management Areas on Van Sickle and Chipps islands* | *No Locations specified* | | | | | |

# 2.0 SCOPE OF THE PLAN

## 2.1 Introduction

The initial evidentiary hearing of the Bay-Delta proceedings, Phase I, has been completed. Succeeding phases have been renamed to clarify the purposes each is to serve. They are:

- o The Water Quality Phase
- o The Scoping Phase
- o The Water Right Phase

The Water Quality Phase will continue the review, revision and adoption of the Plan. A separate Pollutant Policy Document (PPD) for the Bay-Delta Estuary adopted by the State Board (June, 1990) addresses the effects of certain pollutants on beneficial uses in the Bay-Delta Estuary; it contains policy guidance to be used by the San Francisco Bay Region (2) and the Central Valley Region (5) when they update their Basin Plans. Other pollutants of concern are addressed in the Statewide Water Quality Control Plans for Inland Surface Waters and for Enclosed Bays and Estuaries. The Scoping Phase has already begun on issues related to water quality in the Estuary; it will include scoping hearings on such matters as the public trust, physical facilities, negotiated agreements and potential, administrative and legislative actions. A draft Environmental Impact Report (EIR) will be developed and circulated as a result of the Scoping Phase. Various alternatives developed in the Scoping Phase will be explored in the draft EIR. The Water Right Phase will include a water right hearing with adoption of a final EIR and water right decision(s). In these water right decisions the Board will decide which water users will help meet water quality objectives and flow requirements in the Estuary.

During the course of the water quality proceedings the Board received evidence on:

- o The beneficial uses being made of water flowing into, within, and from the Bay-Delta Estuary;
- o The levels of protection which should be afforded these beneficial uses;
- o Reasonable consumptive uses made of Bay-Delta waters;
- o The effects of pollutants on beneficial uses of Bay-Delta Estuary waters; and
- o Implementation measures available to achieve the levels of protection necessary to protect the beneficial uses.

## 2.2 Scope and Purpose of the Plan

o Scope

This Plan is a narrowly focused Basin Plan for the waters of the Bay-Delta Estuary. It is to be considered together with other water quality control plans applicable to the waters of the Bay-Delta Estuary, such as the 1978 Delta Plan, the Pollutant Policy Document for the Bay-Delta Estuary, and the Statewide Water Quality Control Plans for Inland Surface Waters and for Enclosed Bays and Estuaries in California, as well as all applicable San Francisco Bay (Region 2) and Central Valley (Region 5) Regional Basin Plans. This Plan supersedes any existing salinity and temperature objectives to the extent of any conflict.

o Review and Revision

The water quality objectives established in the Plan, together with other currently effective controls, will protect established beneficial uses in compliance with all applicable state laws.

This Plan is a substitute for a separate environmental document (Public Resources Code Section 21080.5). It therefore includes a discussion of alternatives in order to comply with CEQA's mandate to consider all reasonable alternatives to the preferred project.

This Plan is not meant to supersede any designation of beneficial uses, objectives (except where conflict exists), or other matter set forth in either the Basin 2 Plan or the Basin 5B Plan. Any questions of whether this Plan supersedes any provisions in either Regions' Plans, or in any other water quality control plan adopted by the State Board for the waters of the Bay-Delta Estuary, should be addressed to the State Board for an interpretation.

The Plan will undergo public review either on a triennial basis or sooner if needed.

o Flow Considerations

Although flow requirements are not set as objectives in this Plan, the State Board recognizes that flow requirements and salinity objectives are largely met by the regulation of water flow. The reasonableness of a salinity objective can be evaluated by using operation studies to estimate the impacts of these objectives on water supplies. Effects on these supplies may be used to evaluate the economic and social costs.

o Established Objectives

The State Board has established the following categories of objectives:

- Salinity for municipal and industrial uses,
- Salinity for Delta agriculture,
- Salinity for export agriculture,
- Salinity for fisheries in the Delta,
- Temperature and dissolved oxygen for fisheries in the Delta, and
- Salinity for Suisun Marsh habitat.

## 2.3 Authority for Regulation of Water in the Bay-Delta Estuary

The State Board is responsible for formulating and adopting state policy for water quality control (WC Section 13140). The authorities for regulation of water in the Bay-Delta Estuary are found in Appendix 2.0, State Board Authority.

# 3.0 BASIN AND HYDROLOGY DESCRIPTION

## Conclusions: WATER YEAR TYPES

- **The Bay-Delta Estuary is a dynamic system characterized by wide annual, seasonal, and daily fluctuations in fresh water inflows and ocean derived salinities.**
- **Defining water year types is an essential tool in evaluating the amount of water available.**
- **Water availability is an essential factor in establishing reasonable objectives for ocean derived salts.**
- **The Board adopts the "40-30-30 Water Year Index" for the Sacramento River Basin as proposed by the Operational Studies Workgroup. In subsequent phases of the proceedings, the Board wishes to examine critically the use of the "subnormal snowmelt" and "year following dry or critical year" provisions which allow alterations of objectives.**
- **Changes to water year types will include development and refinement of an appropriate index before it can be implemented for the San Joaquin River Basin.**

## 3.1 Introduction

The Bay-Delta Estuary and tributary areas described in this Plan include:

- The Delta (Figure 3-1);
- The Delta's tributary areas, that is, the Sacramento River, the Central Sierra, the San Joaquin River basins[1/] (Figure 3-2); and
- The San Francisco Bay and its tributary hydrologic basin (Figure 3-3).

The Estuary and tributary areas provide about two-thirds of all the water used in California, including 40 percent of the state's drinking water.

This chapter and Appendix 3.0, Basin Description, outline the hydrologic conditions of the Estuary and its tributary areas by providing a description of each area's:

Physical Characteristics -- the geographical and legal dimensions; and

Hydrology -- the characteristics and nature of water movement, which can include:

- Unimpaired Flow Conditions -- the flow that would be available assuming no upstream impoundments, use, or diversions of runoff under current upstream and Delta channel configurations (SWRCB,3,8).

---

1/ *The Tulare Lake Basin (Central Valley Regional Water Quality Control Board Basin 5D), although part of the Central Valley, is not considered to be tributary to the Delta for the purposes of this Plan.*

FIGURE 3-1 Boundary of the Bay-Delta Estuary and locations of Estuary exports
(From: SWRCB, 3, 5)

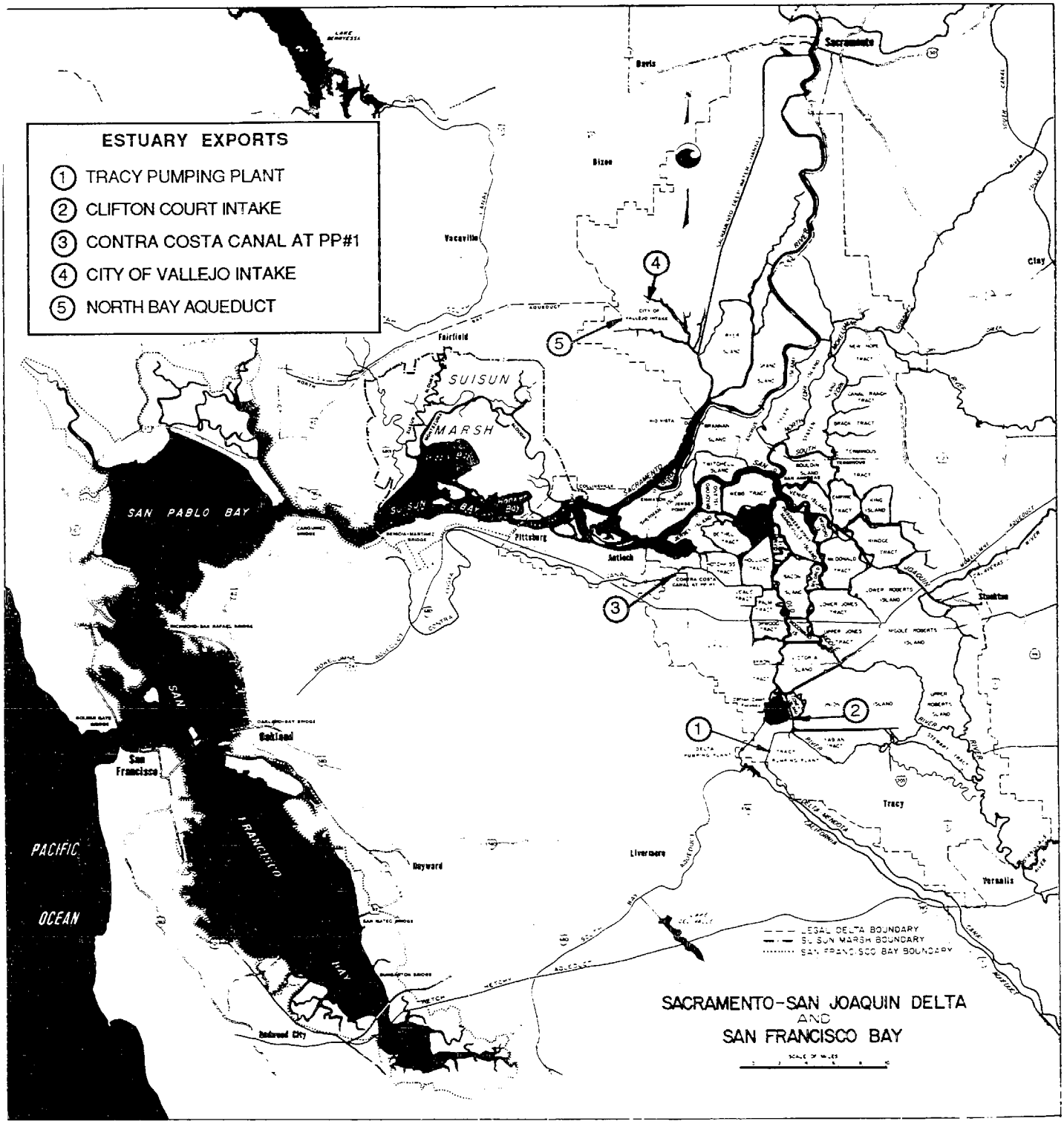


**FIGURE 3-2 Boundaries of the Sacramento River (5A), Central Sierra and Delta (5B), and San Joaquin (5C) Basins (From: RWQCB 5, 1975)**

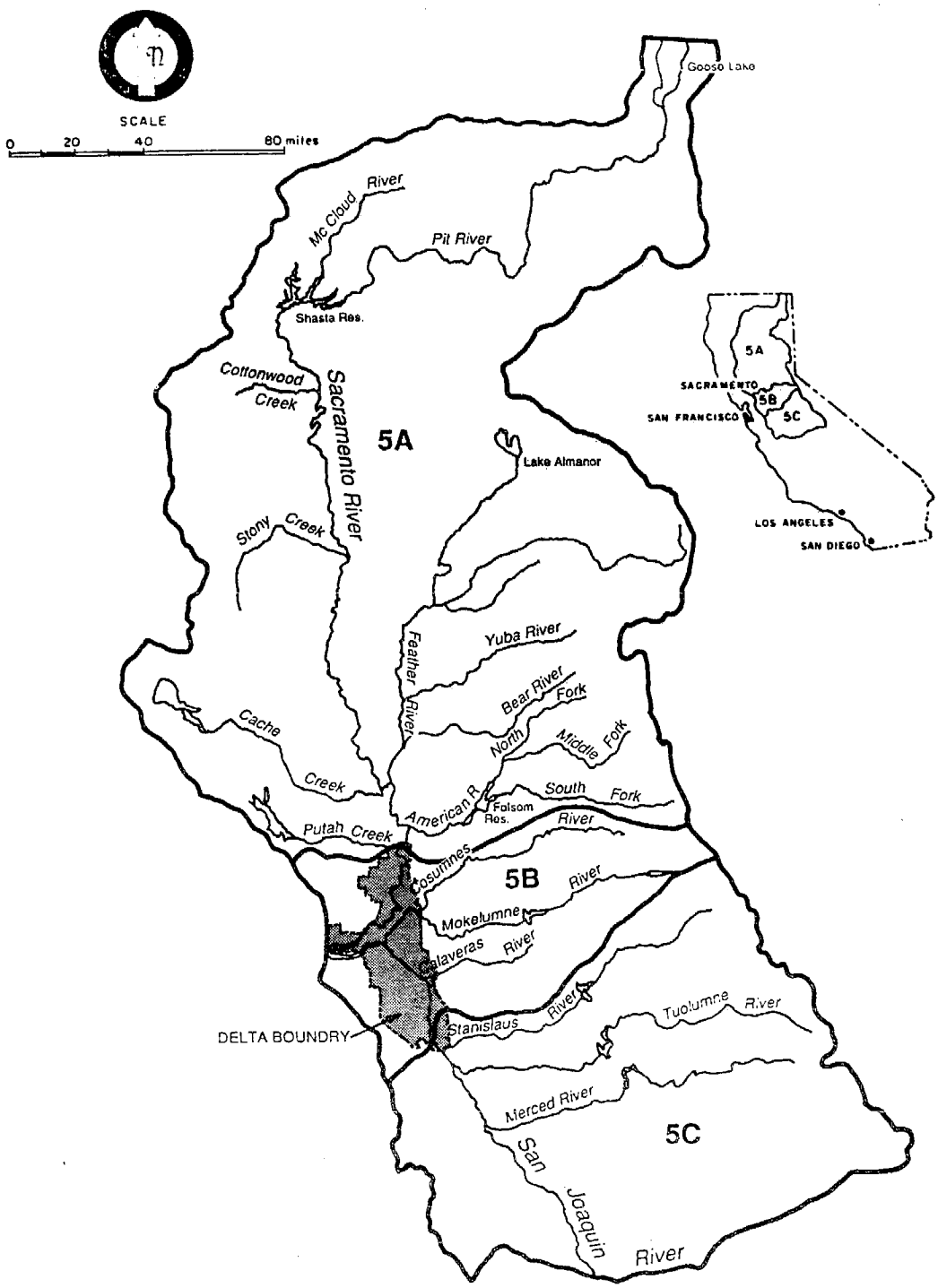
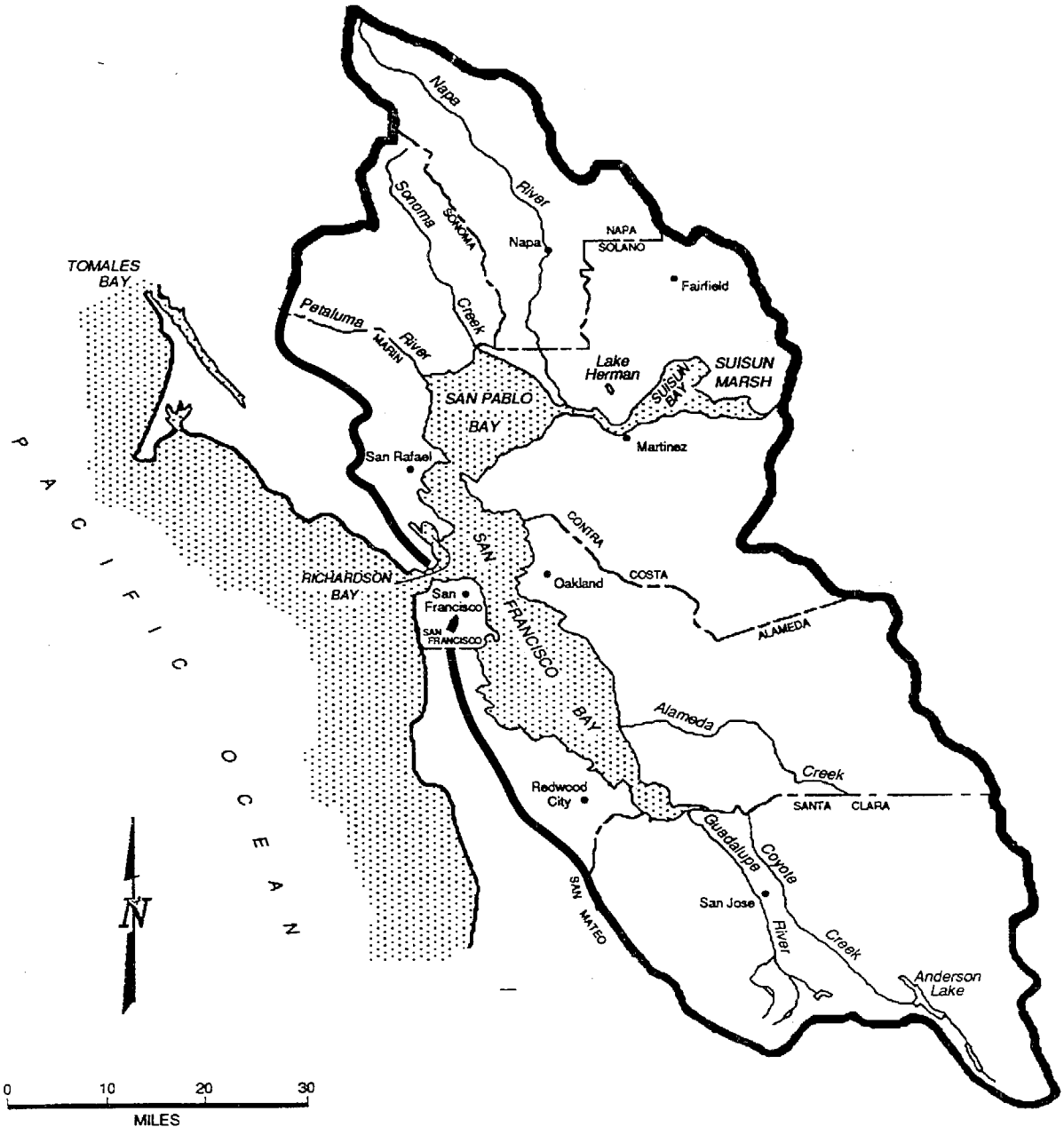


**FIGURE 3-3 Boundary of the San Francisco Bay Basin**
**(From: SWRCB, 3, 12)**




MAP0022

Unimpaired flow could also be defined as the present-day conditions if all storage and diversion were to cease. It is not a measure of natural or historic conditions (T,II,114:2-15).

- Historic Flow Conditions -- the flow conditions that actually occurred over the historic hydrological period and were measured at various locations in the Central Valley Basin using flow measuring devices. These flows reflect upstream impoundments, use or diversions of runoff under the existing upstream storage, and channel configuration at the time of measurement.

- Present Level Flow Conditions--the historic flow conditions that have been adjusted to reflect the present level-of-development reservoir operations, consumptive demands and Delta Plan standards or, where appropriate, the recent historic flow conditions from 1972 to the present. Present level-of-development flows are those estimated by DWR's 1990 level-of-development operations study. The Operations Study, which is conducted using DWR's Planning Simulation Model (DWRSIM), uses the hydrologic sequence of flows for the years 1922 through 1978. The 1972 to present historical flows represent the conditions under recent levels of water resource development. Compared with the pre-1972 development, the water resources development within the Bay-Delta watershed has been relatively minor since 1972. New Melones Reservoir, which became operational in 1978, and increasing Delta exports over these years are notable exceptions (SWRCB,3,8).

## 3.2 Water Year Types

### 3.2.1 Classifying Water Years for a Basin

Water Year (WY) classification systems provide relative estimates of the amount of water originating in a basin from rainfall and snowmelt runoff, and ground water accretion which is available to meet all demands.

This Plan improves the WY classification system used in the 1978 Delta Plan. The new classification system includes consideration of water availability from storage facilities as well as seasonal runoff.

Modified Water Year Classification System

This new WY classification uses the forecasted unimpaired runoff in millions of acre-feet (MAF) from two separate periods of the current water year (April through July and October through March) and a third parameter which accounts for the effects of reservoir storage, in order to determine the runoff classification for any particular year. This new method was used to develop the modified Sacramento Four River Index (Figure 3-4). Refer to Appendix 3.1 for an expanded description of the components of the new classification.

## FIGURE 3-4
## Sacramento Valley
## Water Year Hydrologic Classification

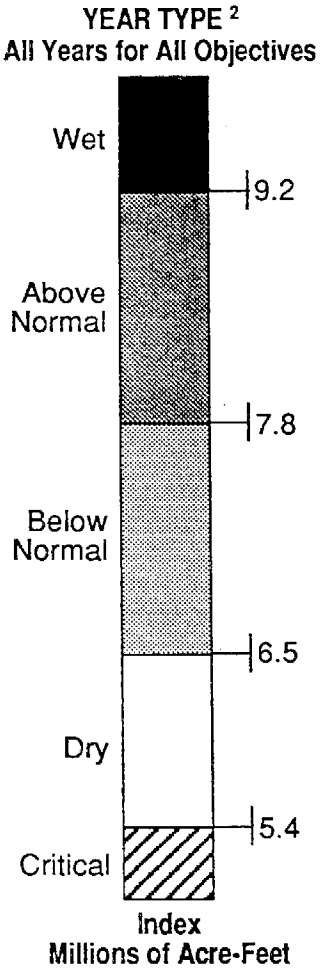
Year classification shall be determined by computation of the following equation:

**INDEX = 0.4 * X + 0.3 * Y + 0.3 * Z**

Where:
- X = Current years April – July Sacramento Valley unimpaired runoff
- Y = Current October – March Sacramento Valley unimpaired runoff
- Z = Previous years index [1]

The Sacramento Valley unimpaired runoff for the current water year (October 1 of the preceding calendar year through September 30 of the current calendar year) as published in California Department of Water Resources Bulletin 120 is a forecast of the sum of the following locations: Sacramento River above Bend Bridge, near Red Bluff; Feather River, total inflow to Oroville Reservoir; Yuba River at Smartville; American River, total inflow to Folsom Reservoir. Preliminary determinations of year classification shall be made in February, March, and April with final determination in May. These preliminary determinations shall be based on hydrologic conditions to date plus forecasts of future runoff assuming normal precipitation for the remainder of the water year.

| Classification | Index Millions of Acre-Feet |
|---|---|
| **Wet** | Equal to or greater than 9.2 |
| **Above Normal** | Greater than 7.8 and less than 9.2 |
| **Below Normal** | Equal to or less than 7.8 and greater than 6.5 |
| **Dry** | Equal to or less than 6.5 and greater than 5.4 |
| **Critical** | Equal to or less than 5.4 |




[1] A cap of 10.0 MAF is put on the previous years index (Z) to account for required flood control reservoir releases during wet years.

[2] The year type for the preceding water year will remain in effect until the initial forecast of unimpaired runoff for the current water year is available.

CHA0040R3

3.2.1.1 Sacramento Basin Index Description

The modified classification splits the index into three terms. The form of the index equation is as follows:

$$Index = C1*X + C2*Y + C3*Z$$

Where:

C1, C2, and C3 are weighting coefficients of 0.4, 0.3 and 0.3, respectively.

And:

X = April through July Four River Unimpaired Flow (MAF)
Y = October through March Four River Unimpaired Flow (MAF)
Z = Previous year's WY index (MAF) having a maximum cap value of 10 MAF.

Division of the index into three terms recognizes that there are distinct differences in seasonal contribution to water availability and accounts for reservoir carryover storage. The April-through-July period's runoff (factor X) is the most important contribution to water availability. The runoff contribution during October through March (factor Y) is less important due to flood control limitations on available reservoir storage space. The previous year's index (factor Z) is important because it accounts for carryover reservoir storage. A maximum value or cap of 10 MAF expressed in the third term sets a maximum level of the previous year's hydrology that can be maintained as carryover storage due to the limitations of total reservoir capacity and the requirement to maintain a flood control reservation space.

Water Year Classification Breakpoints

The method used to determine the index breakpoints that define the boundaries of the five water year types in the Delta Plan was also used to determine the breakpoints for this modified approach. This method is discussed in Appendix 3.1.

Regression Results

Table 3-1 lists some of the regression results of these statistical analyses. These results indicate that breaking the index into two separate hydrologic periods and adding the effect of the previous year's hydrology enhances the index's predictability.

TABLE 3-1
SELECTED RESULTS OF THE STATISTICAL ANALYSIS TO DETERMINE OPTIMAL WEIGHTING COEFFICIENTS

| Classification[1/] | Weighting Coefficients(%) | R Squared Value |
|---|---|---|
| Proposed Modified | 40 -- 30 -- 30 w/cap. | .85[2/] |
| Selected Alternatives | 40 -- 20 -- 40 | .88 |
| | 40 -- 30 -- 30 | .87 |
| Delta Plan w/new BP[3/] | 33 -- 67 -- 00 | .74 |
| April through July | 100 -- 00 -- 00 | .66 |

3.2.1.2 San Joaquin Basin Index

Because of the differences in hydrology between the Sacramento and San Joaquin basins, a separate San Joaquin River Basin classification is needed.

The tools that were used in developing the Sacramento Basin Index were not available to develop an index for the San Joaquin Basin. These tools, a San Joaquin River Basin Operations Model and data base, recently became available. Development of the San Joaquin Basin Classification will soon begin. An example of a possible San Joaquin River Basin Classification using Sacramento River Basin coefficients is shown in Figure 3-5.

3.2.1.3 Eastside Basin

A separate classification for the Eastside Basin was not developed. The contribution to the Delta from the eastside rivers, the Cosumnes, Mokelumne and the Calaveras, is small compared to the Sacramento and San Joaquin Basins. Based on information that indicates the hydrologies of the Eastside Basin and the Sacramento Basin are similar (DWR,1,1-2;1978 D-1485 Hearing exhibit), the Sacramento Basin WY classification was also applied to the Eastside Basin.

3.2.1.4 Adjustments to Water Year Classification

In the 1978 Plan classification, two adjustments were created to account for unusual hydrologic conditions: a second classification for a year which follows a critical year, and a sub-normal snowmelt adjustment.

The "year following critical year" classification was developed to account for the effects that depleted reservoir and ground water storage have on the ability of project operations to meet their demands. Because the effects of previous year's conditions are included in the third term of the 40-30-30 Index, the "year following critical year" adjustment is not necessary. The "year following critical year" adjustment applies only to fish and wildlife standards.

*1/ All classifications except proposed modified have no cap on third term.*

*2/ The R squared value for the Proposed Modified and Selected Alternatives classifications are very similar, with the values for the latter being slightly higher. It was the consensus of the subworkgroup that the 40-30-30 W/CAP Index was the preferable index.*

*3/ Breakpoint (BP), or threshold values are revised to reflect 1906 -- 1987 hydrology.*

**FIGURE 3-5**
**San Joaquin Valley**
**Water Year Hydrologic Classification [1]**

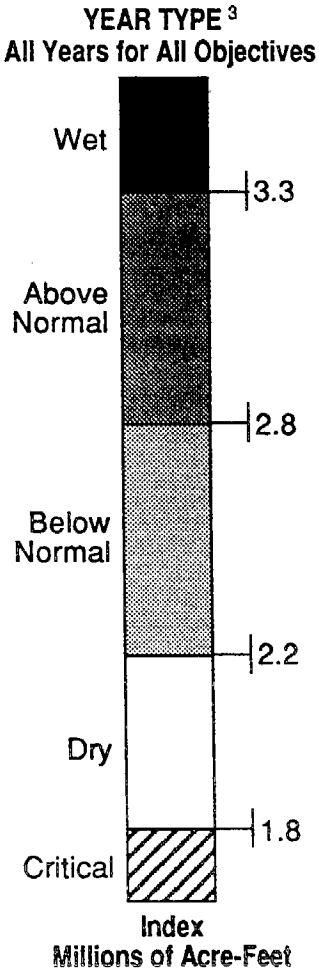
Year classification shall be determined by computation of the following equation:

**INDEX = 0.4 * X + 0.3 * Y + 0.3 * Z**

Where:
X = Current years April – July San Joaquin Valley unimpaired runoff
Y = Current October – March San Joaquin Valley unimpaired runoff
Z = Previous years index [2]

The San Joaquin Valley unimpaired runoff for the current water year (October 1 of the preceding calendar year through September 30 of the current calendar year) as published in California Department of Water Resources Bulletin 120 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. Preliminary determinations of year classification shall be made in February, March, and April with final determination in May. These preliminary determinations shall be based on hydrologic conditions to date plus forecasts of future runoff assuming normal precipitation for the remainder of the water year.

| **Classification** | **Index Millions of Acre-Feet** |
|---|---|
| **Wet** | Equal to or greater than 3.3 |
| **Above Normal** | Greater than 2.8 and less than 3.3 |
| **Below Normal** | Equal to or less than 2.8 and greater than 2.2 |
| **Dry** | Equal to or less than 2.2 and greater than 1.8 |
| **Critical** | Equal to or less than 1.8 |




[1] This is example of the San Joaquin River Basin classification using Sacramento River Basin coefficients. When the San Joaquin Basin operations model is finished the San Joaquin River Basin classification will be developed using the same analytical techniques used for the Sacramento River Basin.

[2] A cap of 4.0 MAF is put on the previous years index (Z) to account for required flood control reservoir releases during wet years.

[3] The year type for the preceding water year will remain in effect until the initial forecast of unimpaired runoff for the current water year is available.

The subnormal snowmelt adjustment was developed to account for years having spring runoff from snowmelt much less than expected. In the current objectives, the adjustment only applies to fish and wildlife flow standards. The 40-30-30 Index accounts for subnormal snowmelt from a water supply aspect but not from a level of protection aspect (when linked to the current flow standards in D-1485). The application of the 40-30-30 Index to determine the effects of various alternatives is discussed in Chapter 6, Section 6.2.1B.

#### 3.2.1.5 Differences in Classification

The differences between the current and modified WY classifications for the Sacramento Basin are shown in Table 3-2. Two differences make these classifications not strictly comparable. First, the periods of the databases that were used to develop these classifications are not the same --1922-71 was used for the current classification used in the 1978 Delta Plan, and 1906-88 was used for the modified classification. This difference causes a shift in the threshold values. Second, where the current classification modifies the year type for subnormal snowmelt years and years following critical years, the modified classification does not. Together, these differences between the two classifications seem to show that the modified classification shifts the average classification to a drier condition. If, however, the conditions discussed above are accounted for in this comparison, the averages of these two classification systems are very similar. For the Sacramento River Basin (Table 3-2), as an example, about 35 percent of the years are classified by both systems as wet; about 33 percent as above normal, below normal (or below normal with subnormal snowmelt); and about 31 percent as dry or critical.

# TABLE 3-2
# SACRAMENTO RIVER BASIN:

## COMPARISON OF PROPOSED MODIFIED 40-30-30 AND DELTA WATER YEAR CLASSIFICATION

| WATER YEAR | DELTA PLAN CLASSIFICATION | INDEX 40-30-30 | WATER YEAR | DELTA PLAN CLASSIFICATION | INDEX 40-30-30 |
|---|---|---|---|---|---|
| 1906 | W | W | 1948 | AN | BN * |
| 1907 | W | W | 1949 | D | D |
| 1908 | BN/SS | BN * | 1950 | BN | BN |
| 1909 | W | W | 1951 | W/SS | AN * |
| 1910 | W | W | 1952 | W | W |
| 1911 | W | W | 1953 | W | W |
| 1912 | D | BN * | 1954 | AN | AN |
| 1913 | BN | D * | 1955 | D | D |
| 1914 | W | W | 1956 | W | W |
| 1915 | W | W | 1957 | BN | AN * |
| 1916 | W | W | 1958 | W | W |
| 1917 | AN | AN | 1959 | D | BN * |
| 1918 | D | D | 1960 | BN/SS | D * |
| 1919 | BN | BN | 1961 | D | D |
| 1920 | C | C | 1962 | BN | BN |
| 1921 | W | AN * | 1963 | W | W |
| 1922 | AN | AN | 1964 | D | D |
| 1923 | BN | BN | 1965 | W | W |
| 1924 | C | C | 1966 | BN/SS | BN * |
| 1925 | AN | D * | 1967 | W | W |
| 1926 | D | D | 1968 | BN/SS | BN * |
| 1927 | W | W | 1969 | W | W |
| 1928 | AN/SS | AN * | 1970 | W/SS | W * |
| 1929 | C | C | 1971 | W | W |
| 1930 | BN/D | D * | 1972 | BN/SS | BN * |
| 1931 | C | C | 1973 | W | AN * |
| 1932 | BN/D | D * | 1974 | W | W |
| 1933 | C | C | 1975 | AN | W * |
| 1934 | C | C | 1976 | C | C |
| 1935 | AN | BN * | 1977 | C | C |
| 1936 | AN | BN * | 1978 | W | AN * |
| 1937 | BN | BN | 1979 | D | BN * |
| 1938 | W | W | 1980 | W | AN * |
| 1939 | C | D * | 1981 | D | D |
| 1940 | W/AN | AN * | 1982 | W | W |
| 1941 | W | W | 1983 | W | W |
| 1942 | W | W | 1984 | W/SS | W * |
| 1943 | W | W | 1985 | D | D |
| 1944 | D | D | 1986 | W/SS | W * |
| 1945 | BN | BN | 1987 | C | D * |
| 1946 | AN | BN * | 1988 | C | C |
| 1947 | D | D | 1989 | | |

* Indicates year type has changed from Delta Plan year type

# 4.0 BENEFICIAL USES OF BAY-DELTA ESTUARY WATER

## 4.1 Introduction

The beneficial uses of Bay-Delta water are presented here in summary form. For a detailed account, see Appendix 4.0, Beneficial Uses of Bay-Delta Estuary Water.

## 4.2 Beneficial Uses

| | |
|---|---|
| Agricultural Supply (AGR) | Includes crop, orchard and pasture irrigation, stock watering, support of vegetation for range grazing and all uses in support of farming and ranching operations. [SWRCB, Standard Beneficial Uses, Management Memorandum No. 20, March 1973] |
| Cold Fresh-Water Habitat (COLD) | Provides a coldwater habitat to sustain aquatic resources associated with a coldwater environment. [SWRCB, Standard Beneficial Uses, Management Memorandum No. 20, March 1973] |
| Estuarine Habitat (EST) | Provides 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. [RWQCB2, Water Quality Control Plan, San Francisco Bay Basin (2), December 1986] |
| Fish Migration (MIGR) | Provides a migration route and temporary aquatic environment for anadromous or other fish species. [SWRCB, Standard Beneficial Uses, Management Memorandum No. 20, March 1973] |
| Fish Spawning (SPWN) | Provides a high quality aquatic habitat especially suitable for fish spawning. [SWRCB, Standard Beneficial Uses, Management Memorandum No. 20, March 1973] |
| Groundwater Recharge (GWR) | Natural or artificial recharge for future extraction for beneficial uses and to maintain salt balance or halt saltwater intrusion into freshwater aquifers. [SWRCB, Standard Beneficial Uses, Management Memorandum No. 20, March 1973] |

| | |
|---|---|
| Industrial Process Supply (PROC) | Includes process water supply and all uses related to the manufacturing of products. [SWRCB, Standard Beneficial Uses, Management Memorandum No. 20, March 1973] |
| Industrial Service Supply (IND) | Includes uses which do not depend primarily on water quality such as mining, cooling water supply, hydraulic conveyance, gravel washing, fire protection and oil well repressurization. [SWRCB, Standard Beneficial Uses, Management Memorandum No. 20, March 1973] |
| Municipal and Domestic Supply (MUN) | Includes usual uses in community or military water systems and domestic uses from individual water supply systems. [SWRCB, Standard Beneficial Uses, Management Memorandum No. 20, March 1973] |
| Navigation (NAV) | Includes commercial and naval shipping. [SWRCB, Standard Beneficial Uses, Management Memorandum No. 20, March 1973] |
| Non-Contact Water Recreation (REC-2)[1] | Recreational uses which involve the presence of water but do not require contact with water, such as picnicking, sunbathing, hiking, beachcombing, camping, pleasure boating, tidepool and marine life study, hunting and esthetic enjoyment in conjunction with the above activities as well as sightseeing. [SWRCB, Standard Beneficial Uses, Management Memorandum No. 20, March 1973] |
| Ocean Commercial and Sport Fishing (COMM) | The commercial 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. [SWRCB, Standard Beneficial Uses, Management Memorandum No. 20, March 1973] |

*1/ OHS has recently (10/24/90) suggested different language and three separate parts, Rec. 1, 2 and 3.*

| | |
|---|---|
| Preservation of Rare and Endangered Species (RARE) | Provides an aquatic habitat necessary, at least in part, for the survival of certain species established as being rare and endangered species. [SWRCB, Standard Beneficial Uses, Management Memorandum No. 20, March 1973] |
| Shellfish Harvesting (SHELL) | The collection of shellfish such as clams, oysters, abalone, shrimp, crab and lobster for either commercial or sport purposes. [SWRCB, Standard Beneficial Uses, Management Memorandum No. 20, March 1973] |
| Warm Fresh-Water Habitat (WARM) | Provides a warm-water habitat to sustain aquatic resources associated with a warmwater environment. [SWRCB, Standard Beneficial Uses, Management Memorandum No. 20, March 1973] |
| Water Contact Recreation (REC-1) | Includes all recreational uses involving actual body contact with water, such as swimming, wading, waterskiing, skin diving, surfing, sport fishing, uses in therapeutic spas, and other uses where ingestion of water is reasonably possible. [SWRCB, Standard Beneficial Uses, Management Memorandum No. 20, March 1973] |
| Wildlife Habitat (WILD) | Provides a water supply and vegetative habitat for the maintenance of wildlife. [SWRCB, Standard Beneficial Uses, Management Memorandum No. 20, March 1973] |

# 5.0 ALTERNATIVE LEVELS OF PROTECTION FOR BENEFICIAL USES OF BAY-DELTA ESTUARY WATER

**Conclusions: WATER QUALITY OBJECTIVES**

- **There are numerous influences on the Estuary's beneficial uses. Some are not fully defined, including the impacts of commercial and sport fishing (legal and illegal), the adverse effects of accidentally introduced species (e.g., the clam Potamocorbula amurensis), and the possible problems with genetic alteration in fish resulting from reliance on hatcheries. There are also known harmful effects from toxic materials, dredging, structures, and others, on the health of the aquatic habitats in the Bay-Delta Estuary.**

## 5.0.1 Overview

Chapter 4 and Appendix 4.0 identified the beneficial uses of Bay-Delta waters. In this chapter, the evidence supporting these uses is analyzed. Where the data are determined to be both appropriate and adequate to develop water quality objectives and the issue is within the scope of this Plan, potential objectives are established.

The water quality objectives in the Delta Plan were adopted in 1978. Water Rights Decision 1485 (D-1485) was adopted at the same time as the primary way to implement the Delta Plan. While water quality objectives for the southern Delta were included in the Delta Plan, they were not part of D-1485 and therefore have not been implemented. Water quality objectives in Suisun Marsh were set but consideration of alternative objectives proposed in the Suisun Marsh Preservation Agreement (SMPA) is pending (see 5.10). All of these matters are time consuming since they require substantial funds from the state and federal government, construction of physical facilities, and subsequent testing of these facilities to ensure that the desired objectives can be achieved.

Water quality objectives for parts of San Francisco Bay other than the Suisun Marsh were not adopted in the Delta Plan. Development of objectives for the south Delta will commence upon receipt of a negotiated agreement between the South Delta Water Agency (SDWA), USBR, and DWR.

The "estuarine habitat" beneficial use designation, for the purposes of this Plan, is broken down into various components, such as specific fisheries and fish protective habitat, to develop protection for those components addressed during the Phase I hearing. Further, there are several designated beneficial uses addressed in the Basin Plans of Regions 2 and 5 for which the State Board received evidence. However, that evidence did not indicate that salinity, temperature or dissolved oxygen would affect the beneficial uses of either contact or non-contact recreation or navigation. Therefore, even though discussed in this Plan, salinity, temperature and dissolved oxygen objectives are not proposed for these beneficial uses.

Specific water quality objectives have been developed for designated beneficial uses. In the case of estuarine habitat, the State Board has identified certain areas and life stages for the protection of specific fish species. These objectives, the State Board believes, will provide protection for other species until more appropriate measures are developed. The following uses are designated as beneficial uses to be specially protected by objectives in this Plan: (See Chapter 4 for more details)

| USE | AREA |
|---|---|
| Municipal and Industrial (ind, proc, mun, gwr) | San Francisco Bay-Delta, Export Area |
| Agriculture (agr) | Delta, Export Area |
| Estuarine Habitat (est, migr, spwn, cold, warm, comm) | |
| Chinook Salmon (fall and winter run) | Delta |
| Striped Bass | Delta |
| Marsh Resource | Suisun Marsh |

5.0.2 Hydrologic Considerations

Salinity at any particular location in the Delta is dependent upon Delta inflows, agricultural drainage return flows, consumptive uses, exports, tidal stage and the operation of the Delta Cross-Channel gates. The southern Delta is almost exclusively influenced by the San Joaquin River. The internal Delta, on the other hand, is influenced to some degree by both river systems, especially when Delta exports are high. For the purpose of considering river effects on the beneficial uses discussed in this chapter, all of the Estuary locations were considered to be part of the hydrologic classification of the Sacramento River system, except for the following which were considered to receive water from the San Joaquin River system: San Joaquin River at Vernalis, at Mossdale, at Rough and Ready Island, at Buckley Cove, and at the former location of Brandt Bridge; the bifurcation of Old and Middle River; Middle River at Howard Road Bridge; and Old River at Tracy Road Bridge.

5.0.3 Alternative Levels of Protection for Beneficial Uses

The following sections describe alternative levels of each protection for beneficial use in categories:

1. Present Conditions -- The current water quality conditions. These are usually reflected in the requirements set forth in D-1485 as amended or in a few cases more protective requirements contained in agreements between Delta interests and certain water projects. In many cases quality is better than objectives because of uncontrolled flow.

2. State Board Considerations -- State Board analysis of existing objectives, advocated levels of protection, any additional data obtained from agencies with appropriate expertise (e.g., DFG), peer reviewed literature, etc.

3. Potential Objectives -- Appropriate Alternatives proposed for each beneficial use. These potential objectives are further analyzed for economic and environmental effects in Chapter 6.

Levels of Protection advocated by the various parties are contained in Appendix 5.0, under the heading Advocated Levels of Protection. A matrix of the present, advocated and proposed potential objectives concludes the chapter (Table 5-5, Alternative Water Quality Objectives).

## 5.1 Municipal and Industrial

**Conclusions: Salinity Requirements**

- **For all municipal and industrial intakes within the Bay-Delta Estuary, the Board adopts the 250 mg/l chloride (salinity) objective which is the secondary standard for aesthetics (taste) and corrosion established by the Department of Health Services. However, additional salinity protection may be needed in some areas to protect drinking water supplies from disinfection by-products (DBPs).**

- **The D-1485 objective of 150 mg/l chloride at the Contra Costa Water District's Rock Slough intake protects the municipal and industrial beneficial uses in Contra Costa County and provides benefits to the municipal supplies exported from the Delta. If and when substantial additional storage capacity is built or other information is developed, this objective and its monitoring location will be reviewed. Meanwhile, deleting the 150 mg/l chloride objective in D-1485 could result in increased bromide concentrations and increased salinity and consumer complaints due to the salty taste in water.**

### 5.1.1 Present Conditions - (Salinity and Sodium)

Municipal and Industrial (M&I) use is currently protected by standards specified in the 1978 Delta Plan or D-1485 (in this Plan referred to as D-1485 or current objectives) (see Table 5-5). The 250 mg/l (maximum) chlorides level of protection considered adequate to protect municipal uses is based on the secondary standard for aesthetics (taste) and corrosion set by the Department of Health Services (DHS) and adopted by the Board in 1978 as being in the public interest.

The present objective of 150 mg/l chlorides was established at the Contra Costa Canal Intake during a portion of the year, depending on water year type, in order to protect industrial uses. This standard was intended to protect the historical water supply of two paper manufacturers in the Antioch area by providing a salinity necessary to maintain the quality of industry products. In adopting this standard the State Board recognized that it also provided better water quality to municipal customers.

### 5.1.2 State Board Considerations

Chlorides

The D-1485 objectives, with the inclusion of a MUN objective at Barker Slough and a conditional MUN objective at Cache Slough, sufficiently protect M&I uses (see Table 5-5).

MUN use is protected with respect to salinity, and taste and odor by the 250 mg/l chloride drinking water standard.

Industrial use is protected by the D-1485 150 mg/l periodic chloride objective at Rock Slough and Antioch. Industries requiring water quality of 150 mg/l chloride or less are negotiating with DWR to obtain alternative sources of high quality water; negotiations have been successful, although one industry is still negotiating with DWR. The negotiations to eliminate this objective have not been concluded; this is one reason that this objective will be maintained.

The 50 mg/l objective recommended for blending purposes for MUN use is addressed in the following section on trihalomethanes.

Because the North Bay Aqueduct diversion point is at Barker Slough and the old diversion point at Cache Slough will be used on occasion as an alternative point of diversion, objectives will be needed at both of these diversion points.

Sodium

Another issue related to salinity involves the consumption of sodium. Diets high in sodium, especially for people with a history of cardiovascular problems, can contribute to such problems. Some participants in the hearing suggested a sodium objective be adopted to protect against such concerns. Others were concerned that water containing high levels of sodium may reduce the efficiency of dialysis machines. The information presented to the State Board shows that sodium contained in drinking water represents a very small portion of normal daily sodium intake. People on restricted sodium diets should consult their physician and dietitian to revise their diet based on their local water supply or in rare cases consider bottled water low in sodium.

These sodium issues were all debated before adoption of D-1485. No new information was presented compelling a specific sodium objective. Concerns involving sodium levels can be resolved by achieving the 250 mg/l chloride objective in Delta waters or special action by health professionals.

5.1.3 Potential Objectives

No change (see Table 5-5).

5.2 Trihalomethanes (THMs) and other Disinfection By-Products (DBPs)

**Conclusions:**

- **Delta water at times contains bromides (often measured via correlations with chlorides) and organic substances which, upon disinfection, increase the risk of forming by-products (including trihalomethanes (THMs)) that are human health concerns.**

- **In the Delta THM precursors come from organic carbon in Delta peat soils and from the watershed upstream. Bromides which naturally occur in ocean water and connate water exacerbate the formation of THMs upon disinfection.**

- **Existing drinking water standards are being met through a combination of source water controls and current drinking water treatment processes.**

- **If drinking water standards on DBPs are revised, the State Board will consider modifying existing salinity objectives.**

- **In the future the Board will review and weigh all factors that might result in more stringent salinity objectives for drinking water after disinfection. This includes alternative water disinfection methods.**

- **Due to the concerns with DBPs in treated water from the Delta and in keeping with the goal (not objective) of obtaining the best available drinking water, the Board finds that, whenever feasible, municipal water supply agencies should strive to obtain bromide levels of 0.15 mg/l or less (about 50 mg/l chloride in the Delta). Appropriate actions by these supply agencies include encouraging DWR and USBR to work with the SWRCB to ensure development of facilities to make maximum use of uncontrolled flows through off-stream storage, encouraging those agencies to move water supply intakes to better locations, working with the State and Regional Boards to eliminate problem discharges within the Delta, and continuing the development of alternative water treatment technologies.**

### 5.2.1 Present Conditions

Trihalomethanes (THMs) are a subset of chemicals known as disinfection by-products (DBPs) which are formed when waters are disinfected. THMs are produced when dissolved organic substances, such as fulvic and humic acids produced by decaying crop residues or peat soil in fresh or saline waters, come in contact with the oxidizing agents used to disinfect drinking water (T,VI,38:3-5; T,XLVI,99:11-19). The levels of dissolved organic materials in water are most often assumed to be represented by the total organic carbon (TOC) concentration of the water. However, since TOC is a measure of all organic carbon, not just precursor molecules, it has not been found to be a consistent predictor of THM formation potential (THMFP) in Delta waters. Bromides contribute to the production of THMs and other DBPs. Bromides enter the Delta predominantly from ocean water. Minor sources of bromides are the Sacramento, and San Joaquin rivers, and connate water.

Drinking water supplies with THMs may pose a significant problem because health effects studies have indicated that chloroform and bromoform are animal carcinogens and are suspected human carcinogens (T,VI,38:12-16;DWR,226,2). For regulatory purposes, EPA assumes that all THMs are equally toxic to humans (T,VI,46:5-7) and in 1979 adopted a water quality standard for total THMs of 100 ug/l (EPA National Primary Drinking Water Regulations, 40 CFR 141). This standard is monitored in distribution systems of domestic water supplies. Sampling is performed at three month intervals and compliance is based upon a running average of four samples (T,XLVI,118:1-5). The EPA THM maximum contaminant level (MCL) applies to

treated drinking water, rather than to sources of water, such as the Delta. D-1485 did not include any water quality objective for THMs. It was concluded that for public health reasons protection from THMs in water from the Delta is more properly addressed through the use of alternative water treatment techniques or relocation of problem intakes rather than through the setting of more stringent salinity or TOC objectives (Second Triennial Review of the Delta Plan, October 1984).

Data presented by the Metropolitan Water District of Southern California (MWD) show that chlorinated Delta water with postammoniation occasionally has produced finished drinking water with THM concentrations close to the present EPA water quality MCL (Krasner, 1989). In addition, it has been shown that when a water supply, such as the Delta, contains a significant concentration of bromide, THMs and DBPs can also be formed using disinfectants other than chlorine (e.g., ozone) (Delta Municipal and Industrial Water Quality Workgroup, 1989, p.4.; T,VI,44:8-45:1).

Data presented to the Delta Municipal and Industrial Water Quality Workgroup (Delta M&I Workgroup) by several researchers demonstrate that the presence of bromide exacerbates the problem of DBP formation in general, as well as the problem of THM formation. As bromide concentrations in Delta water increase, brominated forms of DBPs and THMs increase and at times dominate the total THM concentration (Krasner, 1989).

By analyzing THMFP data which were generated using a consistent set of collection and analytical techniques, it is possible to draw general conclusions regarding the sources of THMs in drinking water supplies taken from the Delta. Sources of THMFPs in Delta water appear to be ocean tidal waters, Delta organic soils and decaying crop residues, and Sacramento and San Joaquin river inflows to the Delta. One set of calculations concludes that "within-Delta" sources appear to contribute approximately 25 percent of the THMFPs in Delta water (SWC, Brief on Phase 1, February 1, 1988; p. V-7). DWR is currently conducting a study to determine the THMFP contribution to Delta water quality coming from local agricultural drainage returns (T,XLVI,83:14-84:12). To date, studies show that the mineral soils in the Delta contribute less THM precursors than the organic soils (T,XLVI,84:13-22).

If EPA's MCL for THM is lowered, it is likely that conventionally treated (chlorinated) Delta water with current inputs of total organic carbon and bromide will not be usable as a direct source of drinking water. At present, because of the correlation between chloride and bromide, when chloride concentrations exceed 100 mg/l and standard chlorination treatment is used, THM concentrations approach, but do not exceed, the current EPA THM MCL of 100 ug/l (Delta M&I Workgroup, Appendix A.10, 1989).

### 5.2.2 State Board Considerations

Information compiled by members of the Delta M&I Workgroup suggest that alternative water treatment techniques may not resolve all the concerns related to THMs. Reasons for this include:

1. The presence of bromide ions in the Delta (the majority of which come from seawater) and the inability of conventional and non-conventional treatment processes to remove either the bromide ion or the brominated forms of THMs;

2. The formation of other disinfection by-products (DBPs) which are suspected human health hazards by conventional and non-conventional water treatment processes;

3. The statement by EPA that it will be proposing maximum contaminant levels (MCLs) for disinfectants currently used to treat drinking water (e.g., chlorine and chloramines). New MCLs are also expected for DBPs. These MCLs are likely to include the DBPs formed by chlorination (e.g., trihalomethanes) as well as other oxidant DBPs.

A discussion of the three reasons mentioned above is found in Appendix 5.1, Trihalomethanes. The discussion is limited to information provided by the Delta M&I Workgroup, from the hearing record of Phase I, and to other information cited concerning formation of DBPs resulting from ozonation/chlorination treatment of drinking water.

Based on a detailed review of the information presented the State Board has concluded the following:

1. THMs, DBPs and some disinfectants (e.g., chlorine, chloramine and chlorine dioxide) currently in use present possible hazards to human health. Brominated THMs and chloroform are suspected human carcinogens.

2. EPA may be revising the total THM MCL in the near future. The revised standard may be more stringent. Under the current timetable, compliance is expected in 1994.

3. EPA is expected to set MCLs for other disinfection by-products and for disinfectants. Ranges of MCLs are unknown at this time. Under the current timetable, compliance is expected in 1994.

4. Every disinfectant currently being used produces some kind of disinfectant by-products. New treatment technologies contain technical and economic uncertainties which compound those associated with the health effects and potential regulation of disinfectant by-products.

5. The presence of bromide ions in the source water exacerbates the THM and DBP concerns. Bromide ions in the source water significantly increase levels of brominated DBPs produced by chlorination, chloramination and ozone.

6. A major source of bromide ions in Delta waters is sea water and a relationship has been documented to exist between chloride levels and bromide levels in seawater. However, the relationship between chloride and bromide levels in the Delta needs further study.

7. In addition to bromide, TOC is an important factor in the production of THMs and DBPs. Sources of TOC include seawater and estuarine water, the Sacramento River, the San Joaquin River and the Delta.

8. While the existing MCL for THMs is usually met with the current chloride objective in the Delta, concern exists that a new MCL for THMs is expected from EPA which may not be achieved without great cost to municipal users who divert from the Delta.

Solutions for the THM concern and newly recognized DBP concern do not lie solely with alternative water treatment techniques or relocation of existing intakes. Before costly and unproven steps are taken, there is urgent need for monitoring and research. Also, basic decisions by EPA are needed before objectives can be set to help address the DBP concerns which include THMs. Finally, the State Board realizes that while THMs are the DBP of current concern, further studies may indicate that other DBPs are of greater concern.

5.2.3 Potential Objectives

1. The current 150 mg/l chloride industrial objective which provides ancillary protection to municipal uses.

2. None. A water quality objective for THMFP is not appropriate at this time. The non-standardized nature of the analytical technique and the lack of a THMFP to THM correlation work together to render such a water quality objective scientifically unsound. A THM workgroup should be formed to address this, and other THM related issues (see Chapter 7.

3. A 0.15 mg/l bromide (about 50 mg/l chloride) level as advocated by the Delta M&I Workgroup. The State Board wants to examine the effects of setting such an objective. Therefore this concentration level will be identified as a "goal" for further analysis.

5.3 Agriculture

**Conclusions:**

**Western and Interior Delta Agriculture**

- **To reasonably protect crops grown in the western and interior Delta, water quality objectives were developed using corn as the representative salt-sensitive crop.**

- **Assuming improved leaching practices are used, salinities up to 1.5 mmhos/cm EC could be allowed during the irrigation season without affecting crop yield. However, the economic costs of these practices are not in the record.**

- **Until adequate economic data are available on leaching costs, the Board will maintain the existing salinity objectives.**

**Southern Delta Agriculture**

- **To reasonably protect crops grown in the southern Delta, water quality objectives were developed using beans and alfalfa as representative salt-sensitive crops.**

- **The objective of 0.7 mmhos/cm EC in the southern Delta protects beans during the summer irrigation season and the objective of 1.0 mmhos/cm EC protects alfalfa during the winter irrigation season. These objectives or other adequately protective objectives at specified locations will be implemented over time.**

  - Southern Delta

The implementation plan is comprised of two interim stages and a final stage.

Interim Stage 1 -- 500 mg/l mean monthly TDS all year at Vernalis.

Interim Stage 2 -- (to be implemented no later than 1994) 0.7 mmhos/cm EC April 1 to August 31, 1.0 mmhos/cm EC September 1 to March 31; 30-day running average at Vernalis and Brandt Bridge, with water quality monitored at three current interior stations -- Mossdale, Old River, near Middle River and Tracy Road Bridge; and an additional interior monitoring station on Middle River at Howard Road Bridge.

Final Stage -- (to be implemented no later than 1996)
0.7 mmhos/cm EC April 1 to August 31, 1.0 mmhos/cm EC September 1 to March 31; 30-day running average at Vernalis and Brandt Bridge on the San Joaquin River, with two interior stations at Old River near Middle River and Old River at Tracy Road Bridge. Monitoring stations will be at Mossdale at head of Old River and Middle River at Howard Road Bridge.

or

If a three-party contract has been implemented among DWR, USBR and the SDWA, that contract will be reviewed prior to implementation of the above and, after also considering the needs of other beneficial uses, revisions will be made to the objectives and compliance/monitoring locations noted above, as appropriate.

5.3.1 Present Conditions

5.3.1.1 Western Delta

In D-1485, an agricultural water quality objective with a base level of 0.45 mmhos/cm EC was set for applied water in the western Delta. This objective is based upon estimates presented in the University of California exhibits. The information provided estimates of the quality needed to provide 100 percent corn yield in this region's subirrigated organic soil (1978 Delta Plan, UC ex. 1,2, and 8). On varying dates during the irrigation season, depending on year type, this objective is adjusted to a lower quality. This adjustment is made for all water year types except wet years at Emmaton and Jersey Point, and above normal years at Jersey Point. The amount of the adjustment is based on the time-weighted average of water quality over the period April 1 to August 15 for conditions that would exist without the CVP and the SWP (without project conditions).

5.3.1.2 Interior Delta

The D-1485 agricultural water quality objectives for the interior Delta uses the same estimates as the western Delta. However, under "without project" conditions, water quality in the interior Delta during the irrigation season was better than in the western Delta. Therefore, water year type adjustments for the interior Delta were smaller.

Table 5-5 lists western and interior Delta water quality objectives used as the present condition objectives.

5.3.1.3 Southern Delta

Three requirements primarily control current agricultural conditions in the southern Delta. These are:

- o Regional Water Quality Control Board 5 Basin Plan (Basin 5 Plan)
- o State Water Resources Control Board Decision 1422
- o The terms of the draft contract for settling litigation brought by the SDWA against the USBR and DWR.

Current controlling conditions are set by the Basin 5 Plan objective for southern Delta agriculture (Table 5-5). This objective provides that "[i]n the San Joaquin River near Vernalis, the mean average TDS concentration shall not exceed 500 mg/l over any consecutive 30-day period" (Basin 5 Plan). This objective is set forth in Water Right Decision 1422 (New Melones Decision) (Table 5-5). Upon completion of the New Melones Reservoir the Bureau was required to meet the Basin 5 Plan objective with the necessary reservoir releases (SWRCB Decision 1422, April 1973).

This objective has not always been met, particularly in the recent years of drought. South Delta Water Agency and USBR have agreed on a number of occasions to release the limited supply from New Melones in a pattern which causes the objective to be violated at certain times of year, in order to preserve the dilution capability for more critical periods.

The USBR, SDWA and DWR entered into the Framework Agreement in October 1986 in an attempt to settle litigation brought by SDWA against the USBR and DWR. Since that time the parties have negotiated a proposed contract to settle the SDWA litigation. The proposed contract was agreed to by DWR's Director, USBR's Director of the Mid-Pacific Regional Office and SDWA's Board of Directors in August 1990. Each party also has its own approval process that must take place before the contract is fully executed.

5.3.2 State Board Considerations

Table 5-1 presents selected information concerning salt threshold and yield levels for sensitive and moderately sensitive surface irrigated crops grown on mineral soils (DWR,328). The salt threshold for a particular crop is the level below which no loss in yield is experienced due to soil salinity conditions.

TABLE 5-1

DELTA SERVICE AREA CROP SALT SENSITIVITY
(DWR,328)

| Crop | Crop Salt Sensitivity | |
|---|---|---|
| | Threshold ECe[1] | Incremental Loss[2] |
| **Sensitive Crops** | | |
| Beans | 1.0 | 19% |
| Onion | 1.2 | 16% |
| **Moderately Sensitive Crops** | | |
| Fruits & Nuts | | |
| Almonds | 1.5 | 19% |
| Apricots | 1.6 | 24% |
| Peaches | 1.7 | 21% |
| Grapes | 1.5 | 9.6% |
| Corn | 1.7[3] | 12% |
| Corn (subirrigated, organic soil) | 2.1 | 20.2% |
| Potatoes | 1.7 | 12% |
| Miscellaneous Truck Crops | | |
| Carrots | 1.0 | 14% |
| Lettuce | 1.3 | 13% |
| Cabbage | 1.8 | 9.7% |
| Broccoli | 2.8 | 9.2% |
| Alfalfa | 2.0 | 7.3% |
| Tomatoes | 2.5 | 9.9% |
| Sudan | 2.8 | 4.3% |
| Rice | 3.0 | 12% |

[1] *ECe means Electrical Conductance of the soil saturation extract, reported as deciSiemens per meter (dS/m). With the exception of corn, which has both organic and mineral values, all crop values are based on mineral soil sensitivity.*

[2] *Loss in Yield per Unit Increase in dS/m Beyond Threshold.*

[3] *This tolerance of corn shown is for corn grown on a mineral soil using conventional methods of surface irrigation (furrow or sprinklers). The Delta corn trials (a.k.a. Corn Study) (reported by Hoffman et al., 1983) indicated that subirrigated corn has a slightly higher salt tolerance when grown on Delta peat soils. It is reported to be ECe=2.1 dS/m, or 23 percent higher. This is probably due to the higher water content of the peat. The usual tolerance (for mineral soils) can be multiplied by a factor of 1.23 to obtain tolerance of similar crops grown on subirrigated organic soils.*

5.3.2.1&2 Western and Interior Delta

Protection for western and interior Delta agriculture is primarily based on the protection of corn grown on organic subirrigated soil.

In this region corn is a major salt-sensitive crop. Corn is grown on more than 21 percent of the total Delta land area, including more than 26 percent of the Delta lowlands (DWR,304). To help ensure a reasonable level of protection for agriculture in the western and interior Delta, the following information on leaching practices is needed:

(1) The effects of irrigation and leaching water quality on crop yield,
(2) The economics of implementing leaching practices, and
(3) The practicality of implementing leaching practices and their effectiveness.

Based on results from the Corn Study and the subworkgroup on western and interior Delta agriculture, it appears that corn can be grown and maintained with saltier water than proposed in D-1485; however, controlled leaching would be required periodically. The controlled leaching would be in addition to any leaching effect from rainfall and winter ponding. (See Appendix 5.2, Analysis of Corn Study to Variations in Applied Water and Leach Water Salinity). Information on the effectiveness, practicality, and the economics of such leaching needs field demonstration. Until this information is obtained, the D-1485 objectives will be continued for the protection of western and interior Delta agriculture.

5.3.2.3 Southern Delta

Beans and alfalfa, the two most widely grown salt-sensitive crops in the southern Delta, were chosen as target crops for the purpose of setting objectives. Meeting the objectives for these crops will protect the less salt-sensitive crops. In developing objectives for beans and alfalfa, the evidence and exhibits from the Phase I hearings, information from the DWR-sponsored South Delta Agriculture Subworkgroup, and the southern Delta negotiations were taken into consideration.

Within the subworkgroup, three key issues were discussed that influence the level of salinity required for the protection of beans and alfalfa: crop response during the early stages of growth, the determination of leaching fractions[1] and the effectiveness of rainfall in reducing soil salinity during the irrigation season. The members of the subworkgroups have been unable to reach consensus. The State Board will base its analysis on the University of California's "Guidelines for The Interpretation of Water Quality for Agriculture" and the Delta Plan (1978, Delta Plan, UC ex.D).

The subject of agricultural objectives for the southern Delta should consider ongoing negotiations between DWR, USBR, and SDWA. Care should be exercised in setting objectives so as not to undermine negotiations but to bring the negotiations to a timely and fruitful conclusion. Any agreement resulting from the negotiations will be reviewed by the State Board before the objectives are revised to reflect those contained in the agreement.

*1/ Leaching fraction is that fraction of the total amount of applied water that passes through a crop root zone (SWRCB,29,2).*

5.3.2.4 San Francisco Bay

No data have been presented nor a need demonstrated to protect agriculture in the San Francisco Bay area. Therefore, no alternatives are being considered for Bay agriculture in this Water Quality Control Plan.

5.3.3 Potential Objectives

5.3.3.1 Western and Interior Delta

No change (see Table 5-5).

5.3.3.2 Southern Delta

A staged implementation of objectives is one alternative. For the reasons stated under "State Board Considerations" it is the only alternative to the existing objective which will be carried forward. The staged implementation plan, which contains two interim stages and a final stage, is discussed in Chapter 7, Program of Implementation. The objectives for the final stage are presented in Table 5-5.

The final stage (to be implemented by 1996) will be 0.7 mmhos/cm EC April 1 to August 31 and 1.0 mmhos/cm EC September 1 to March 31; 30-day running average at Vernalis, Brandt Bridge, Old River near Middle River, and Tracy Road Bridge.

In the final stage of the phased Plan, the State Board will consider requiring full implementation of water quality objectives as set forth in the 1978 Delta Plan for the southern Delta area. Also, any agreement affecting south Delta water quality will be fully reviewed by the State Board prior to implementation of the final stage. The objectives and locations at that time may be revised as the State Board deems appropriate.

5.4 Fish and Wildlife Beneficial Uses

**Conclusions:**

- **The State Board supports the natural perpetuation of species affected by water and water quality. It is the policy of the state to significantly increase the natural production of salmon by the end of this century.**
- **Because of the amounts of data, past practices and public perception, striped bass and Central Valley Chinook salmon will be given separate consideration in the development of water quality objectives.**
- **Fish hatcheries for some species are a management tool that will be evaluated for their benefit and operation within the watershed during subsequent phases of the Bay-Delta proceedings.**

- **With respect to temperature and salinity, the objectives set in this Plan protect selected estuarine habitat beneficial uses. There is insufficient information in the record to set specific salinity and temperature objectives for the protection of Delta smelt, American shad, benthos, resident fish or marine habitat outside the Estuary.**

5.4.1 Present Conditions -- Fishery Habitat Protection (Entrapment Zone) in the Bay-Delta Estuary

In recent years there have been extensive changes in the Bay-Delta Estuary area, the effects of which are not well understood. These changes include:

1. The introduction of the Asian copepod, Sinocalanus doerrii, and its apparent displacement of the native copepod, Eurytemora affinis, from the entrapment zone area (DFG,28,25-28);

2. Changes in phytoplankton bloom patterns in the Delta and Suisun Bay, with the appearance of dense blooms of the chain diatom, Melosira, in the central Delta (DFG,28,14-19);

3. Changes in Delta outflow, salinity, and rate of water exports from the Delta (DFG,20,22-25);

4. Increases in releases of water from New Melones Reservoir for interim improvement of southern Delta water quality (T,XV,21:1-9); and

5. The introduction and rapid increase in numbers and range of the Asian clam Potamocorbula and its possible adverse effects on phytoplankton and zooplankton abundance.

The largest concentrations of phytoplankton, zooplankton, and detritus are generally found in the entrapment zone, an area where suspended materials concentrate as a result of two-layered flow circulation (USBR,112). Depending upon season, the type of water year, the tidal stage, and the preceding freshwater flow patterns, the entrapment zone could occur anywhere from upstream of the mouth of the Sacramento River to San Pablo Bay. The timing of phytoplankton blooms and the size of the resulting standing crop have been directly associated with the tidally-averaged location of the entrapment zone adjacent to or just upstream of extensive shallow shoal waters (T,XLVI,44:9-11,48:6-10; CCCWA/EDF,9). The location of the entrapment zone can be approximated from specific conductance values of 2 to 10 millimhos/cm (approximately 1 to 6 parts per thousand (ppt) salinity) (CCCWA/EDF,9).

The various species of zooplankton are found at different salinities. Neomysis mercedis are most abundant in areas with surface salinities ranging from 1.2 to 4.6 ppt (CCCWA/EDF,8). As salinity intrusion decreases, Neomysis abundance increases (T,XLI,54:23-24).

Neomysis feed on a variety of phytoplankton; diatoms are the most important class eaten and are also the most abundant class in the estuary (T,XLI,54:25-55:3). Other zooplankton also constitute a significant portion of their diet (T,XLI,55:4-5). Both phytoplankton and zooplankton concentrations have declined, thus reducing the food supply for Neomysis (T,XLI,55:6-8). Statistical analyses indicate that the abundance of Neomysis increases as its food supply increases (T,XLI,54:21-23).

Phytoplankton and zooplankton are important parts of the food chain supporting fish and larger invertebrates in the Estuary. There are no current water quality objectives specifically to protect phytoplankton and zooplankton. There are some benefits provided by water quality objectives set for other beneficial uses, e.g., Delta agriculture or Delta outflow for striped bass spawning and survival.

5.4.2 State Board Considerations

The location of the entrapment zone plays a role in the abundance of phytoplankton and zooplankton in the Suisun Bay area. Salinity is an indication of its location. Because the location of the entrapment zone in Suisun Bay is related primarily to the freshwater outflow, however, the State Board will defer consideration of this issue to the Scoping and Water Right phases of the proceedings.

5.4.3 Potential Objectives

To be discussed in the Scoping and Water Right phases.

5.5 Chinook Salmon

**Conclusions:**

- **The Estuary is a migratory corridor and rearing area for Chinook salmon.**
- **Hatchery production has kept the total numbers of fall-run salmon relatively stable.**
- **The diversity of the gene pool from naturally produced salmon is desirable.**
- **The Sacramento River winter-run of the Chinook salmon has been listed as an endangered species and will receive additional consideration in the final phases of these proceedings.**
- **The Board finds that salinity is not a factor affecting salmon as they migrate through the Estuary.**
- **Elevated temperature is one of the factors which can affect Chinook salmon during their migration through the Delta.**
- **Temperatures no greater than 68°F during the periods of April through June and September through November should be achieved by controllable factors, such as waste discharge controls, increases in riparian canopy, and bypass of warming areas (e.g., Thermalito Afterbay).**

- Controllable water quality factors are those actions, conditions, or circumstances resulting from human activities that may influence the quality of the water of the State, that are subject to the authority of the State Board, or the Regional Board, and that may be reasonably controlled. Based on the record in these proceedings, controlling temperature in the Delta utilizing reservoir releases does not appear to be reasonable, due to the distance of the Delta downstream of reservoirs, and uncontrollable factors such as ambient air temperature, water temperatures in the reservoir releases, etc. For these reasons, the State Board considers reservoir releases to control water temperatures in the Delta a waste of water; therefore, the State Board will require a test of reasonableness before consideration of reservoir releases for such a purpose.

- No temperature requirements were submitted for winter-run Chinook salmon. To provide some protection for this endangered species, the more conservative temperature objective of 66°F (developed for the fall-run) is provided for the winter-run. This objective should be achieved by controllable factors, as noted above, during the period January through March at Freeport on the Sacramento River.

5.5.1 Present Conditions

Flow requirements in D-1485 were established at Rio Vista on the Sacramento River for the protection of Chinook salmon, Oncorhynchus tshawytscha. There are no fishery flow requirements for the San Joaquin portion of the Delta. In addition to flow requirements, D-1485 contains a provision to close the Delta Cross Channel to minimize cross-Delta movement of salmon. D-1485 does not include any water quality objectives for the protection of salmon.

5.5.1.1 Salinity, Temperature and Dissolved Oxygen

Various water quality conditions can affect Chinook salmon survival in the Delta. The water quality variables under consideration were temperature, dissolved oxygen (DO) and salinity. During and after Phase I of the proceedings, data were presented on some water quality requirements of the different runs of Chinook salmon during the freshwater life stages. Most of the information concerning water quality is related to temperature requirements.

No salinity objectives exist for salmon in the Sacramento and San Joaquin basins and Delta, and no salinity objectives have been proposed. Chinook salmon (adults and juveniles) tolerate and even benefit from a gradual salinity gradient from the upstream headwaters to the ocean. The Chinook salmon as they migrate through the Delta are genetically adapted to migrate well beyond the fresh and salt water boundary.

Natural populations of San Joaquin and Sacramento salmon are declining and San Joaquin populations are undergoing extreme fluctuations (USFWS,31,58). Natural populations of the fall-, late fall-, winter- and spring- Chinook salmon runs are smaller than they were when first recorded by DFG in 1959. The catch of fall-run Chinook salmon has been relatively stable over time because the increasing number of hatchery-produced fish has offset the decline in naturally-produced fish.

The winter-run Chinook salmon has been listed as an Endangered Species under State law by the Fish and Game Commission and as a Threatened Species under federal law by the National Marine Fisheries Service (NMFS). Additional information about this run has been submitted to the State Board (see below).

San Joaquin River flow at Vernalis during smolt emigration has been identified as a major factor affecting subsequent adult escapement of hatchery and naturally-produced Chinook two and one-half years later (T,XXXVI,139:17-22) (Figures 5-1 and 5-2). The temperatures in the south Delta are often too high for smolts (WQCP-USFWS-5). Survival of the hatchery fish transported by truck and released below the Delta is six to eight times better than naturally or hatchery-produced fish emigrating from upstream through the Delta (T,XXXVII,153:2-154:1,161:22-162:1).

Very little water quality information is available about the effects of present conditions on salmon smolts migrating through San Francisco Bay. The USFWS did however determine that Chinook survival through San Francisco Bay in 1985 was estimated to be 93 percent based on the ratio of tag recoveries of two and three-year-olds released at both Port Chicago and the Golden Gate Bridge, respectively (Table 15, see USFWS Exhibit 31 for methods). The survival rate in 1984 was 81 percent. Both years had a delta outflow of about 10,000 cfs during the smolt out-migration (WQCP-USFWS-3,54).

#### 5.5.1.2 Legislation for Upper Sacramento River Fishery Resources and Riparian Vegetation Restoration

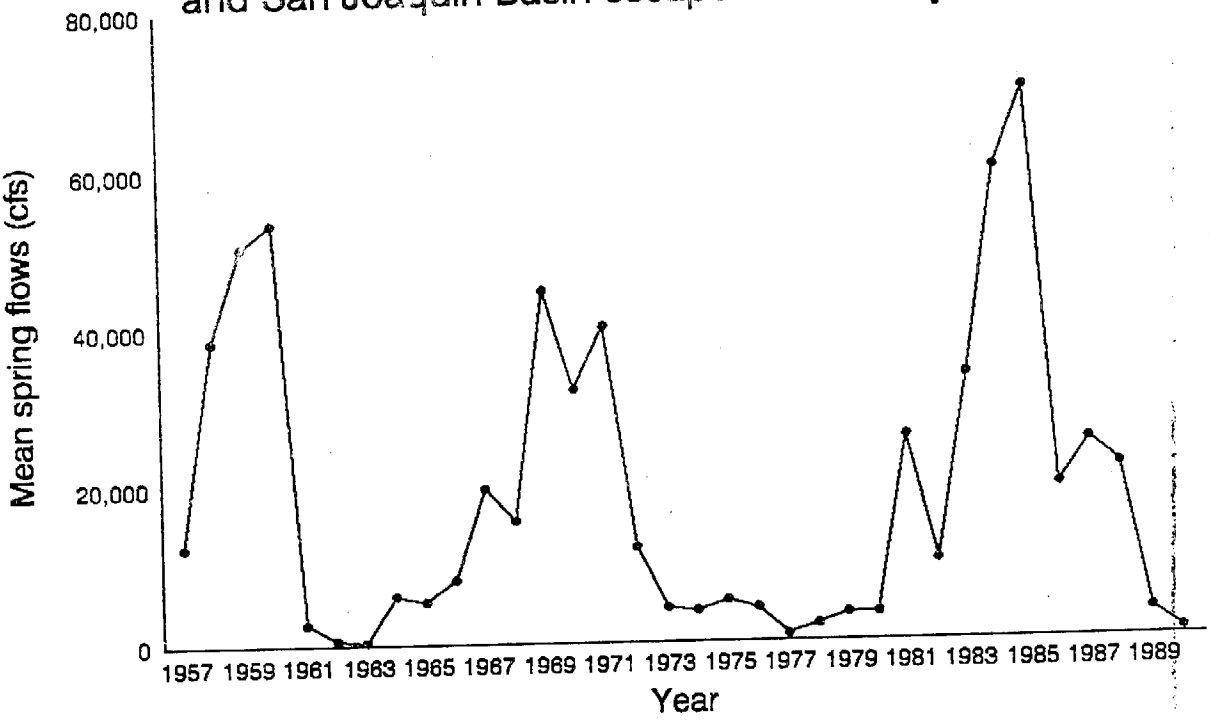
A number of efforts are being made in both the state legislature and congress to improve the anadromous fishery and the riparian vegetation in the upper Sacramento River. In 1986, Senate Bill 1086 (Nielsen) created an advisory council and action team of federal, state and local agencies and interested parties to develop the Upper Sacramento River Fisheries and Riparian Habitat Management Plan. The plan, submitted in 1989, addressed the issues concerning the declining population of anadromous fish in the Sacramento River and listed 22 specific actions to restore and protect the fisheries and riparian vegetation. The plan includes priority issues such as flows, modification of diversion facilities, and temperatures and turbidity control in the Sacramento River. Senate Concurrent Resolution 62 (Nielsen), filed as a follow-up to SB 1086, passed in October, 1989. The Resolution declares that it is state policy to proceed with appropriating sufficient funds to implement the various recommendations in the management plan.

### 5.5.2 State Board Considerations

#### 5.5.2.1 Temperature

There are a number of factors that influence water temperatures in the Delta; they include water temperatures of tributary inflow, amount of inflow, solar radiation, ambient temperatures, temperature of irrigation return flow and the extent of the riparian vegetation or shade. There is

Figure 5-1 Mean spring flows at Vernalis and San Joaquin Basin escapement 2 1/2 years later



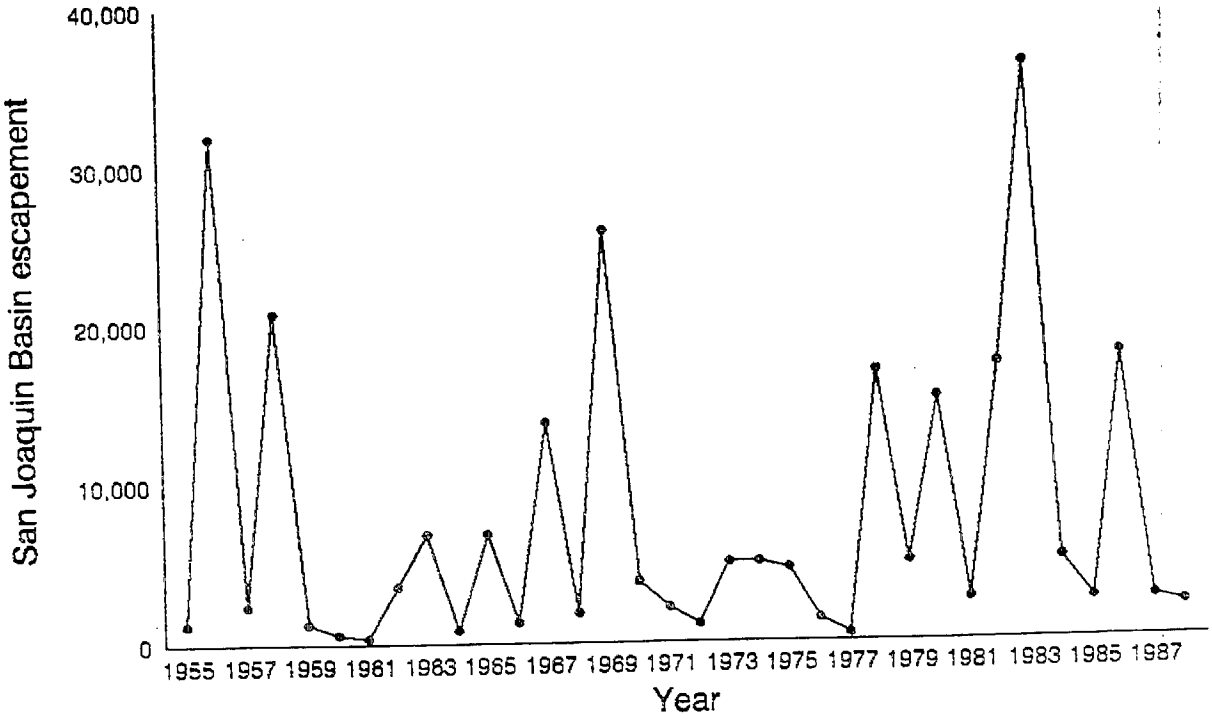
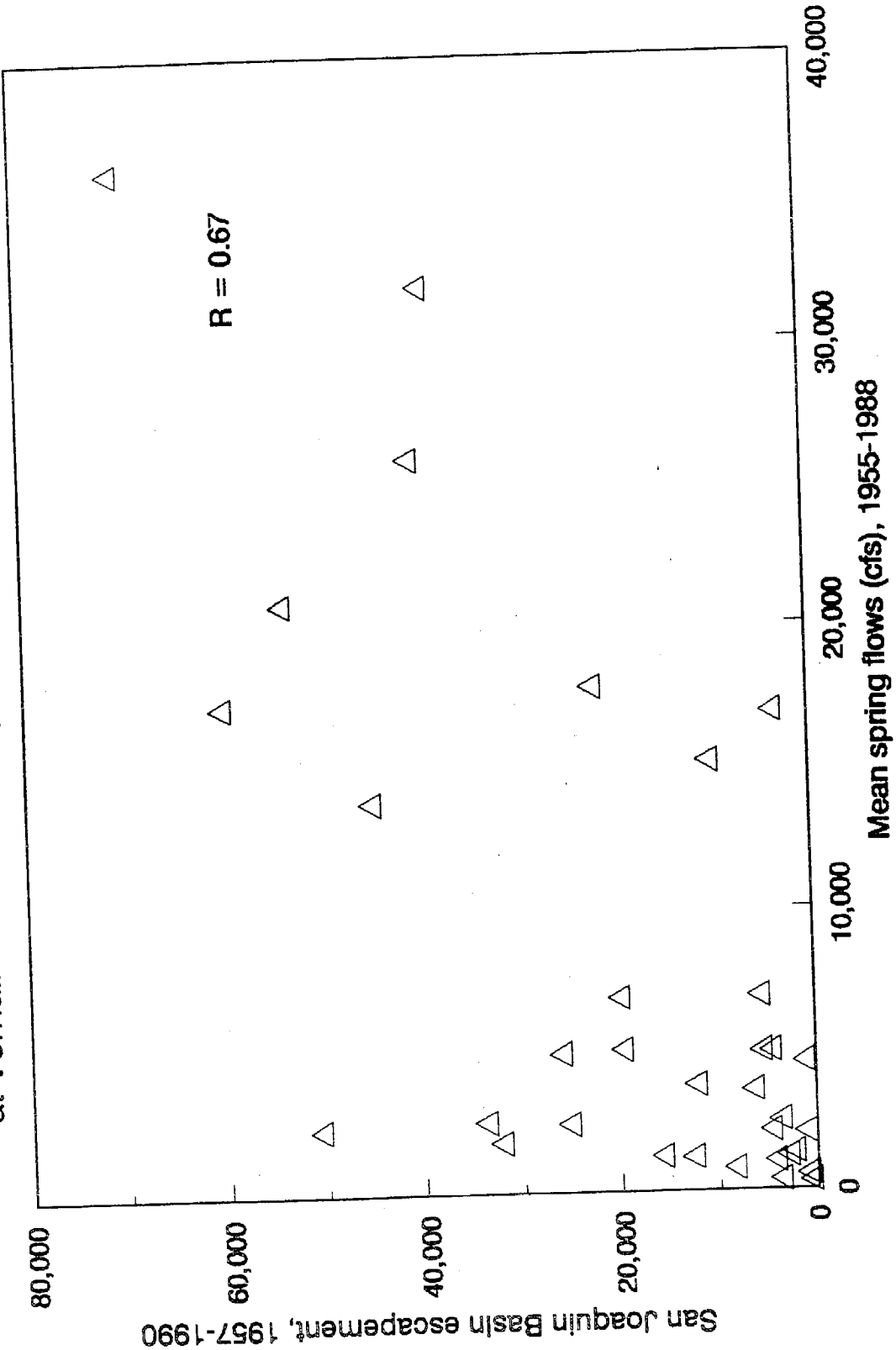



Figure 5-2 Relationship between mean spring flows
at Vernalis and San Joaquin Basin escapement 2 1/2 years later



a general relationship between temperature and flow, with a considerable amount of variation in temperature at any given flow (DFG,15,145) (DWR,562). Water temperatures in the Delta/Estuary range from optimal to lethal to Chinook salmon depending on at least the above factors. Several methods are being pursued to improve the water temperatures in the Sacramento River and increase the survival rate of the various runs of Chinook salmon. Increased flows to move the juvenile salmon more quickly downstream, thus reducing exposure time to potential hazards, could have an effect on temperature.

The critical periods for fall- and winter-run Chinook salmon in the lower Sacramento and San Joaquin rivers are between December 1 and June 30 and September 1 and November 30 of each year, because these encompass the spawner migration and the juvenile outmigration phases through this area (See Appendix 5.3, Chinook Salmon). The ability and options available to attain a desired temperature objective at Freeport on the Sacramento River or Vernalis on the San Joaquin River during the various water year types have not been fully investigated.

Cooler water temperatures in the Sacramento River during the spring, early summer and fall months benefit different life stages of the winter-run as well as the fall-run Chinook salmon. In the spring and early summer, cooling the river for the outmigrating fall-run smolts would also benefit the winter-run adults spawning upstream. In the fall, cooling the water for the fall-run spawners would concurrently benefit the rearing of juvenile winter-run salmon in the river and the beginning of their emigration.

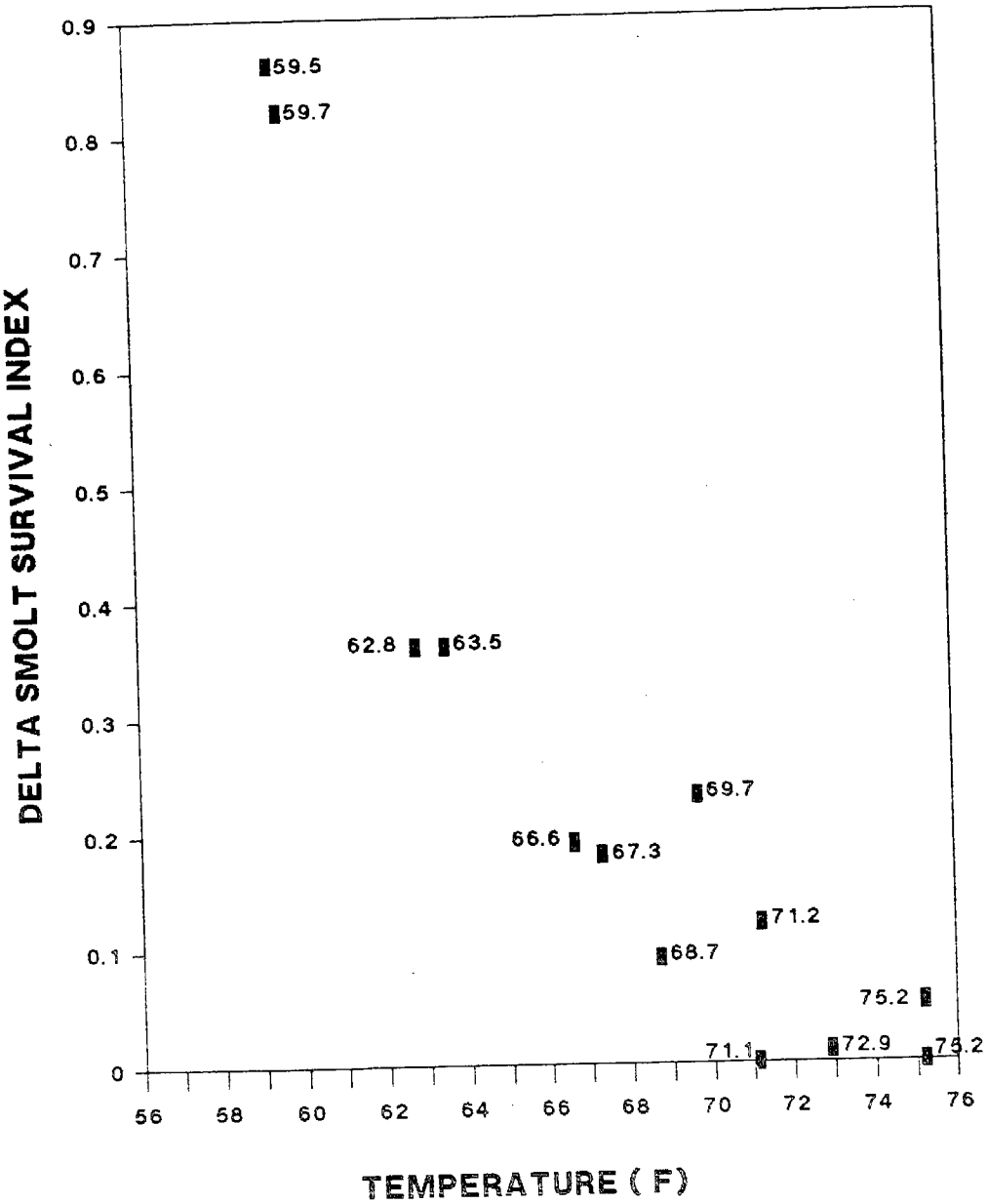
DWR's consultant testified that, since 1978, temperatures in the Sacramento River at Sacramento have been two to three degrees centigrade (about four to six degrees Fahrenheit) higher than before 1978 (T,XXXVII,157:11-15) (DWR,562,2). An evaluation of this theory might be possible by using the USBR Sacramento River temperature model (WQCP-USBR-127). Smolts emigrating in the months of warmer water temperatures are likely to suffer higher mortalities (T,XXXVII,226:15-20). Both wild and hatchery fish from both river systems are vulnerable to loss due to high temperature (WQCP-USFWS-5). The San Joaquin River portion of the Delta warms sooner than the Sacramento River system and is often about 70°F in early May. In the last few years, fishery investigators have determined that high water temperatures as well as low flows are a major problem for smolts emigrating through the San Joaquin River and Delta. Based on ocean tag recoveries, smolt survival through the Delta decreased as mean water temperatures in the Delta increased (USFWS,31,43). The same relationship is illustrated in Figure 5-3 which indicates the effect of temperature on the survival of emigrating juvenile salmon (See also Appendix 5.3, Chinook Salmon).

In contrast, the survival index generally exceeded 0.50 when the Sacramento River temperature at Freeport was 66°F or less (USFWS,31,43).

5.5.2.2 Fall-run Chinook Salmon

The upstream migration of fall-run Chinook salmon extends from approximately September through November in both the lower San Joaquin and Sacramento rivers. High water temperatures have blocked or delayed

**FIGURE 5-3 Adjusted survival index of Chinook salmon smolts based on trawl recovery versus maximum daily water temperature on release day at Freeport, Reach 1 (WQCP-USFWS-1)**



the upstream migration of fall-run Chinook in the years when there were high water temperatures in the fall. Temperatures above 70°F in the San Joaquin River have prevented salmon from migrating upstream from the Delta. This has often coincided with low dissolved oxygen levels especially between Stockton and Turner Cut. (Dissolved oxygen levels can be affected by temperature both directly and indirectly and the solubility of oxygen in the water varies inversely with temperature.) In the fall months in which DFG studied the situation, Chinook salmon were blocked by high water temperature in the lower San Joaquin River and upstream migration resumed when temperatures declined to 65°F. Temperatures between 65°F and 70°F created a partial block to salmon migration (Hallock et al., 1970). Although comparable findings have not been made for conditions in the Sacramento River, temperatures in the lower river, and in the tributaries as well, have sometimes been higher than optimum for adult migrants during the fall months.

Given the timing of the up- and downstream migration of the fall-run Chinook salmon, and the testimony and evidence of the parties at the hearing, the potential temperature objective for fall-run Chinook salmon is 68°F from April 1 through June 30 and from September 1 through November 30.

The fall-run Chinook salmon population has been supported by artificial propagation in hatcheries in both the Sacramento and San Joaquin rivers.

5.5.2.3 Winter-run Chinook Salmon

The winter-run has not been successfully produced in the hatcheries, in spite of numerous attempts. The population of the winter-run has declined in recent years, with the 1990 adult population estimated to be less than 500 fish. Given the current endangered status of the fish and its recent decline, a more conservative approach should be taken when determining a temperature objective for the winter-run Chinook salmon.

Both adult and young winter-run Chinook salmon would benefit from having a gradual salinity gradient from the Delta to the ocean and temperatures that do not exceed the mid-60 degrees Fahrenheit (memorandum to SWRCB from DFG, August 9, 1989). Temperature tolerances of winter-run Chinook salmon are unknown, although the Department of Fish and Game believes that they are similar to other Chinook runs. The timing of the outmigration of juveniles and the duration of rearing of the winter-run in the Delta are generally unknown. However, the time of the winter-run outmigration has been estimated from counts made in the upstream areas and subsequent catches of appropriately sized fish in the Delta area. These Chinook are determined to be winter-run by comparison with growth curves of winter-run hatchery fish. From these data, the DFG has determined that the period of peak outmigration through the Delta for juvenile winter-run Chinook salmon is between the months of January and April, with occasional downstream movements of fry during the fall months.

The adult winter-run Chinook salmon begin entering San Francisco Bay in November and continue to be found in the Sacramento-San Joaquin Delta into June. Peak adult migration through the Delta probably occurs from January to March.

Although there was no testimony presented on temperature requirements specifically for the winter-run, based on the hearing record and the testimony presented at the hearing, consideration of the more conservative temperature objective (66°F) for the fall-run Chinook salmon would be appropriate for the winter-run (Appendix 5.3, Chinook Salmon) during the period they are in the Sacramento River.

The winter-run Chinook salmon temperature objective is a cap to prevent water temperature from going higher than the present temperatures in the Delta. It is not a goal. This objective is just one of several ways of providing protection from elevated water temperatures. Other such protection measures include the Thermal Plan (see in Section 5.5.2.5) and the State Board "anti-degradation policy", "Statement of Policy With Respect to Maintaining High Quality of Water in California," Resolution 68-16.

5.5.2.4 Dissolved Oxygen

No objectives for dissolved oxygen were developed in D-1485.

The Central Valley Basin Plan (1975, Vol. I-4-12) states that: "The following objectives apply to Delta waters: The dissolved oxygen concentrations shall not be reduced below the following levels:

- 7.0 mg/l in the Sacramento River (below the I Street Bridge) and in all Delta waters west of the Antioch Bridge; and,

- 5.0 mg/l in all other Delta waters except for those bodies of water which are constructed for special purposes and from which fish have been excluded or where the fishery is not important as a beneficial use."

"Temperatures over 65°F have partially blocked migrations in the San Joaquin River past Stockton and ... dissolved oxygen concentrations of less than 5 mg/l constitute a virtual barrier to adult migrants" (USFWS,31,94). According to Hallock et al. (1970), after four years of investigation, "... no salmon moved past Stockton until the dissolved oxygen had risen to about 4.5 ppm, and the run did not become steady until oxygen levels were above 5 ppm." To address the problem of low dissolved oxygen levels in the San Joaquin River, an agreement was reached in 1969 between the USFWS, USBR, DWR, and DFG, in part, to take specific actions "...to maintain the dissolved oxygen content in the Stockton Ship Channel generally above 6 ppm when necessary...." DWR monitors DO levels in the San Joaquin River between Stockton and Turner Cut (Stockton Ship Channel) during the fall Chinook salmon migration. (Monitoring data are summarized and a report is submitted by DWR to the SWRCB annually in accordance with Water Right Decision 1485, Order 4(f)). If DO levels drop to 6 mg/l, a temporary rock barrier is installed across the head of Old River to increase San Joaquin River flows past Stockton, thus improving DO levels (T,XXXVII,85:4-22). Better treatment of cannery wastes since 1978 (reducing the biochemical oxygen demand) and improved flows and water quality from New Melones Reservoir operations were reported to have helped alleviate this problem (USFWS,31,94). Since then, the Old River barrier has been installed in the fall of 1979, 1981, 1984, 1987, 1988 and 1989 (H. Proctor, DWR, pers. comm.).

In the lower Sacramento River, no problems with dissolved oxygen levels were identified.

5.5.2.5 Miscellaneous Considerations for Salmon

o Pulse Flows as an Operational Option

Various operational options are available which may be beneficial to the salmon smolts but have not been not fully tested. "Pulse flows" are released from Shasta Dam on the Sacramento River to increase flows at the same time salmon smolts are released from the USFWS Coleman Hatchery on Battle Creek (tributary to the Sacramento River). The purpose of the "fish flush" is to move hatchery fish rapidly down the Sacramento River, past a number and variety of potential hazards. Pulse flows (fish flush flows) provide a window of time in which to coordinate the operation of various water diversion facilities, such as the Delta Cross Channel Gates, to maximize survival of the smolts. The fish are released as early in the season as possible to reduce the exposure to adverse water temperatures in the river.

The "pulse flow" experiment has been conducted for the last four years; however, the effects of the experimental operation on the hatchery fish as well as naturally produced fish are not yet fully known. Questions remain on the effects of the pulse flows on the rearing, timing of emigration and survival of the natural fish. The pulse flow experiment was conducted because it would have a beneficial effect, with spring flows higher than in recent years, but substantially less than would have occurred under natural conditions (WQCP-USFWS-2,-3 and-5). Pulse flow experiments are being considered in the San Joaquin River system as well.

o Temperature Model

The USBR temperature model (WQCP-USBR-127) may be helpful in evaluating the Sacramento River flows required to achieve various temperature alternatives at points in the Sacramento River or Delta during different months. The report on the temperature model describes a monthly time-step reservoir and river model developed as a tool to try to evaluate the effects of CVP and SWP project operations on water temperatures as they affect Chinook salmon in the Sacramento River Basin. Because it is a monthly rather than a daily model, it provides only a qualitative comparison of various operating scenarios. Average monthly temperatures can mask short-term fluctuations in temperature that could be lethal to certain salmonid life stages. The model, however, given operational flexibility and sufficient water, indicates relative benefits of various options to the instream life stages of the salmonids. A review of the model should be made to help clarify further the factors influencing temperatures in the Delta.

Because the runs of Chinook salmon can be impacted by temperatures in the spring, early summer and fall, it will be imperative to evaluate the flexibility of the operations and achieve the coldest temperatures possible in the different water year types. The Five-Agency Salmon Management Group is evaluating the costs and benefits of decreasing water temperature and the use of other measures in the Delta to improve salmon smolt survival. A temperature model at present is not available but would be useful for the San Joaquin River.

o Regional Water Quality Control Board Temperature Objectives

The temperature objective in the Central Valley Regional Board's Basin Plan for the Sacramento River is as follows: "The temperature shall not be elevated...above 68°F in the reach from Hamilton City to the I Street Bridge during periods when temperature increases will be detrimental to the fishery." This objective is based upon "controllable factors" discussed below. There is no temperature objective on the San Joaquin River system.

The fishery's temperature objective for the Delta specifies: "The natural receiving water temperature of intrastate waters shall not be altered unless it can be demonstrated to the satisfaction of the Regional Board that such alteration in temperature does not adversely affect beneficial uses." (Water Quality Control Plan Report, Central Valley Region 5, Vol. I, p.I-4-9)

o Thermal Plan

The State Water Resources Control Board adopted on May 18, 1972, A "Water Quality Control Plan for Control of Temperature in the Coastal and Interstate Waters and Enclosed bays and Estuaries in California," referred to as the "Thermal Plan." The Plan specifies limiting conditions of temperature in wastewaters discharged into interstate and coastal waters, estuaries and enclosed bays. For example, elevated temperature waste discharges into interstate waters designated as "cold" waters are prohibited while this type of discharge into "warm" interstate waters cannot be more than 5°F warmer than the receiving water and shall not cause the temperature in the receiving water to rise more than 5°F. Existing thermal discharges into coastal waters, estuaries and enclosed bays must comply with limitations necessary to assure protection of the beneficial uses and, for coastal waters, areas of special biological significance. (Water Quality Control Plan Report, Central Valley Region 5, Vol. II, p.II-9-14).

o Controllable Factors

Water temperature objectives in the Central Valley Basin Plan apply to controllable water quality factors which are defined as: "...those actions, conditions, or circumstances resulting from human activities that may influence the quality of the waters of the State, that are subject to the authority of the State Board or the Regional Board, and that may be reasonably controlled." (Revised Region 5 Basin Plan for Basins 5A, 5B, and 5C as approved by the State Board on March 22, 1990; also please see Tables 1-1 and 6-3, page 8 of 8).

In order to implement a water quality objective for temperature in the Delta, the Board will examine the controllable factors, and, where reasonable, require maintenance of the water temperatures such that they will not impact, and perhaps will improve, survival of anadromous salmonids.

### 5.5.3 Potential Objectives for Chinook Salmon

#### 5.5.3.1 Temperature for Fall-Run Salmon

The following objective will be considered for the protection of the fall-run Chinook salmon:

The daily average water temperature shall not be elevated by controllable factors above 68°F from the I Street Bridge to Freeport on the Sacramento River, and at Vernalis on the San Joaquin River between April 1 through June 30 and September 1 through November 30 in all water year types.

When other factors result in the degradation of water quality beyond the levels of limits established as water quality objectives, then controllable factors shall not cause further degradation of water quality.

#### 5.5.3.2 Temperature for Winter-Run Salmon

The following objective will be considered for the protection of the adult and juvenile life stages of the endangered winter-run Chinook salmon:

The daily average water temperature shall not be elevated by controllable factors above 66°F from the I Street Bridge to Freeport on the Sacramento River between January 1 through March 31 in all water years.

#### 5.5.3.3 Dissolved Oxygen

Factors that may contribute to the low levels of dissolved oxygen, in addition to low flows in the San Joaquin River during the fall months, include: 1) the recently deepened ship channel; 2) the enlarged turning basin at the Port of Stockton; 3) the Stockton Sewage Treatment Plant; 4) upstream BOD sources; and 5) commercial use of the dead-end portion of the ship channel.

The following objective is proposed for consideration for the protection of the Chinook salmon in the San Joaquin River:

Minimum dissolved oxygen levels shall not fall below 6 mg/l from September 1 through November 30 in all water year types between Stockton and Turner Cut in the San Joaquin River.

Measures to implement this objective include the following: 1) regulation of the effluent from the Stockton Sewage Treatment Plant and other upstream discharges contributing to the BOD load; 2) installation of the temporary barrier or additional barriers as may be needed, 3) investigation of mechanical or chemical methods to oxygenate the water at critical points along the river channel, and 4) increase of flows in the San Joaquin River. A decision on the precise implementation measures will be made during the forthcoming proceedings.

## 5.6 Striped Bass

Conclusions:

- Studies over many years indicate that there are numerous factors affecting striped bass abundance, including diversions from the Delta, reduced Delta outflow, flow patterns in the interior Delta, fewer adults, toxic effects, changes in the food chain due to introduced species, recreational angler harvest, and illegal poaching.

- Studies should be continued and additional water operation tests should be conducted to determine the effects on striped bass and the best means for their protection.

- In light of various impacts on the fishery, particularly of the exports pumps, it is necessary to examine existing points of water diversion. Within the Scoping Phase, the Board will consider the alternatives to the existing points of diversion.

Striped Bass - Spawning Habitat from Prisoners Point to Vernalis

- Review of the evidence indicates that it may be desirable to expand existing spawning habitat for striped bass in the Delta. However, the State Board concludes that the most significant factor in the decline of striped bass is entrainment[1] due to pumping. The State Board will consider actions to be taken concerning entrainment losses during the Scoping and Water Right phases of the proceedings. Upon examination of the results of these actions, the State Board will consider the issue of expansion of spawning habitat.

Striped Bass - Spawning Habitat from Antioch to Prisoners Point

- The major spawning areas for striped bass are the Sacramento River above the Delta and the San Joaquin River area between Antioch and Prisoners Point.

- The Board finds benefits for the resource in maintaining spawning habitat in this reach by establishing boundary salinities at Antioch of 1.5 and at Prisoners Point of 0.44 mmhos/cm EC from April 15 through May 31. The end date of May 31 may be shortened if data indicate that spawning has ceased.

- Deficiencies in firm supplies and the level of protection afforded by the striped bass spawning objective should be correlated.

- The Board needs better information than is currently available to consider the complete economic relationship between improvements in striped bass spawning habitat and water availability.

---

*1/ Entrainment means primarily the effects of project operations, such as operation of the Delta Cross Channel gates, export pumping, and reverse and low river flows, plus local non-project diversions.*

## 5.6.1 Present Conditions

### 5.6.1.1 Background: D-1485 Objectives

Striped bass are specifically protected in D-1485 (Table II,38,39,40). These requirements evolved out of negotiations conducted among DFG, DWR, USFWS, and USBR prior to the 1978 hearing as part of a draft Four-Agency agreement; this agreement was never signed (DFG,25,133). Salinity (EC) objectives at Antioch and at Prisoners Point on the San Joaquin River establish a striped bass spawning area estimated to be about 17 miles in length from April 1 to May 5 in all water years. These objectives were first established (in an earlier form) by Water Right Decision 1379, adopted in July 1971. They were established after a review of an earlier State Board Resolution (68-17; Supplemental Water Quality Control Policy) indicated that striped bass spawning was not being protected. The recommended protection measures were similar to those proposed by a Department of Interior task force on Delta salinity objectives (Decision 1379, 32).

The objective at Antioch is 1.5 mmhos/cm EC (the first two weeks of protection are provided by a Delta Outflow Index requirement of 6,700 cfs rather than an EC objective to provide some ramping capability for the CVP and SWP water projects). This objective also includes a relaxation provision when the SWP or CVP declares deficiencies in delivery of firm project supplies. Upstream, the objectives provide for a maximum of 0.55 mmhos/cm EC at Prisoners Point; no relaxation provision is included.

In May, June and July, minimum Delta Outflow Index flows and limitations on export levels come into effect for protection of young bass. These requirements were designed to help move eggs and young into suitable nursery areas and to reduce entrainment into the SWP and CVP export systems. The Delta outflows were also expected to provide equivalent protection for later spawning in the San Joaquin River, at least in wet, above normal, and below normal water years; outflows during these periods were expected to be higher than the 6,700 cfs estimated to be required to maintain the 1.5 mmhos/cm EC at Antioch under steady-state conditions (1978 Delta Plan, VI-4). Provisions for periodic closure of the Delta Cross Channel gates (to reduce translocation of Sacramento River striped bass eggs and young into the central Delta) and recommendations (not mandatory requirements) for the operation of the projects' fish recovery facilities are included in D-1485. Other than the Delta Cross Channel gate closure, there are no specific objectives for protection of spawning or young bass in the Sacramento River.

### 5.6.1.2 Current Status

The adult population of striped bass in the Estuary has declined in recent years to about one-third or one-fourth of the population levels seen in the 1960s. A variety of sampling programs are employed to monitor various components of the striped bass population (see Appendix 5.4.1). While the decline rates and patterns may vary somewhat, all programs measuring striped bass abundance show large declines (DFG,25,6,9). The primary means of evaluating the overall condition of striped bass between years has been the Striped Bass Index (SBI). The objectives in D-1485 were designed to maintain the SBI at a long-term

average of 79 (the so-called "without project" conditions). This goal has not been achieved; in 1990, the actual SBI reached an all-time low of 4.3; 1988 was the second-lowest on record with 4.6, and in 1989 the SBI was 5.1. The average SBI for the period 1979-1990 is 19.1 (see Appendix 5.4.2).

In the late 1970s declining striped bass populations indicated that the requirements in D-1485 for protection of striped bass were not achieving their intended and expected results. In response, the State Board organized a Striped Bass Work Group composed of staff from several state and federal agencies and outside consultants to investigate the cause(s) of this decline and to make recommendations on actions to correct it. Subsequent discussion and data analysis have resulted in an expanded and refined list of possible causative factors. These are discussed in Appendix 5.4.3. The relationship of the export area striped bass fishery to the Estuary fishery is discussed in Appendix 5.4.4. In large part, while the reasons for the striped bass decline are known, the relative importance of each factor is not completely understood (WQCP-DFG-3).

### 5.6.2 State Board Considerations

General: Salinity Objectives

Salinity objectives for striped bass apply to the spawning conditions and limitations for adult striped bass in the San Joaquin River. Striped bass in the Sacramento River spawn well above the influence of ocean-derived salinity, and, unlike the San Joaquin River, water quality and river flow are sufficient to prevent the formation of upstream salinity barriers to fish passage due to land-derived salts. No D-1485 objectives or advocated positions consider this area, and no alternatives are offered for consideration.

The D-1485 salinity objectives were expected to provide minimal, yet adequate, spawning habitat from approximately Antioch to Prisoners Point to sustain a healthy striped bass population. However, the continuing decline indicates that some new actions must be considered. Therefore, as one part of an overall program to increase protection for estuarine habitat, it is appropriate to consider modifying the three D-1485 San Joaquin River spawning objectives.

This section considers temperature in addition to salinity objectives at Antioch and Prisoners Point:

5.6.2.1 Antioch: Period of Protection for Spawning
5.6.2.2 Antioch: Relaxation Provision
5.6.2.3 Prisoners Point: EC Modification
5.6.2.4 Prisoners Point: Relaxation Provision
5.6.2.5 Temperature Objectives

5.6.2.1 Antioch: Period of Protection for Spawning

The current D-1485 objectives provide for striped bass spawning protection in the lower San Joaquin River for a period of 35 days, from April 1 to May 5. Protection during the first two weeks of this period is permitted to be met by a Delta Outflow Index (DOI) value of 6,700 cfs, rather than the EC objective of 1.5 mmhos/cm, to provide some operational flexibility for the SWP and CVP without significantly degrading protection of spawning habitat. Since spawning activity is minimal in early April in most years, the small variations in salinity which may occur under this provision are not significant.

After May 5, striped bass spawning habitat is not specifically protected, although spawning in the Delta continues through most of May and occasionally even into June, depending upon water temperatures and perhaps other factors. Some collateral protection is provided by DOI flows designated for protection of young bass. The flow requirements in wet, above normal, and below normal water years are generally sufficient to maintain the 1.5 mmhos/cm EC salinity in the vicinity of Antioch (the lower end of the spawning area) or even farther downstream. However, in subnormal snowmelt, dry and critical water years, DOI requirements are reduced, resulting in loss of spawning habitat. DFG testified that the spawning habitat protection provided under present D-1485 objectives is minimal rather than optimal, and that striped bass would be put under additional stress if the relaxation provision were in effect (see below) (1978 Delta Plan testimony, May 30, 1978, 67:14-19). DFG also testified that the flow requirements (DOI) set for striped bass do not provide adequate protection during dry or critical water years, or those of subnormal snowmelt (T,LXVIII,76:2-4). Therefore, several alternative spawning habitat objectives which provide various levels of protection are considered.

The current objectives provide protection through May 5. Table 5-2 shows the results of DFG egg sampling in the San Joaquin River. For each year, the date on which a specified percentage of total eggs collected is noted. For example, in 1985, 30 percent of the total number of eggs collected by DFG that year were collected by May 1. These data are analogous to, and derived in part from, the cumulative total curves in Turner (1976). This table indicates that a May 5 cutoff date for protection of spawning means that only 30 to 40 percent of the total spawning activity (as measured by eggs collected) in any given year has occurred by that date. The data in Table 5-2 indicate that extending the cutoff date to May 31 protects about 95 percent of the spawning activity in most years.

Alternative levels of protection may be summarized as follows:

TABLE 5-2

STRIPED BASS SPAWNING PATTERNS, SAN JOAQUIN RIVER

PERCENT OF LIVE EGGS COLLECTED, BY DATE

WATER YEAR IS 40/30/30

| YEAR | WATER YEAR | PERCENT OF TOTAL EGGS COLLECTED | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | >0 | 5 | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 95 | 100 |
| 1963* | AN | 4/26 | 5/01 | 5/05 | 5/14 | 5/15 | 5/16 | 5/16 | 5/17 | 5/19 | 5/21 | 5/23 | 5/27 | 6/13 |
| 1964* | D | 4/15 | 4/15 | 4/27 | 5/06 | 5/15 | 5/16 | 5/16 | 5/17 | 5/18 | 5/19 | 5/23 | 5/25 | 6/05 |
| 1965* | W | Very few eggs collected; sampling program missed most of spawning; eggs present through 6/19 | | | | | | | | | | | | 6/19 |
| 1966* | BN | 4/14 | 4/15 | 4/16 | 4/20 | 4/25 | 4/27 | 5/01 | 5/02 | 5/05 | 5/07 | 5/08 | 5/14 | 6/18 |
| 1967* | W | 5/03 | 5/04 | 5/04 | 5/06 | 5/09 | 5/17 | 5/18 | 5/19 | 5/20 | 5/23 | 6/13 | 6/18 | 6/22 |
| 1968+ | BN | 4/03 | 4/12 | 4/26 | 5/02 | 5/08 | 5/08 | 5/08 | 5/08 | 5/10 | 5/10 | 5/17 | 5/24 | 6/14 |
| 1969* | W | 4/08 | 4/11 | 4/15 | 4/21 | 5/02 | 5/08 | 5/14 | 5/17 | 5/20 | 5/24 | 5/27 | 6/01 | 6/12 |
| 1970+ | AN | 4/21 | 5/02 | 5/04 | 5/05 | 5/14 | 5/14 | 5/15 | 5/15 | 5/17 | 5/18 | 5/19 | 5/21 | 6/30 |
| 1971+ | W | Sampling begun in late May, eggs present from 5/23 to 7/12; bulk of spawning probably somewhat earlier | | | | | | | | | | | | 7/12 |
| 1972+ | D | 4/29 | 5/07 | 5/08 | 5/10 | 5/10 | 5/10 | 5/11 | 5/12 | 5/13 | 5/19 | 5/23 | 5/31 | 7/06 |
| 1973+ | AN | Sampling begun in late May; eggs present from 5/29 to 7/04; bulk of spawning probably somewhat earlier | | | | | | | | | | | | 7/04 |
| 1975+ | W | 5/01 | 5/08 | 5/11 | 5/13 | 5/18 | 5/21 | 5/24 | 5/26 | 5/27 | 5/28 | 6/05 | 6/06 | 7/14 |
| 1977 | C | 4/19 | 4/20 | 4/21 | 4/30 | 5/01 | 5/01 | 5/09 | 5/14 | 5/15 | 5/15 | 5/15 | 5/28 | 6/10 |
| 1984+ | W | 4/16 | 4/23 | 4/25 | 5/02 | 5/07 | 5/08 | 5/09 | 5/13 | 5/13 | 5/14 | 5/15 | 5/17 | 7/01 |
| 1985+ | BN | 4/16 | 4/19 | 4/24 | 4/29 | 5/01 | 5/03 | 5/06 | 5/12 | 5/13 | 5/15 | 5/19 | 5/22 | 6/27 |
| 1986+ | W | 4/16 | 4/21 | 4/21 | 4/23 | 4/30 | 5/09 | 5/10 | 5/11 | 5/12 | 5/17 | 5/22 | 5/25 | 7/01 |
| 1988+ | C | 4/12 | 4/14 | 4/21 | 4/23 | 4/25 | 4/26 | 4/27 | 5/07 | 5/08 | 5/09 | 5/18 | 5/24 | 6/15 |
| 1989+ | D | 4/12 | 4/17 | 4/18 | 4/20 | 4/24 | 5/03 | 5/04 | 5/05 | 5/06 | 5/10 | 5/26 | 6/01 | 6/23 |
| AVERAGE DATE OF COLLECTION FOR PERCENT INDICATED | | -- | 4/23 | 4\26 | 4/30 | 5/05 | 5/08 | 5/11 | 8/13 | 5/14 | 5/17 | 5/22 | 5/27 | 6/21 |

**********

* = Values derived from curves in Figure 2 of Turner (1976);
remaining years from cumulative totals of live eggs from DFG data (Lee Miller)

\+ = Eggs present on first day of sampling (date in >0 column); some spawning probably occured prior to date shown

| Alternatives | Approximate percent of spawning activity protected |
|---|---|
| 1. April 1 through May 5, with ramping* (present condition) | 30-40% |
| 2. April 15 through May 15, without ramping | 55-65% |
| 3. April 1 through May 15, with ramping | 60-70% |
| 4. April 15 through May 31, without ramping | 90% |
| 5. April 1 through May 31, with ramping | 95% |
| 6. April 1 through May 31, without ramping | >95% |

* ramping = 6,700 cfs Delta Outflow Index value for period April 1 through April 14

The percent of spawning activity assumed protected under each alternative in the table above is determined directly from Table 5-2. The range of percent spawning activity protected is simply the amount of spawning activity measured (i.e., percent of total eggs collected) by the end date of each alternative. There is assumed to be relatively little spawning which occurs before about April 15 each year, so the absence of ramping (i.e., appropriate salinity from April 1 rather than ramping flows to April 14) was assumed to add only about 5 percent additional spawning activity protection over that provided by ramping. The relative lack of data before April 15 makes this somewhat speculative, but in any case it is probably not significant.

The State Water Contractors proposed extending protection of spawning activity only to May 21 in dry and critical years (WQCP-SWC-627,3-4).

The present Antioch standard of 1.5 mmhos/cm EC was primarily designed, as is described in Section 5.6.1.1, to provide a suitable spawning habitat upstream of Antioch, not at the Antioch location itself. According to the recollection of Don Stevens of DFG (pers. comm., 3/91), Antioch was chosen as a monitoring point because a salinity monitoring station was already established at the Antioch Water Works. The use of 1.5 mmhos/cm EC at Antioch for spawning protection appears not to be generally appropriate, since DFG's own testimony indicates that striped bass prefer to spawn in freshwater, and that a spawning objective of 0.44 mmhos/cm EC represents the "best scientific evidence" of the water quality needed to restore spawning in the historical spawning area of the San Joaquin River (DFG-WQCP-9,4) (see Section 5.6.2.3). However, the Antioch water quality objective may continue to serve the purpose of being an ultimate delimiter of spawning habitat; the Antioch objective can also be considered an "implementing measure" since maintaining that objective should produce less saline, and thus more suitable habitat, upstream of Antioch in the San Joaquin River. DFG has observed some spawning in the Antioch to Jersey Point reach, sometimes in ECs of 1.5 mmhos/cm or higher, in some very dry years (1972 and 1977). Laboratory

studies also indicate that egg survival is not affected adversely in water with ECs up to 1.5 mmhos/cm (DFG,25,46). These conditions have typically produced some of the lowest abundance indices, however. We also agree that the striped bass spawning objectives, as proposed, do not in fact designate a spawning reach, but only a single location (Prisoners Point) where appropriate salinities for the majority of spawning, as determined by DFG, are required to be present.

5.6.2.2 Antioch: Relaxation Provision

Decision 1485 provides for a relaxation of the protection for striped bass spawning when the SWP or CVP impose deficiencies in their firm supplies. The EC objective is relaxed proportional to the amount of deficiency imposed. Under extreme conditions, when the projects impose deficiencies of 4.0 MAF or more, D-1485 in theory allows the EC at Antioch to degrade to 25.2 mmhos/cm, which would result in substantial reduction of spawning habitat to an estimated reach of about 9.5 miles or less (Delta Plan and D-1485 Final EIR,V-24 to V-26). However, it was believed that the Suisun Marsh protection objectives (critical years) or Delta agricultural objectives (dry years) would in fact control salinity in the lower San Joaquin River throughout the month of May. Therefore, the actual EC at Antioch, regardless of the size of the deficiency imposed, was not expected to exceed 3.7 mmhos/cm in critical years, and 1.8 mmhos/cm in dry years (letter from SWRCB to EPA April 3, 1979 -- information based on DWR 1978 Hearing Ex. 7B).

As several participants have pointed out, there is considerable confusion about the appropriateness of the proposed relaxation criteria, in terms of what salinity is appropriate at Antioch for various deficiency levels. As has been discussed, the 1978 Delta Plan and EIR based the relaxations on a salinity/flow relationship for the Sacramento River, which was assumed to be applicable to the San Joaquin River as well. In addition, the theoretical extent of salinity degradation was supposedly limited to a maximum of 3.7 mmhos/cm EC because of the Chipps Island Suisun Marsh standard. The entire process is built on a series of artificial relationships which are unrelated to the main issue at hand, which is the establishment and maintenance of suitable spawning habitat for striped bass in the San Joaquin River and the relaxation of that habitat requirement when water project firm deliveries are reduced.

The State Board continues to believe that, as stated in its conclusions on striped bass (Section 5.6), the "[d]eficiencies in firm supplies and the level of protection afforded by the striped bass spawning objective should be correlated." The present deficiency schedule does not do that, since no specific relationship between extent of habitat and change in salinity intrusion has been made. The present relationship is based on a Sacramento River salinity/flow relationship. Several participants have appropriately questioned the basis for this relationship.

In 1990, the projects declared a deficiency and invoked the relaxation provision. Despite compliance with other D-1485 standards, the theoretical expected Antioch maximum EC of 3.7 mmhos/cm was exceeded. In addition, monitoring data from 1990 suggest that ECs greater than 0.44 mmhos/cm occurred throughout nearly all of the striped bass spawning area, not simply at the downstream end.

The State Board would like to relate deficiencies to spawning area in a direct, measurable way: by simply making increases in deficiencies directly related to the shortening of the length of river reach in which suitable spawning habitat will be required to be maintained. The Board believes this approach would have a negligible effect on water supplies during most years because D-1485 provides some umbrella spawning protection upstream of Antioch by means of the central and western Delta agricultural standards. These standards are presently under review, and the required water quality at some locations may be reduced (salinity increased). By establishing a separate spawning habitat objective, no re-evaluation of the effects of water quality degradation on striped bass habitat will be required. The present agricultural water quality objective includes a level of 0.45 mmhos/cm EC at Jersey Point from April 1 to August 15 (in all but critical years). This objective essentially duplicates the current EC and starting date requirements for striped bass spawning protection. In Section 7.5.2.4, Program of Implementation, the State Board outlines a proposal for evaluation of the concept of establishment of a specific spawning protection zone and a directly related relaxation provision.

5.6.2.3 Prisoners Point: EC Modification

The D-1485 objective for EC at Prisoners Point on Venice Island is 0.55 mmhos/cm for the period April 1 to May 5, in all water years, to delimit the upstream end of the San Joaquin River spawning area. No relaxation provision for deficiencies is included. Transfer of water across the Delta to the export pumps results in relatively low salinity in the Prisoners Point area of the San Joaquin River. Salinity in the San Joaquin River increases upstream of Prisoners Point due to reduced freshwater inflow and saline agricultural return flows from the eastern and southern Delta and from the River above the Delta. Thus, the absence of salinity objectives above Prisoners Point effectively establishes a barrier to adult migration and spawning farther upstream on the San Joaquin River.

Three issues are involved with this standard: period of protection, extension of spawning habitat farther upstream, and appropriate EC levels.

Period of Protection

As noted above, there is substantial spawning in the Delta throughout May. Flows through the Mokelumne River system, especially the movement of Sacramento River water through the Delta Cross Channel, most likely provide considerable protection of water quality in the area around Prisoners Point throughout much of the spring months.

For consistency with the objectives proposed for Antioch, the State Board will examine the effect of setting the same period of protection as at Antioch: April 1 to May 31 in all water years.

Extension of Available Spawning Habitat Upstream

The major issue involving the current striped bass spawning objectives is whether the spawning area should be expanded beyond its present size. The present objective results in substantial spawning in the channels which move water to the export pumps in the south Delta; for part of the spawning period (April), there are no restrictions on export rates. This undoubtedly results in substantial losses of eggs and young. In its comments on the proposed objectives in D-1485, DFG noted that the designated spawning area provided "minimal suitable conditions" (Testimony, 1978 Delta Plan, 4/27/77, XXII, 160:17-19).

In Phase I, DFG testified that striped bass used to spawn farther up the San Joaquin River than at present, but do not do so now because of increased salinity (T,XLI,68:3-20). Despite testimony to the contrary (see for example, U.S. Department of Interior comments, 4/23/90, p.6), numerous records from the early decades of this century indicate that striped bass regularly migrated up the San Joaquin River and its tributaries. As late as 1963, substantial spawning in the San Joaquin River occurred in the reach between Stockton and Mossdale (Farley, 1966). Spawning occurred above Vernalis in 1968, with many of the eggs appearing near Patterson, 104 miles above the mouth of the river (Turner, 1976). In wetter years large striped bass are still seen in the San Joaquin River tributaries (W. Loudermilk, DFG, pers. comm., 1988). It appears that the upper Delta and the tributary rivers may still support striped bass spawning when appropriate habitat conditions are provided.

On the other hand, several arguments have been offered to support retention of the present objective (limit spawning to west of Prisoners Point). These arguments are based primarily on two factors: (1) assumptions that eggs and young that were produced farther upstream would be carried to the export pumps and lost to the Delta; and (2) lack of a strong experimentally-derived correlation between salinity and spawning success. These arguments are discussed in Appendix 5.4.5.

Appropriate Electrical Conductivity Levels

The Phase I testimony and exhibits indicate that striped bass prefer to spawn in water with an EC of less than 0.3 mmhos/cm (TDS=170 mg/l) (DFG,25,46 and 47). Farley (1966) concluded that striped bass require a TDS of less than 250 mg/l (= 0.44 mmhos/cm EC). It is DFG's belief that this represents the "best scientific evidence" to restore spawning in the historical spawning area of the San Joaquin River (WQCP-DFG-4,9). Higher salinities may affect egg survival as well as spawning activity. Turner (1976) found that, in water of 600-800 mg/l TDS (= 1.03-1.36 mmhos/cm EC) on the San Joaquin River above the Delta in 1968, 94 percent of the eggs he collected were dead. However, it is not clear whether this high percent of dead eggs was caused by salinity or some other factor.

Establishing an objective of 0.55 mmhos/cm EC in the reach from Prisoners Point to Vernalis would not expand the spawning area since, based on prior testimony, that EC level would still act as a barrier to migration upstream of Prisoners Point. Likewise, establishing any objective at a single location well up in the Delta (such as at Vernalis) will not

assure that the intervening stretch of river will be of quality adequate for spawning. The appropriate objective must be applied at several points along the San Joaquin River to assure continuity.

5.6.2.4 Prisoners Point: Relaxation Provision

The D-1485 objective for Prisoners Point did not include a relaxation provision. However, consideration of a relaxation provision is appropriate, should one of the alternatives which improve water quality above the present objective of 0.55 mmhos/cm EC be selected.

5.6.2.5 Temperature Objectives

Evidence presented in Phase I, and analysis of other data, indicate that high water temperatures may result in some possible losses of bass eggs and young. However, these losses are not considered significant. Temperature issues are discussed in Appendix 5.4.6. Based on the information available, no special measures are warranted at this time.

5.6.3 Potential Objectives

In view of the above considerations, the State Board has developed the following potential objectives at these locations, in addition to the possible retention of the current objectives.

5.6.3.1 Antioch: Period of Protection for Spawning
5.6.3.2 Antioch: Relaxation Provision
5.6.3.3 Prisoners Point: EC Modification
5.6.3.4 Prisoners Point: Relaxation Provision
5.6.3.5 Temperature Objectives

5.6.3.1 Antioch: Period of Protection for Spawning

Objective 1-A The 14-day running average of the mean daily EC at the Antioch Waterworks Intake on the San Joaquin River shall be not more than 1.5 mmhos/cm for the period April 1 to May 31, or until spawning has ended, in all water years.

Objective 1-B The 14-day running average of the mean daily EC at the Antioch Waterworks Intake on the San Joaquin River shall be not more than 1.5 mmhos/cm for the period April 1 to May 31, or until spawning has ended, in all water years, except that protection during the period April 1 to April 14 may be provided by maintenance of an average Delta Outflow Index for that period of not less than 6,700 cfs.

Objective 1-C The 14-day running average of the mean daily EC at the Antioch Waterworks Intake on the San Joaquin River shall be not more than 1.5 mmhos/cm for the period April 1 to May 31, or until spawning has ended, in wet, above normal, and below normal water years; or for the period April 1 to May 21, or until spawning has ended, in dry and critical water years; except that protection during the period April 1 to April 14 in all water years may be provided by maintenance of an average Delta Outflow Index for that period of not less than 6,700 cfs.

5.6.3.2 Antioch: Relaxation Provision

Objective 2-A No relaxation provision.

Objective 2-B The 14-day running average of the mean daily EC at the Antioch Waterworks Intake on the San Joaquin River shall be not more than the values (shown in the table below) corresponding to the deficiencies in firm supplies declared by the SWP and CVP, in dry and critical water years, for the period April 1 to May 31, or until spawning has ended.

| Total Annual Declared Deficiencies (MAF) | April 1 to May 31 EC in mmhos/cm | |
|---|---|---|
| | Dry | Critical |
| 0.0 | 1.5 | 1.5 |
| 0.5 | 1.8 | 1.9 |
| 1.0 | 1.8 | 2.5 |
| 1.5 | 1.8 | 3.4 |
| 2.0 or more | 1.8 | 3.7 |

Linear interpolation is to be used to determine values between those shown.

Objective 2-C Same as 2-B, except that deficiencies are defined as deficiencies in firm supplies declared by a set of water projects representative of the Sacramento River and San Joaquin River watersheds. The specific representative projects and amounts of deficiencies would be defined in subsequent phases of the proceedings under this alternative.

Objective 2-D Same as Objective 2-B or 2-C except the period of protection is April 1 to May 21.

Objective 2-E The 14-day running average of the mean daily EC at the Antioch Waterworks Intake on the San Joaquin River shall be not more than 3.7 mmhos/cm for the period April 1 to May 31, or until spawning has ended, when the April 1, 40-30-30 Sacramento Basin Index is equal to or less than 4.8 MAF.

5.6.3.3 Prisoners Point: EC Modification

Objective 3-A The 14-day running average of the mean daily EC shall be not more than 0.30 mmhos/cm (TDS=170 mg/l) for the period April 1 to May 31, or until spawning has ended, in all water years, at the following stations: Prisoners Point, Buckley Cove, Rough and Ready Island, Brandt Bridge (site), Mossdale Bridge, and Vernalis.

Objective 3-B The 14-day running average of the mean daily EC shall be not more than 0.44 mmhos/cm (TDS=250 mg/l) for the period April 1 to May 31, or until spawning has ended, in all water years, at the following stations: Prisoners Point, Buckley Cove, Rough and Ready Island, Brandt Bridge (site), Mossdale Bridge, and Vernalis.

Objective 3-C The 14-day running average of the mean daily EC shall be not more than 0.44 mmhos/cm (TDS=250 mg/l) for the period April 1 to May 31, or until spawning has ended, in wet, above normal, and below normal water years; or for the period April 1 to May 21, or until spawning has ended, in dry and critical water years, at the following stations: Prisoners Point, Buckley Cove, Rough and Ready Island, Brandt Bridge (site), Mossdale Bridge, and Vernalis.

Objective 3-D The 14-day running average of the mean daily EC shall be not more than 0.44 mmhos/cm (TDS=250 mg/l) for the period April 1 to May 31, or until spawning has ended, in wet, above normal, and below normal water years, at the following stations: Prisoners Point, Buckley Cove, Rough and Ready Island, Brandt Bridge (site), Mossdale Bridge, and Vernalis. In dry and critical water years, the EC objective would be met only at Prisoners Point.

Objective 3-E The 14-day running average of the mean daily EC shall be not more than 0.44 mmhos/cm (TDS=250 mg/l) for the period April 1 to May 31, or until spawning has ended, at the following river reaches in the respective water years:

| | |
|---|---|
| Wet | Prisoners Point to Vernalis |
| Above Normal | Prisoners Point to Mossdale Bridge |
| Below Normal | Prisoners Point to Rough and Ready Island |
| Dry | Prisoners Point to Buckley Cove |
| Critical | Prisoners Point only |

Objective 3-F The 14-day running average of the mean daily EC at Prisoners Point shall be not more than 0.44 mmhos/cm (TDS=250 mg/l) for the period April 1 to May 31, or until spawning has ended, in all water years.

5.6.3.4 Prisoners Point: Relaxation Provision

Objective 4-A No relaxation provision.

Objective 4-B The 14-day running average of the mean daily EC shall be not more than 0.55 mmhos/cm for the period April 1 to May 31, or until spawning has ended, at Prisoners Point only, when the Antioch relaxation provision for spawning protection is in effect.

(It can be argued that the use of the Sacramento Basin 40-30-30 Water Year Index, or SWP and CVP deficiency declaration, to trigger a relaxation on an upper San Joaquin River objective is inappropriate. However, since consensus has not yet been reached on an appropriate San Joaquin Basin Index, it cannot be applied here. On the other hand, the hydrologic record shows that a critical year in the Sacramento Basin is almost always accompanied by similar conditions in the San Joaquin Basin. The State Board urges participants to complete development of a San Joaquin Basin Index for application to upper San Joaquin River objectives as soon as possible.)

5.6.3.5 Temperature Objectives

No temperature objectives are proposed at the present time for protection of adult striped bass migration and spawning, or for survival of young striped bass.

5.7 American Shad

5.7.1 Present Conditions

There are no D-1485 objectives specifically for the protection of American shad, although the striped bass standards were expected to provide collateral protection for American shad as well. DFG estimates of population size based on sampling in the mid-1970s suggest that the population is one-third to two-thirds as large as it was in the early decades of this century (DFG,23). About this same time, DFG lowered the daily catch limit from 50 to 25 fish (Michael Meinz, SWRCB, pers. comm., 6/90). Abundance of adult shad has been relatively stable over the past two decades. However, abundance of juvenile shad may vary by more than an order of magnitude between years, with the strongest year classes occurring with the highest river flows during the spawning and nursery periods (DFG,23).

5.7.2 State Board Considerations

The decline of American shad in the Estuary from levels found early in the century appears to parallel, although perhaps not so severely, the great decline seen in East Coast shad populations (USFWS & NMFS, 1977, viii). Declines in East Coast stocks have been attributed to a variety of causes, including pollution, lack of floodplain management, construction of barrier dams without fish passage facilities, and expanded and indiscriminate inshore and offshore fishing (USFWS & NMFS, 1977, vii-viii). Most of these elements may also be playing a part in the decline in Estuary stocks (DFG,23,23), although DFG cites flows and diversions as the primary areas of concern (T,XXXIX,16:4-18:18;47:7-16). DFG also testified that temperature and salinity, as well as flow, were important to production of American shad (T,XXXIX,24:22-25:1), but did not specify what temperature and salinity requirements were critical to shad production.

Because no information on salinity requirements for shad was presented or obtained from other sources, no salinity objective is offered. However, shad feed on Neomysis and other zooplankton during their spawning migration through the Delta (see Table A4-8), which suggests that the entrapment zone may serve an important function for adults as well as young of the year of this species. The nature of this function warrants study.

The Delta and its tributary streams, especially in the Sacramento Valley, are major spawning and nursery areas for American shad. If young shad react to high temperatures as many other fish species do, they are most sensitive during their first few days to weeks of growth. Young are found in the Delta and at the SWP facilities in midsummer, indicating substantial summer spawning activity within or near to the Delta (DFG,23,8-10). DFG observations indicate that these eggs and young are susceptible to considerable risk from elevated water temperatures: eggs appeared deformed and failed to develop normally when water temperatures were 70°F and above (Michael Meinz, SWRCB, pers. comm., October 1989). As indicated in Table A4-8, the optimum spawning temperature for American shad is between 60° and 70°F. The temperature objective for salmon may serve to protect American shad to some degree. The actual status and population trend of American shad remains unclear. Substantial additional work is recommended in the areas of population, reproduction and ecological requirements for this species, to provide a firm basis for possible future actions.

### 5.7.3 Potential Objectives

On the basis of the foregoing discussion, no objectives for protection of American shad are proposed at this time.

## 5.8 Delta Smelt

### 5.8.1 Present Conditions

Currently there is no D-1485 objective specifically for the protection of the Delta smelt, Hypomesus transpacificus, in the Delta. The Delta smelt is endemic to the Sacramento-San Joaquin Delta-Estuary (Moyle, 1989) and, at present, is not known to exist anywhere else in the world (Federal Register, Volume 154, No. 4). Their range extends from below Mossdale on the San Joaquin River and Isleton on the Sacramento River to Suisun Bay, Carquinez Strait and San Pablo Bay during portions of the year (Moyle, 1976).

The population of Delta smelt, once very common in the upper Estuary, has been declining over time and appears to be critically low. Several sources of information regarding long-term trends in Delta smelt numbers are available, the primary ones being: (1) DFG, mid-water trawl surveys (Stevens et al., 1990); (2) research and monitoring data from the University of California at Davis (UC Davis) (Moyle and Herbold, 1989; Moyle and Herbold, 1990); and (3) and screen salvage data from the Byron and Tracy Pumping Plants (SWC,1990;DFG,17,1-20). The data from the

pumping plants are not very reliable due to the lack of an effective quality control program which may have resulted in misidentification (e.g., other species of smelt or other fish altogether) and other recording errors (SWC, 1990). Each data set however indicates a decline in the numbers of Delta smelt.

DFG (Stevens et al., 1990) stated that like the summer townet survey, the fall midwater trawl survey indicates that abundance of Delta smelt has been highly variable and has suffered a major decline. Bay survey catches show a striking decline in Delta smelt abundance after 1981, and since 1981 there has been an irregular but persistent decline. Part of this is due to the fact that the four of the last five years were low flow years and the population has been concentrated in the Delta. In the seine survey, the lowest average catches of adult Delta smelt occurred in 1980 and 1984-1989. The persistent low catches from 1984-1989 are consistent with the population decline exhibited by the midwater trawl and summer townet surveys. The DFG concluded that "the relatively stable, albeit low, population is not in imminent danger of extinction," however the Delta smelt may well "become an endangered species in the foreseeable future."

The Delta Smelt Index (Stevens and Miller, 1983) has been calculated annually from 1967-1990, except for 1974 and 1979 when no surveys were conducted; it shows an overall decrease in population size, especially from 1980-1988 (see Table 5-3; Figure 5-4). The population has fluctuated a great deal over the years; however, since 1983, the population has been consistently low. The UC Davis data show a similar trend. Several factors have possibly contributed to the decline, including invasions of exotic phytoplankton and invertebrates, entrainment into diversions and modification of the Delta smelt habitat.

### 5.8.2 State Board Considerations

Delta smelt are affected by the location of the entrapment zone, which appears to be important to their survival. When the entrapment zone is located in the deep, narrow channels of the Delta and Sacramento River, or in Carquinez Strait and the deeper parts of San Pablo Bay, primary productivity is lower (Moyle and Herbold, 1989). When the entrapment zone is located in Suisun Bay, the nutrients and algae can circulate in sunlit water, allowing algae to grow and reproduce rapidly, in turn, providing an abundance of food for plankton-feeding fish, such as the Delta smelt (Moyle, 1989). Years of major decline in the Delta Smelt Index occurred not only in dry years (1987,1988) but also wet years (1982,1986); in both cases, the entrapment zone moved out of Suisun Bay. Thus, Stevens and Miller (1983) did not develop a regression model for Delta smelt because all of the correlations between their abundance and flow measurements were not statistically significant. One of the strongest determinants of Delta smelt abundance is high primary productivity (as reflected by phytoplankton abundance) in late spring, April to June (Moyle and Herbold, 1989).

Table 5-3

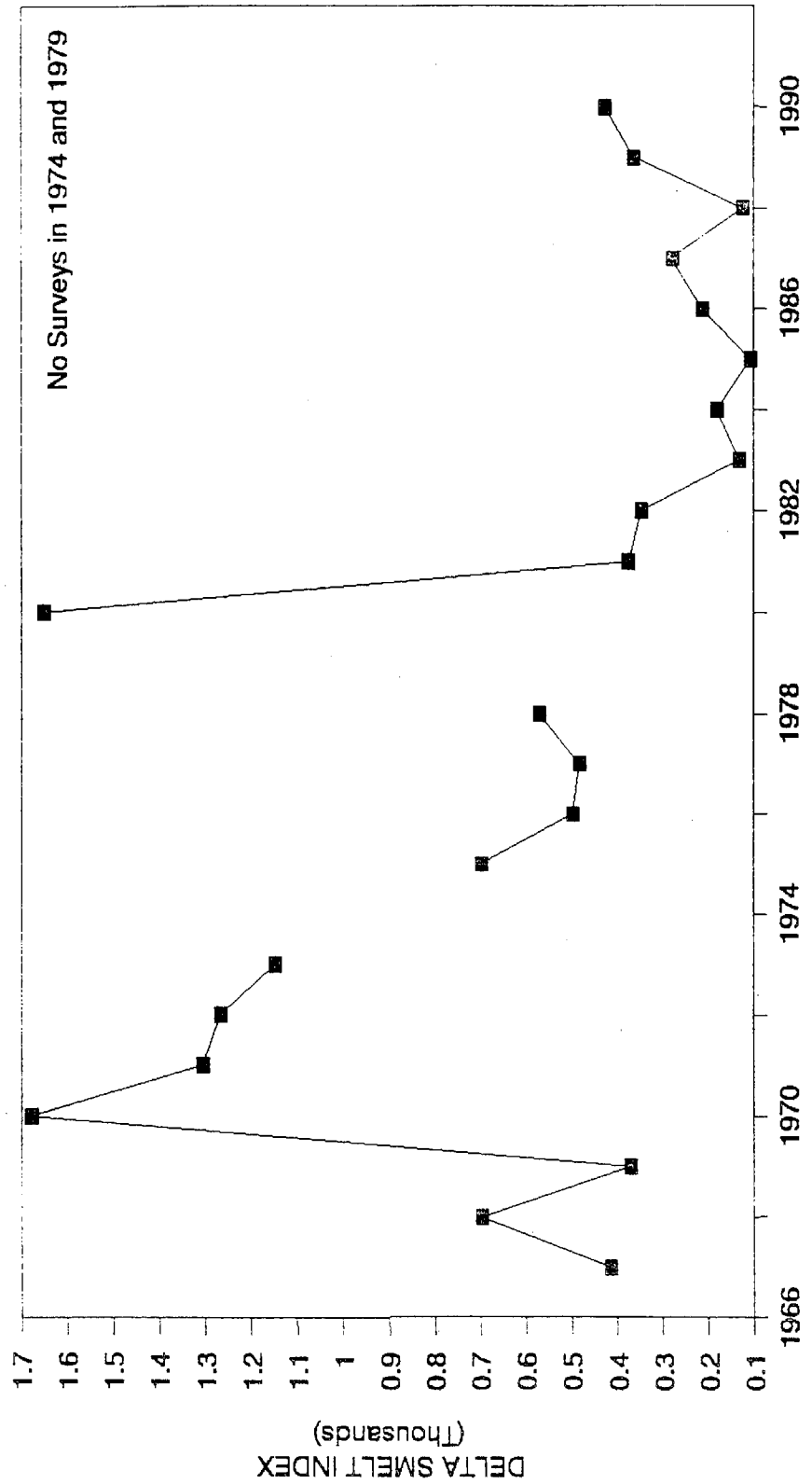
DELTA SMELT ABUNDANCE INDEX
MIDWATER TRAWL SURVEY
1967-1990

| YEAR | INDEX |
|---|---|
| 1967 | 415 |
| 1968 | 697 |
| 1969 | 371 |
| 1970 | 1678 |
| 1971 | 1305 |
| 1972 | 1267 |
| 1973 | 1146 |
| 1974 | |
| 1975 | 698 |
| 1976 | 497 |
| 1977 | 483 |
| 1978 | 570 |
| 1979 | |
| 1980 | 1651 |
| 1981 | 375 |
| 1982 | 346 |
| 1983 | 132 |
| 1984 | 181 |
| 1985 | 109 |
| 1986 | 212 |
| 1987 | 280 |
| 1988 | 126 |
| 1989 | 364 |
| 1990 | 427 |

Note: Trawl surveys were not conducted in 1974 & 1979.

From Stevens, D.E., L.W. Miller and B.C. Bolster. 1990. Report to the Fish and Game Commission: A status review of the Delta smelt (Hypomesus transpacificus) in California.

# Figure 5-4 Delta Smelt Index Values




Stevens, D.E., L.W. Miller and B.C. Bolster. 1990. Report to the Fish and Game Commission: A status review of the Delta smelt (Hypomesus transpacificus) in California. Department of Fish and Game.

Further study will be required to define more specifically the habitat requirements of the Delta smelt and identify the variables contributing to their decline. The Fish and Game Commission has made a decision not to place the Delta smelt on the endangered species list; however, further analyses are being conducted in part for the requirements of the state and federal Endangered Species Acts.

Delta smelt habitat indicates a salinity preference of less than 2 ppt and seldom greater than 10 ppt (Ganssle, 1966 in SWC 1990) (less than 15 mmhos/cm EC). Another critical life history characteristic is that they spawn in sloughs and channels in the upper Delta, although spawning has also been recorded in Montezuma Slough in Suisun Bay (Moyle, 1989; SWC, 1990). They spawn from January through May and where they spawn may be influenced by the location of the fresh-saltwater interface during this time period (Moyle and Herbold, 1990). Peak numbers of smelt are salvaged at the SWP and CVP pumping plants each year during April and May (SWC, 1990, Figure 7). These smelt are either the spawning adults or the larval smelt (the information presented does not indicate which stage of development). One effective means of reducing impacts to the Delta smelt would be to reduce entrainment into the SWP and CVP pumping plants.

The location of the entrapment zone appears to be important to the survival of the Delta smelt. Although the precise level of salinity that separates acceptable and unacceptable spawning conditions is not known, existing knowledge suggests that salinities of 2 ppt or less are desired in Suisun Bay from March through June. The same needs exist for protection of the Delta smelt nursery area in Montezuma Slough (WQCP-USFWS-5). As the entrapment zone is a flow issue, this will be discussed in the Scoping and Water Right Phases of the proceedings.

There is insufficient information to set an EC or salinity objective for spawning for Delta smelt at present. Further study may provide an objective to help reverse their decline. Further studies are proposed for determining, with greater accuracy, the abundance and the factors affecting Delta smelt abundance in the Delta. The details of these studies will be discussed in the Program of Implementation, Chapter 7. Subsequent review of data may lead to appropriate water quality objectives.

### 5.8.3 Potential Objectives

No potential salinity or temperature objectives can be specified at this time.

## 5.9 Other Resident Fish in the Bay-Delta Estuary

### 5.9.1 Present Conditions

The Department of Fish and Game presented information on several species of resident fish found in the Bay-Delta Estuary (Appendix 4). The information on water quality habitat criteria was of a very general nature. Some species, for example, were said to have a relatively greater preference, or tolerance, for higher levels of dissolved solids or turbidity than other species. DFG recently submitted a report on white sturgeon that states the fish move up or downstream in response to salinity changes and that management of the volume of freshwater flow may be important in maintaining the sturgeon population (WQCP-DFG-1).

5.9.2 State Board Considerations

For the majority of the resident fish of the Estuary, the material presented is insufficient to be used to develop water quality objectives.

5.9.3 Potential Objectives -- None

5.10 Suisun Marsh

**Conclusions:**

- **The Board believes that the managed portions of Suisun Marsh are currently being protected by D-1485 as amended in 1985. The protections, including the operation of the Suisun Marsh Salinity Control Gate, are being used and evaluated.**

- **A biological assessment is needed to assess the water quality requirements of the rare, threatened and endangered plants and animals (and their habitats) in the wetlands surrounding Suisun Bay to determine reasonably necessary amendments and additions to the Suisun Marsh objectives. The results will likely not be available in time for inclusion in the final Bay-Delta Environmental Impact Report or water right decision in 1992. Shortly thereafter, the objectives will be evaluated and incorporated as warranted.**

5.10.1 Present Conditions

Since adoption of the Delta Plan and D-1485 in 1978, the SWP and CVP have been operated to meet the "interim standards." The water quality has thus been equal to or better than the interim standards.

Since the adoption of the 1978 Delta Plan and D-1485, the Four Parties have worked to implement the Plan of Protection (see Appendix 5.6). The interim Suisun Marsh standards in the 1978 Delta Plan, as implemented by D-1485, were met consistently by the DWR and the USBR. The internal marsh control stations on Montezuma Slough at National Steel and near Beldon's Landing became effective on October 1, 1988, in accordance with the amended schedule of compliance approved by the State Board on December 5, 1985 ("amended D-1485").

The improved duck club management schemes discussed in the Plan of Protection have been, for the most part, implemented. Some other intake or drainage improvements may still be needed. Construction of the Suisun Marsh Salinity Control Gate (referred to in the 1978 Delta Plan and described in more detail in the Plan of Protection) was completed in 1988; testing was begun in the winter of 1988-89 and continued through 1990. Full operation of the control gates causes a fairly rapid drop in salinity at Beldon's Landing, with a slower and more limited change in salinity in the western Marsh (farther downstream). Further testing to refine the optimal scheme for operation of the structure was done during the winter of 1990-91. The extent of the control gate's effects on western Suisun Marsh water quality will help determine whether or not additional structures mentioned in the Plan of Protection are needed, and, if any are needed, which one(s) would be best.

5.10.2 State Board Considerations

A technical analysis of the water quality standards in the SMPA is found in Appendix 5.6, Technical Analysis of the SMPA.

The 1978 Delta Plan listed eight salinity control stations for the original Suisun Marsh objectives. Seven of these stations were interior marsh stations; the eighth was on the Sacramento River at Collinsville Road, upstream of Montezuma Slough. In 1985 the State Board amended D-1485 to change both some control station locations and the compliance schedule.

The control stations on the Sacramento River at Collinsville (C-2) and Suisun Slough near Volanti Slough (S-42) were not changed. The station on Cordelia Slough above S.P.R.R. (mis-labeled S-32 in the Delta Plan) is actually the same as the station on Cordelia Slough, 500 feet west of the Southern Pacific crossing at Cygnus (S-33).

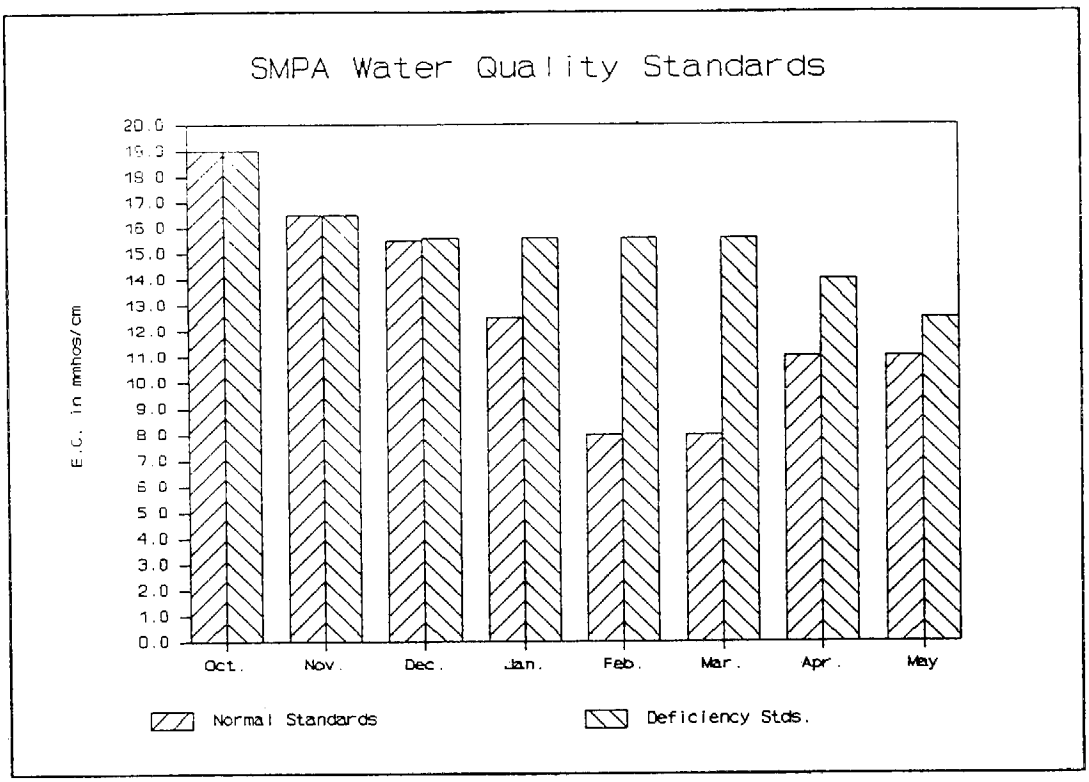
The station at Miens Landing on Montezuma Slough (S-64) was replaced with National Steel on Montezuma Slough (also S-64), three miles to the south (upstream) of Miens Landing. The station on Montezuma Slough at Cutoff Slough (S-48) was replaced with Montezuma Slough near Beldon's Landing (S-49), 0.35 miles east of Grizzly Island Bridge, approximately one-half mile upstream from the old station. The station on Goodyear Slough south of Pierce Harbor (S-35) was moved about one-half mile upstream to the Morrow Island Clubhouse, but is still designated S-35. These changes would not seem to change the level of protection afforded by the original Delta Plan stations.

The major change that the amended D-1485 made in the salinity control stations was the elimination of the two westernmost stations in Suisun Slough near its mouth (mis-labeled S-31 in the Delta Plan, actually designated S-36) and Montezuma Slough near its mouth (no exact designation in the Delta Plan, but often called D-7 in other documents). No substitutes for S-36 and D-7 are proposed. The managed marshes in this area now receive water from inland sources rather than Grizzly or Suisun bays.

Based upon the work done to date, the "Normal Standards" (see Figure 5-5) in the SMPA may adequately protect the managed wetland habitat of the Suisun Marsh. However, the SMPA also contains relaxations of these conditions during dry periods. The State Board needs additional information on the water quality requirements of the rare, threatened, and endangered species identified since DWR prepared the 1984 Plan of Protection before it can consider modifying the current water quality objectives.

A biological assessment under CESA and ESA is needed to determine the water quality requirements of the rare, threatened, and endangered plants and animals (and their habitats) in the wetlands surrounding Suisun Bay (see Chapter 7 for a description of the information needed). Based upon the results of the biological assessment, the State Board will review the proposed water quality objectives and determine if any changes are needed. The State Board will then, in a later action, assign responsibilities for meeting any changed objectives.

# Figure 5-5




| Month | SMPA-Normal Standards (Mean Monthly High Tide, E.C. in mmhos/cm) | SMPA-Deficiency[1] Standards (Mean Monthly High Tide, E.C. in mmhos/cm) |
|---|---|---|
| Oct. | 19.0 | 19.0 |
| Nov. | 16.5 | 16.5 |
| Dec. | 15.6 | 15.6 |
| Jan. | 12.5 | 15.6 |
| Feb. | 8.0 | 15.6 |
| Mar. | 8.0 | 15.6 |
| Apr. | 11.0 | 14.0 |
| May | 11.0 | 12.5 |

[1] SMPA Article 1(f): "Deficiency Period" shall mean (1) a Critical Year following a Dry or Critical Year; or (2) a Dry Year following a year in which the Four Basin Index was less than 11.35; or (3) the second consecutive Dry Year following a Critical Year.

SMPA Article 1(r): "Wet Year", "Above Normal Year", "Below Normal Year" and "Subnormal Snowmelt Year" are as defined in Footnote 2 of Table II of D-1485 as adopted by the SWRCB in August 1978. "Critical Year" and "Dry Year" are also as defined in Footnote 2 of Table II of D-1485 except that runoff for the remainder of the water year shall be assumed to be equal to the lower value of the 80 percent probability range, as shown in the most recent issue of Bulletin 120, "Water Conditions in California".

5.10.3 Potential Objectives

In order to allow sufficient time for the biological assessment to be completed, the State Board will continue implementation of the interim standards for Suisun Marsh as identified in the 1978 Delta Plan. An implementation plan is proposed, with the first stage based on D-1485 as amended in 1985. A discussion of this implementation plan is found in Chapter 7 (see also Table 1-2).

5.11 Wildlife Habitat in Other Tidal Marshes

- **Water quality objectives for San Pablo Bay exist in the Statewide Water Quality Plan for Enclosed Bays and Estuaries of California and in the Water Quality Control Plan for Region 2.**

5.11.1 Present Conditions

The tidal marshes outside the legally-defined Suisun Marsh include the southern shore of Suisun Bay (essentially from Pittsburg to Martinez) as well as the marshes around San Pablo Bay, Central Bay, and South Bay.

The current objectives provide protection for the managed marshes within the legally-defined Suisun Marsh. No water quality objectives were set specifically for tidal marshes either inside or outside the legally-defined Suisun Marsh.

5.11.2 State Board Considerations

The marshes of Central San Francisco Bay and South Bay support mostly pickleweed or cordgrass. DFG testified that they have concluded that these salt marshes would not be adversely affected by changes in the salinity regime in the northernmost portion of the Bay-Delta area (T,XXIX,146:22-147:2). The State Board concurs with the conclusions of DFG and therefore does not plan to set water quality objectives specifically for the protection of the Central and South Bay salt marshes.

San Pablo Bay is a transition zone between the saline waters of Central Bay and the brackish to fresh waters of Suisun Bay (T,XXIX,147:3-6). DFG testified that reductions in Delta outflow could result in a vegetative shift from cattails and tules to more salt-tolerant plant species such as cordgrass and pickleweed (T,XXIX,186:18-25; DFG,7,11-12). Such a vegetative shift would be detrimental to some wildlife species and beneficial to others (T,XXIX,187:1-8,223:15-224:7; DFG,7,11-13). DFG considers some impacts on rare plants to be possible.

There is no evidence that might allow the Board to set water quality objectives at this time specifically for the protection of the San Pablo Bay marshes.

The south shore of Suisun Bay is outside the legally-defined Suisun Marsh. Many of the plants and animals found in the unmanaged wetlands of the Suisun Marsh are also found in the tidal marshes of the south shore (also called the Contra Costa County shoreline). The federal and state-listed threatened, endangered, and candidate species found within the legally-defined Suisun Marsh may also be found in the south shore marshes. In addition, the federal and state-listed endangered California least tern (Sterna antillarum browni) has two nesting colonies on the south shore (USFWS,20). Additional information regarding listed species is found in Appendix 4.6.2 and Appendix 5.5.

In addition to the possible direct effects on the habitat (for animals) or on the survival (for plants, especially) of the listed species, changes in the salinity regime could indirectly affect a species by effects on its prey base. The most sensitive species in this regard is the endangered California least tern. The least terns require a nearby supply of small fish in shallow water areas (DFG, At the Crossroads 1980, p.101). USFWS testified that changes in water quality standards that could result in changes in the location of the entrapment zone could significantly affect the prey base for the tern (T,XXX,6:1-6).

Staff compared the water quality objectives proposed by BCDC for protection of the unmanaged tidal marshes outside of the legally-defined Suisun Marsh (BCDC,5,T4) and those for Suisun Marsh in the 1978 Delta Plan (SWRCB,1978,Table VI-1,p.VI-33). The BCDC proposal is based on historical records for the period 1950 to 1977 when brackish tidal marshes persisted in the area (BCDC,5,31-32). Direct comparison of the two sets of values is difficult since BCDC presented only the high-high tide salinities (mean tide salinities adjusted to high tide salinities [BCDC,5,31]) while the 1978 Delta Plan used the daily mean of both high tide salinities.

It is not possible to determine at this time whether or not the stations proposed by BCDC would provide better locations than the 1978 Delta Plan stations at Chipps Island and in Grizzly Bay at which protective levels for south shore tidal marshes can be accurately measured.

### 5.11.3 Potential Objectives

As stated in Section 5.10.2 a new biological assessment will be prepared. Based on the results of the biological assessment, the State Board will decide if additional objectives should be adopted.

## 5.12 Benthos

### 5.12.1 Present Conditions

Densities of benthic organisms are highly variable in the Estuary. At any location their survival, growth and reproduction can be affected by factors such as predation, disease, parasites, currents which carry them away, salinity regime, and broodstock population size (DFG,60,57). Density estimates[1] as high as 910 to 1153 grams of biomass per square meter ($g/m^2$) are reported in South Bay channels, and as low as 4 to 17 $g/m^2$ in the channels of San Pablo Bay. Suisun Bay has benthic

*1/ Abundance or density of benthic organisms measured by biomass per square meter.*

invertebrate biomass ranging from 25 to 34 g/$m^2$ in channel substrates and from 6 to 30 g/$m^2$ in shoal areas (CCCWA/EDF,10,T2). The number of organisms varies much more than the biomass, with a few large animals sometimes equalling the biomass of many smaller ones. At the Carquinez Strait, this biomass was made up of about 160,000 and 40,000 organisms/$m^2$ in June and October of 1976; 25,000 organisms/$m^2$ in March of 1977; and less than 1,000 organisms/$m^2$ in October 1977 and in 1978 (Markmann,1986,F8-F11). Numbers of organisms per square meter at all stations were low in 1978; numbers appeared to recover to about 40,000 organisms/$m^2$ in the western Delta (Station D4) in 1979 and 1981, although Carquinez Strait stations were no longer sampled (Markmann,1986,F8-F11). The brief peak in organism numbers in 1976 and 1977 during a major drought was due in part to an invasion of Suisun Bay by the filter-feeding clam, Mya arenaria, which replaced the usual deposit-feeding fauna (CCCWA/EDF,7,383).

Only limited evidence on the uses of benthic organisms was presented by participants in Phase I. Sport shellfishing is one use of benthic organisms, but their acceptability may be limited by pollutants (T,LIV,56:10-58:4). Both CBE and CCCWA/EDF noted that benthic organisms, especially shellfish, were food for several species of fish in the Estuary, including striped bass, starry flounder, sturgeon, English sole and staghorn sculpin (T,LIV,59:14-16;192:5-8).

### 5.12.2 State Board Considerations

Understanding of the benthos and its relationship to the overall estuarine ecosystem is still limited, and the introduction and rapid proliferation of Potamocorbula amurensis have further complicated benthic data analysis. Substantial additional information is required to provide a basis for possible future actions.

### 5.12.3 Potential Objectives

No objectives are proposed for the protection of benthic organisms at this time.

## 5.13 Marine Habitat

### 5.13.1 Present Conditions

The marine habitat outside the Golden Gate is not formally included in the definition of the San Francisco Bay-Delta Estuary (Workplan). However, the nearshore ocean habitat in the Gulf of the Farallones is closely interrelated with the Estuary by means of freshwater outflow, gravitational circulation, and tidal exchange.

Testimony presented in Phase I concerning outflows from San Francisco Bay described two main effects on marine habitat. The first is that the plume of freshwater in the Gulf of the Farallones provides for an abundant amount of marine life and thus serves as a concentrated feeding habitat for fish, marine mammals and birds (T,LIV,142:13-153:3). Two bird species which particularly use this plume area are the Brandt's cormorant and the common murre (T,LIV,154:3-13). The second effect of

San Francisco Bay outflow is related to the movement of organisms, especially the larvae and juveniles of finfish and shellfish, into the Bay (T,LI,267:23-268:4). In certain cases, such as for bay shrimp, movement of larvae out of the Bay into the Gulf of the Farallones and their return later in the year is facilitated by higher Bay outflows (T,LI,272:6-19). In some circumstances, pulse flows, and their timing, were shown to be important in the determination of abundance of larvae (T,LI,289:5-25). The larvae or adults of English sole, Dungeness crab, Pacific herring and northern anchovy are transported back into the Bay on the bottom current inflows (T,LI,292:15-25).

5.13.2 State Board Considerations

All evidence presented relates to flow rather than salinity factors. The relationship between outflow and effect on beneficial uses has not been quantified. Therefore, protection for marine habitat will be considered if further information becomes available.

5.13.3 Potential Objectives -- None

5.14 Navigation

5.14.1 Present Conditions

At present, U.S. Army Corps of Engineers (COE) criteria provide primary protection for the navigation beneficial use in the Estuary and its tributaries. For example, the CVP is required to maintain a flow of 5,000 cfs at Wilkins Slough, just below the Tisdale Wier on the Sacramento River, for protection of shallow water commercial navigation (T,I,43:15-21). In critical years the flow required is 4,000 cfs (Mike Jackson, USBR, pers. comm., 10/17/89). Likewise, the SWP and CVP export pumps currently operate to COE criteria: maximum flow rates for Clifton Court Forebay are stipulated for various times of the year to maintain minimum depths in South Delta channels (DWR,708,10). There are no Delta Plan objectives in effect specifically for the protection of this beneficial use.

5.14.2 State Board Considerations

The issues of water quality objectives for navigation are concentrated in a few specific areas: present effects of navigation channels and dredging, effects of planned projects to enhance navigation, and consideration of the effects of other projects on the navigation beneficial use. The present COE requirements are not directly related to salinity or temperature objectives for protection of the navigation beneficial use.

Navigation in the Estuary is enhanced by a network of deepwater channels to the major ports, including Sacramento and Stockton. These channels have two major effects. The deeper channels allow increased salt water intrusion into the Estuary (T,LVI,176:9-178:8;DWR,709,1-2). The proposed deepening of the Sacramento River Deep Water Ship Channel from its current 30-foot depth to 35 feet (COE, pers. comm., 10/89) could result in additional salt water penetration into the Delta in the future.

This increased salinity may have impacts on other beneficial uses such as recreational boating, which could see greater maintenance costs from hull fouling, corrosion of propellors and structures, and related problems (T,LV,158:1-7). Increased salinity intrusion could increase the amount of carriage water required to maintain Estuary salinity objectives, and may have impacts on other beneficial uses, such as recreation and sport fishing.

The second effect of the deepwater channels is the impact of dredging and dredge spoils disposal on water quality (see, for example, T,XLVIII,71:20-102:9). In 1985, nearly 8.6 million cubic yards of material were dredged in the Estuary, at a cost of more than $17 million (NOAA, 1986,97). Current and proposed actions, such as the disposal of dredge spoils from Oakland Harbor on Delta island levees, have water quality implications, but these are primarily related to pollutants and turbidity. The water quality impacts of dredging are discussed in the Pollutant Policy Document.

Other proposed projects, such as North Delta and South Delta facilities, could affect the navigation beneficial use, but the effects would primarily be the disruption or blockage of navigation channels. Effects of new projects on the navigation beneficial use will be considered when these projects are formally proposed.

### 5.14.3 Potential Objectives

At present there is no information which indicates that salinity or temperature objectives are needed to protect the navigation beneficial use.

## 5.15 Estuary Recreation Beneficial Use

### 5.15.1 Present Conditions

There are no Delta Plan objectives for the protection of the estuary recreation beneficial use. The waters of the Estuary are used for a variety of contact and non-contact forms of recreation, including swimming, boating, fishing, hunting, water skiing, and houseboating. The waters are also used for competitive events, marine parades and emerging activities, such as boardsailing and jetskiing. There are a variety of water-oriented, non-contact activities, such as sightseeing and bird watching, which depend on the esthetics or visual quality of the Estuary's waters to some degree (EBRPD,1,33).

Delta

SWC presented figures for projected user-days and economic values for freshwater recreation in the Delta as compared to similar types of recreation at storage and export reservoirs and facilities (SWC,65,24). Freshwater-oriented recreation in the Delta was estimated to be 8.3 million user-days in 1977-78, although this number includes some activities which do not depend entirely on the Delta's waters. However, brackish and ocean water activities were not included in the total (SWC,66,5). Testimony and evidence indicated that recreation visits to

Estuary shoreline park facilities have been growing rapidly compared to the projections used by SWC, i.e., 122 percent in two years vs. 0.8 percent/year (EBRPD,24,T1). Millions of user-days per year and daily values of $20 or more per user day for water use are calculated for recreational use of Estuary water (BISF,38,T4). An extrapolation of old studies of Delta recreation has generated estimates in the range of 13 million recreation-days annually (PICYA,2,51). No recent information based on recreation use studies is available (T,LV,137:13-16).

Suisun Marsh and Carquinez Straits Area

Some evidence was submitted on the recreational use of the Suisun Marsh or Carquinez Straits area of the Bay-Delta Estuary. BAAC submitted evidence inferring that bird-watching goes on in the Suisun Marsh (BAAC,20,26,27). From evidence submitted by EBRPD, estimated recreation at its Contra Costa shoreline facilities (Antioch and Martinez shoreline) has increased rapidly from 1981 to 1987, growing from 84,000 visitors to 287,000 visitors, or about 240 percent in six years (EBRPD,34,T1). There is little evidence linking the quantity of recreation in this reach to water quality. Both BAAC and EBRPD expressed concern that visitors to these recreational areas would experience losses of the value they place on wildlife and fish resources if those resources were harmed by flow decreases and resulting salinity increases (T,XXX,45:12-23; T,LV,184:15-25,185:1-2).

Recreational use in EBRPD units with water quality problems, Point Isabel and San Leandro Bay, increased from 71,000 to 487,000 users between 1981 and 1987, an increase of over 680 percent (EBRPD,34,T1). In comparison, the rate of growth at the nearby, unpolluted Hayward and Miller-Knox shorelines has moved from 21,000 users to 196,000, an increase of 830 percent in the same time. There was no specific information on the features which prompt users to attend the various park units, nor on the method by which use estimates were made. It does not seem reasonable to suppose that a moderate change (of one or two parts per thousand) in salinity would substantially change future recreational use. This might not be true if the change were such as to convert a freshwater beach to saltwater; however, no data are in the record on this subject.

San Francisco Bay and Adjacent Ocean

The Basin Plan for Region 2, the San Francisco Bay Basin, identifies most of the same forms of recreation as in the Delta. Recreational uses are identified for the Pacific Ocean, the San Francisco Bay system and all other surface waters (RWQCB,2,1975). Water-oriented recreation in the San Francisco Bay area was estimated to total over 127 million user-days (BISF,38,T3).

5.15.2 State Board Considerations

Water quality objectives to protect specific fish species and marsh habitat areas are intended to protect recreational uses also.

5.15.3 Potential Objectives

No other objectives for recreational use are proposed for consideration.

5.16 Export Recreation and Export Fishery Habitat

5.16.1 Present Conditions

There are no specific Delta Plan objectives for the protection of the export recreation and export fishery habitat. The SWP and CVP reservoirs and conveyance channels provide a warm water fishery habitat, and export area recreation occurs primarily at the reservoirs. Salinity throughout the system is largely controlled by the quality of the Delta water being exported. Water temperature in the export system is a function of ambient Delta water temperatures, export area weather, and project operations (flow rates, reservoir storage levels, etc.). Water temperatures in reservoirs tend to become critical primarily under conditions of extreme drawdown.

5.16.2 State Board Considerations

No participant proposed any salinity or temperature objectives specifically for protection of export recreation and fisheries. As stated before, the SWP and CVP operate to not exceed a minimum export water quality of 250 mg/l chlorides.

5.16.3 Potential Objectives

Because the factors which determine water temperature and salinity in the facilities in the export areas are influenced primarily by operation of these facilities, local water conditions, and Delta water quality, establishment of a separate specific objective for protection of export recreation and export fishery habitat is not warranted.

5.17 Export Agriculture

**Conclusions:**

- **Water is exported from the Delta for agricultural use in the San Joaquin Valley and southern California.**
- **To reasonably protect crops grown in the export areas, water quality objectives were developed using almonds orchards as the representative salt-sensitive crop.**
- **The Board finds that the objective of 1.0 mmhos/cm EC reasonably protects salt-sensitive crops grown in the San Joaquin Valley and southern California.**

5.17.1 Present Conditions

The Delta Plan does not contain any water quality objectives for export agriculture.

5.17.2 State Board Considerations

The drinking water objective, which is about 1.0 mmhos/cm EC, would protect most agricultural uses (see Potential Objectives in this section) of the exported water for irrigation of crops grown in the San Joaquin Valley and southern California. However, whenever a beneficial use of water exists and an appropriate objective can be specified, the use should be provided with specific protection.

5.17.3 Potential Objectives

A water quality objective of 1.0 mmhos/cm EC will be considered for the CVP and SWP export pumps for the protection of export agriculture. This objective fully protects the most sensitive crop in the CVP and SWP service area which constitutes at least 5 percent of each service area, respectively, and provides reasonable protection for minor crops. Based on information on CVP crop acreages (CVPWA,12; EDF,11,G-148), and SWP crop acreages (DWR,489h), the crops which constitute at least 5 percent of either service area are shown in Table 5-4. Salinity tolerances, in terms of EC, of several crops shown in export areas were presented by DWR (DWR,327).

TABLE 5-4

CROPS COMPRISING AT LEAST FIVE PERCENT OF EITHER THE CVP OR SWP SERVICE AREAS AND THEIR SALINITY TOLERANCES

| Crop | Salinity Tolerances, EC (mmhos/cm) | Crop as % of CVP Service Area | Crop as % of SWP Service Area | Crop as % of CVP & SWP Service Area |
|---|---|---|---|---|
| Cotton | 5.1 | 36.5 | 47.2 | 39.4 |
| Alfalfa | 1.3 | 8.5 | 9.0 | 8.6 |
| Wheat | 4.0 | 7.1 | 6.7 | 7.0 |
| Tomatoes | 1.7 | 6.9 | 0.4 | 5.0 |
| Orchards | 1.0 | 6.3 | 15.5 | 8.8 |

5.18 Matrix of Alternative Water Quality Objectives

Table 5-5, Alternative Water Quality Objectives, summarizes beneficial uses according to three categories described in this chapter and Appendix 5.0:

- o Present Objectives
- o Advocated Levels (of Protection)
- o Potential Objectives

## Chapter 5 References

Brown and Caldwell. 1989. Delta Drinking Water Quality Study. May.

California Department of Fish and Game. 1988. Striped Bass Egg and Larva Monitoring, and effects of flow regulation on the larval striped bass food chain, in the Sacramento-San Joaquin Estuary. Final Report to: The State Water Resources Control Board.

California Department of Fish and Game. 1989. Description of Winter Chinook Ocean Harvest Model. Prepared in consultation with the National Marine Fisheries Service and the U.S. Fish and Wildlife Service.

California Department of Fish and Game. 1989. Winter run chinook salmon salvage at the SWP and CVP facilities in the South Delta. Memorandum to H.P. Chadwick, Program Manager, Bay-Delta Project July 13, 1989.

Clark, S. 1989. Delta Municipal and Industrial Water Quality Workgroup to the SWRCB Bay-Delta Hearing Proceeding, Appendix A1.

Daniel, P. 1989. Delta Municipal and Industrial Water Quality Workgroup to the SWRCB Bay-Delta Hearing Proceeding, Appendix A6.

Delta Municipal and Industrial Water Quality Workgroup to the SWRCB Bay-Delta Hearing Proceeding, 1989.

Farley, Timothy C. 1966. Striped bass, Roccus saxatilis, spawning in the Sacramento-San Joaquin river systems during 1963 and 1964. pp. 28-43. In: Turner, Jerry L. and D.W. Kelley. Ecological Studies of the Sacramento-San Joaquin Delta. Part II Fishes of the Delta. California Department of Fish and Game Fish Bulletin 136. 168 pp.

Gaston, J. 1989. Delta Municipal and Industrial Water Quality Workgroup to the SWRCB Bay-Delta Hearing Proceeding, Appendix A3.

Hallock, R.J. and F.W. Fisher. 1985. Status of winter run chinook salmon, Oncorhynchus tshawytscha, in the Sacramento River. DFG Anadromous Fisheries Branch, January 25, 1985.

Jung, M. 1989. Delta Municipal and Industrial Water Quality Workgroup to the SWRCB Bay-Delta Hearing Proceeding, Appendix A8.

Krasner, S. 1989. Delta Municipal and Industrial Water Quality Workgroup to the SWRCB Bay-Delta Hearing Proceeding, Appendix A10.

Markmann, Carla. 1986. Benthic Monitoring in the Sacramento-San Joaquin Delta. Results from 1975 Through 1981. IESP Technical Report 12. 56 pp.

Means, Thomas H., Consulting Engineer. 1928. Salt Water Problem: San Francisco Bay and Delta of Sacramento and San Joaquin Rivers, April 1928.

Moyle, P.B. 1976. Inland Fishes of California. University of California Press, Berkeley.

Moyle, P.B. and B. Herbold. 1989. Status of the Delta smelt, Hypomesus transpacificus. Report to the U.S. Fish and Wildlife Service, Office of Endangered Species, Sacramento, California.

Moyle, P.B., J.E. Williams, and E.D. Wikramanayake. 1989. Fish species of special concern of California. Final report prepared for State of California, Department of Fish and Game, Inland Fisheries Division, Rancho Cordova, California. 222 pp.

National Oceanic and Atmospheric Administration. 1986. Marine Environmental Assessment, San Francisco Bay, 1985 Annual Summary. 122 pp.

Slater, D.W. 1963. Winter run chinook salmon in the Sacramento River, California, with notes on water temperature requirements at spawning. Special Scientific Report-Fisheries No. 461, Bureau of Sport Fisheries and Wildlife, U.S. Fish and Wildlife Service.

State Water Contractors. 1990. Response of the State Water Contractors to the petition to list Delta smelt as an endangered species. Report submitted to the Natural Heritage Division, California Department of Fish and Game.

Stevens, D.E. and L. W. Miller. 1983. Effects of river flow on abundance of young chinook salmon, American shad, longfin smelt, and Delta smelt in the Sacramento-San Joaquin river system. North American Journal of Fisheries Management 3:245-437.

Stevens, D.E., L. W. Miller. and B.C. Bolster. 1990. Report to the Fish and Game Commission: A status review of the Delta smelt (Hypomesus transpacificus) in California. Department of Fish and Game.

Turner, Jerry L. 1976. Striped bass spawning in the Sacramento and San Joaquin rivers in central California from 1963 to 1972. California Department of Fish and Game 62(2): 106-118.

U.S. Fish and Wildlife Service, and National Marine Fisheries Service. 1977. Proceedings of a Workshop on American Shad. December 14-16, 1976, Amherst, Massachusetts.

Upper Sacramento River Salmon and Steelhead Advisory Committee. 1988. An Evaluation of the U.S. Department of Commerce 1987 Ten Point Program to Restore Sacramento River Winter-Run Chinook Salmon. Report No. 5.

Wang, J.C.S. 1986. Fishes of the Sacramento-San Joaquin estuary and adjacent waters, California: A guide to the early life histories. Interagency Ecological Study Program for the Sacramento-San Joaquin Estuary, Technical Report 9.

Winkler, K., DWR. Memo to Gerald Johns, SWRCB Staff, October 16, 1989.

# TABLE 5 – 5 ALTERNATIVE WATER QUALITY OBJECTIVES

## A) MUNICIPAL AND INDUSTRIAL

| ALTERNATIVES/ SOURCE | LOCATION | SAMPLING SITE NOs. (I-A/RKI) | PARAMETER | DESCRIPTION | INDEX TYPE | YEAR TYPE | DATES | VALUES |
|---|---|---|---|---|---|---|---|---|
| PRESENT OBJECTIVES | | | | | | | | |
| D-1485 | Cache Slough at City of Vallejo Intake | C-19 SLCCH16 | Chloride (Cl-) | Maximum mean daily, in mg/l | Not Applicable | All | Oct-Sep | 250 |
| D-1485 | Contra Costa Canal at Pumping Plant #1 | C-5 CHCCC06 | Chloride (Cl-) | Maximum mean daily, in mg/l | Not Applicable | All | Oct-Sep | 250 |
| D-1485 | Contra Costa Canal at Pumping Plant #1 - or - San Joaquin River at Antioch Water Works Intake | C-5 CHCCC06 / D-12(near) RSAN007 | Chloride (Cl-) | Maximum mean daily 150 mg/l chloride for at least the number of days shown during the Calendar Year. Must be provided in intervals of not less than two weeks duration. (% of Calendar Year shown in parenthesis) | D-1485 (Water Year) / D-1485 (Water Year) | W / AN / BN / D / C | No. of days each Cal. Year < 150 mg/l Cl- | 240 (66%) / 190 (52%) / 175 (48%) / 165 (45%) / 155 (42%) |
| D-1485 | West Canal at mouth of Clifton Court Forebay | C-9 CHWST0 | Chloride (Cl-) | Maximum mean daily, in mg/l | Not Applicable | All | Oct-Sep | 250 |
| | Delta Mendota Canal at Tracy Pumping Plant | DMC-1 CHDMC004 | Chloride (Cl-) | Maximum mean daily, in mg/l | Not Applicable | All | Oct-Sep | 250 |
| ADVOCATED LEVELS | | | | | | | | |
| DWR | Barker Slough at North Bay Aqueduct Intake | - SLBAR3 | Chloride (Cl-) | Maximum mean daily, in mg/l | None Specified | All | Oct-Sep | 250 |
| USBR | Barker Slough at North Bay Aqueduct Intake | - SLBAR3 | Chloride (Cl-) | Maximum mean daily, in mg/l | None Specified | All | Oct-Sep | 250 |
| SWC | Barker Slough at North Bay Aqueduct Intake | - SLBAR3 | Chloride (Cl-) | Maximum mean daily, in mg/l | None Specified | All | Oct-Sep | 250 |
| DWR | Contra Costa Canal at Pumping Plant #1 | C-5 CHCCC06 | Chloride (Cl-) | Maximum mean daily, in mg/l | None Specified | All | Oct-Sep | 250 |
| DWR | Old River near Rancho Del Rio | D-28A ROLD21 | Chloride (Cl-) | Maximum mean daily, in mg/l | None Specified | All | Oct-Sep | 250 |

# TABLE 5 – 5 (cont.) ALTERNATIVE WATER QUALITY OBJECTIVES

## A) MUNICIPAL AND INDUSTRIAL

| ALTERNATIVES/ SOURCE | LOCATION | SAMPLING SITE NOs. (I-A/RKI) | PARAMETER | DESCRIPTION | INDEX TYPE | YEAR TYPE | DATES | VALUES |
|---|---|---|---|---|---|---|---|---|
| ADVOCATED LEVELS (cont.) | | | | | | | | |
| USBR | Contra Costa Canal at Pumping Plant #1 | C-5 CHCCC06 | Chloride (Cl-) | Maximum mean daily, in mg/l | None Specified | All | Oct-Sep | 250 |
| SWC | Contra Costa Canal at Pumping Plant #1 | C-5 CHCCC06 | Chloride (Cl-) | Maximum mean daily, in mg/l | None Specified | All | Oct-Sep | 250 |
| SWC | Old River near Rancho Del Rio | D-28A ROLD21 | Chloride (Cl-) | Maximum mean daily, in mg/l | None Specified | All | Oct-Sep | 250 |
| CCWD | Contra Costa Canal at Pumping Plant #1 [1] | C-5 CHCCC06 | Chloride (Cl-) | Maximum mean daily, in mg/l | None Specified | All | Apr-Jun | 50 |
| CCWD | Contra Costa Canal at Pumping Plant #1 | C-5 CHCCC06 | Sodium (Na+) | Maximum mean daily, in mg/l | None Specified | All | Oct-Sep | 20 |
| DWR | West Canal at mouth of Clifton Court Forebay | C-9 CHWST0 | Chloride (Cl-) | Maximum mean daily, in mg/l | None Specified | All | Oct-Sep | 250 |
| DWR | Delta Mendota Canal at Tracy Pumping Plant | DMC-1 CHDMC004 | Chloride (Cl-) | Maximum mean daily, in mg/l | None Specified | All | Oct-Sep | 250 |
| USBR | West Canal at mouth of Clifton Court Forebay | C-9 CHWST0 | Chloride (Cl-) | Maximum mean daily, in mg/l | None Specified | All | Oct-Sep | 250 |
| USBR | Delta Mendota Canal at Tracy Pumping Plant | DMC-1 CHDMC004 | Chloride (Cl-) | Maximum mean daily, in mg/l | None Specified | All | Oct-Sep | 250 |
| SWC | West Canal at mouth of Clifton Court Forebay | C-9 CHWST0 | Chloride (Cl-) | Maximum mean daily, in mg/l | None Specified | All | Oct-Sep | 250 |
| SWC | Delta Mendota Canal at Tracy Pumping Plant | DMC-1 CHDMC004 | Chloride (Cl-) | Maximum mean daily, in mg/l | None Specified | All | Oct-Sep | 250 |
| DWR/SWC CONTRACT | West Canal at mouth of Clifton Court Forebay | C-9 CHWST0 | Chloride (Cl-) | Max monthly average, in mg/l | None Specified | All | Oct-Sep | 100 |

# TABLE 5 – 5 (cont.) ALTERNATIVE WATER QUALITY OBJECTIVES

## A) MUNICIPAL AND INDUSTRIAL

| ALTERNATIVES/ SOURCE | LOCATION | SAMPLING SITE NOs. (I-A/RKI) | PARAMETER | DESCRIPTION | INDEX TYPE | YEAR TYPE | DATES | VALUES |
|---|---|---|---|---|---|---|---|---|
| ADVOCATED LEVELS (cont.) | | | | | | | | |
| *DWR/SWC CONTRACT* | *West Canal at mouth of Clifton Court Forebay* | *C-9 CHWST0* | *Chloride (Cl-)* | *Max 10-year average, in mg/l* | *None Specified* | *All* | *Oct-Sep* | *55* |
| | *West Canal at mouth of Clifton Court Forebay* | *C-9 CHWST0* | *Total Dissolved Solids (TDS)* | *Max monthly average, in mg/l* | *None Specified* | *All* | *Oct-Sep* | *440* |
| | *West Canal at mouth of Clifton Court Forebay* | *C-9 CHWST0* | *Total Dissolved Solids (TDS)* | *Max 10-year average, in mg/l* | *None Specified* | *All* | *Oct-Sep* | *220* |
| POTENTAL OBJECTIVES | | | | | | | | |
| | *Contra Costa Canal at Pumping Plant #1* | *C-5 CHCCC06* | *Chloride (Cl-)* | *Maximum mean daily, in mg/l* | *Not Applicable* | *All* | *Oct-Sep* | *250* |
| | *Contra Costa Canal at Pumping Plant #1* | *C-5 CHCCC06* | *Chloride (Cl-)* | *Maximum mean daily 150 mg/l chloride for at least the number of days shown during the Calendar Year. Must be provided in intervals of not less than two weeks duration. (% of Calendar Year shown in parenthesis)* | *Sac R 40-30-30* | | *No. of days each Cal. Year < 150 mg/l Cl-* | |
| | *- or -* | | | | | *W* | | *240 (66%)* |
| | *San Joaquin River at Antioch Water Works Intake* | *D-12(near) RSAN007* | *Chloride (Cl-)* | | *Sac R 40-30-30* | *AN* | | *190 (52%)* |
| | | | | | | *BN* | | *175 (48%)* |
| | | | | | | *D* | | *165 (45%)* |
| | | | | | | *C* | | *155 (42%)* |
| | *West Canal at mouth of Clifton Court Forebay* | *C-9 CHWST0* | *Chloride (Cl-)* | *Maximum mean daily, in mg/l* | *Not Applicable* | *All* | *Oct-Sep* | *250* |
| | *Delta Mendota Canal at Tracy Pumping Plant* | *DMC-1 CHDMC004* | *Chloride (Cl-)* | *Maximum mean daily, in mg/l* | *Not Applicable* | *All* | *Oct-Sep* | *250* |
| | *Cache Slough at City of Vallejo Intake [2]* | *C-19 SLCCH16* | *Chloride (Cl-)* | *Maximum mean daily, in mg/l* | *Not Applicable* | *All* | *Oct-Sep* | *250* |
| | *and/or* | | | | | | | |
| | *Barker Slough at North Bay Aqueduct Intake* | *- SLBAR3* | *Chloride (Cl-)* | *Maximum mean daily, in mg/l* | *Not Applicable* | *All* | *Oct-Sep* | *250* |

# TABLE 5 – 5 (cont.) ALTERNATIVE WATER QUALITY OBJECTIVES

## A) MUNICIPAL AND INDUSTRIAL

### TRIHALOMETHANES

| ALTERNATIVES/ SOURCE | LOCATION | SAMPLING SITE NOs. (I-A/RKI) | PARAMETER | DESCRIPTION | INDEX TYPE | YEAR TYPE | DATES | VALUES |
|---|---|---|---|---|---|---|---|---|
| **PRESENT OBJECTIVES** | | | | | | | | |
| *EPA Standards [3]* | *All points of delivery* | | *Trihalomethanes (THMs)* | *Running average of quarterly sampling, in ug/l* | *Not Applicable* | *All* | *Oct-Sep* | *100 [3]* |
| **ADVOCATED LEVELS** | | | | | | | | |
| *MWD* | *All M&I supply intakes in Delta* | | *Trihalomethane Precursors (THM Precursors)* | | *None Specified* | *None Specified* | *None Specified* | *To be developed by SWRCB* |
| *Delta M&I Workgroup* | *All M&I supply intakes in Delta* | | *Chloride (Cl-)* | *To limit bromide to <= 0.15 mg/l* | *None Specified* | *None Specified* | *When Feasible* | *50 mg/l* |
| **POTENTIAL OBJECTIVES** | | | | | | | | |
| | *Contra Costa Canal at Pumping Plant #1* | *C-5 CHCCC06* | *Chloride (Cl-)* | *Maximum mean daily 150 mg/l chloride for at least the number of days shown during the Calender Year. Must be provided in intervals of not less than two weeks duration. (% of calendar years shown in parenthesis)* | *Sac R 40-30-30* | | | *No. of days each Cal. [4] Year < 150 mg/l Cl-* |
| | | | | | | *W* | | *240 (66%)* |
| | | | | | | *AN* | | *190 (52%)* |
| | | | | | | *BN* | | *175 (48%)* |
| | | | | | | *D* | | *165 (45%)* |
| | | | | | | *C* | | *155 (42%)* |
| | *All M&I supply intakes in Delta* | | *Chloride (Cl-)* | *To limit bromide to <= 0.15 mg/l* | *None Specified* | *None Specified* | *When Feasible* | *50 mg/l* |

# TABLE 5 – 5 (cont.) ALTERNATIVE WATER QUALITY OBJECTIVES

## B) AGRICULTURAL

### AREA

| ALTERNATIVES/ SOURCE | LOCATION | SAMPLING SITE NOs. (I-A/RKI) | PARAMETER | DESCRIPTION | INDEX TYPE | YEAR TYPE | DATES | VALUES |
|---|---|---|---|---|---|---|---|---|
| | | | 1) WESTERN DELTA | | | | | |
| **PRESENT OBJECTIVES** | | | | | | | | |
| *D-1485* | *Sacramento River at Emmaton* | *D-22 RSAC092* | *Electrical Conductivity (EC)* | *Maximum 14-day running average of mean daily, in mmhos/cm (mmhos)* | *D-1485 (Water Year)* | | *0 45 EC April 1 to Date Shown* | *EC from Date Shown to Aug. 15 [5]* |
| | | | | | | *W* | *Aug. 15* | -- |
| | | | | | | *AN* | *July 1* | *0.63* |
| | | | | | | *BN* | *June 20* | *1.14* |
| | | | | | | *D* | *June 15* | *1.67* |
| | | | | | | *C* | -- | *2.78* |
| | *San Joaquin River at Jersey Point* | *D-15 RSAN018* | *Electrical Conductivity (EC)* | *Maximum 14-day running average of mean daily, in mmhos* | *D-1485 (Water Year)* | | *0.45 EC April 1 to Date Shown* | *EC from Date Shown to Aug. 15 [5]* |
| | | | | | | *W* | *Aug. 15* | -- |
| | | | | | | *AN* | *Aug. 15* | -- |
| | | | | | | *BN* | *June 20* | *0.74* |
| | | | | | | *D* | *June 15* | *1.35* |
| | | | | | | *C* | -- | *2.20* |
| **ADVOCATED LEVELS** | | | | | | | | |
| *CVPWA, SWC* | *Sacramento River at Emmaton - and - San Joaquin River at Jersey Point* | *D-22 RSAC092* | *Electrical Conductivity (EC)* | *Maximum 14-day running average of mean daily, in mmhos* | *None Specified* | | *1.5 EC April 1 to Date Shown* | *3.0 EC Date Shown to Aug. 15 [5]* |
| | | *D-15 RSAN018* | *Electrical Conductivity (EC)* | *Maximum 14-day running average of mean daily, in mmhos* | *None Specified* | *W* | *Aug. 15* | -- |
| | | | | | | *AN* | *Aug. 15* | -- |
| | | | | | | *BN* | *Aug. 15* | -- |
| | | | | | | *D* | *Aug. 15* | -- |
| | | | | | | *C* | *Jul. 31* | *Aug. 1* |
| *DWR* | *Sacramento River at Emmaton -and- San Joaquin River at Jersey Point* | *D-22 RSAC092 D-15 RSAN018* | *Electrical Conductivity (EC)* | *Average monthly, in mmhos* | *None Specified* | ---------- *Based on Corn Study* ---------- | | |

CSPA-243

# TABLE 5 – 5 (cont.) ALTERNATIVE WATER QUALITY OBJECTIVES

## B) AGRICULTURAL

### AREA

| ALTERNATIVES/ SOURCE | LOCATION | SAMPLING SITE NOs. (I-A/RKI) | PARAMETER | DESCRIPTION | INDEX TYPE | YEAR TYPE | DATES | VALUES |
|---|---|---|---|---|---|---|---|---|
| | | | 1) WESTERN DELTA (cont.) | | | | | |
| ADVOCATED LEVELS (cont.) | | | | | | | | |
| *CCCWA* | *Sacramento River at Emmaton -and- San Joaquin River at Jersey Point* | *D-22 RSAC092 D-15 RSAN018* | *Electrical Conductivity (EC)* | *Maximum 14-day running average of mean daily, in mmhos* | *None Specified* | *All* | *Apr 1-Aug 15* | *0.45* |
| *CDWA* | *Sacramento River at Emmaton -and- San Joaquin River at Jersey Point* | *D-22 RSAC092 D-15 RSAC018* | *Electrical Conductivity (EC) Electrical Conductivity (EC)* | *Maximum monthly average of mean daily, in mmhos Maximum monthly average of mean daily, in mmhos* | *None Specified* | *All* | *Apr 1-Mar 31* | *0.45* |
| | | | | | | ------ adjustments not quantified ------ | | |
| | | | | | | *All* | *Apr 1-Mar 31* | *0.45* |
| | | | | | | ------ adjustments not quantified ------ | | |
| POTENTIAL OBJECTIVES | | | | | | | | |
| | *Sacramento River at Emmaton* | *D-22 RSAC092* | *Electrical Conductivity (EC)* | *Maximum 14-day running average of mean daily, in mmhos/cm* | *Sac R 40-30-30* | | *0.45 EC April 1 to Date Shown* | *EC from Date Shown to Aug. 15 [5]* |
| | | | | | | *W* | *Aug. 15* | -- |
| | | | | | | *AN* | *July 1* | *0.63* |
| | | | | | | *BN* | *June 20* | *1.14* |
| | | | | | | *D* | *June 15* | *1.67* |
| | | | | | | *C* | -- | *2.78* |
| | *San Joaquin River at Jersey Point* | *D-15 RSAN018* | *Electrical Conductivity (EC)* | *Maximum 14-day running average of mean daily, in mmhos* | *Sac R 40-30-30* | | *0.45 EC April 1 to Date Shown* | *EC from Date Shown to Aug. 15 [5]* |
| | | | | | | *W* | *Aug. 15* | -- |
| | | | | | | *AN* | *Aug. 15* | -- |
| | | | | | | *BN* | *June 20* | *0.74* |
| | | | | | | *D* | *June 15* | *1.35* |
| | | | | | | *C* | -- | *2.20* |

# TABLE 5 - 5 (cont.) ALTERNATIVE WATER QUALITY OBJECTIVES

## B) AGRICULTURAL

### AREA

| ALTERNATIVES/ SOURCE | LOCATION | SAMPLING SITE NOs. (I-A/RKI) | PARAMETER | DESCRIPTION | INDEX TYPE | YEAR TYPE | DATES | VALUES |
|---|---|---|---|---|---|---|---|---|
| | | | | **2) INTERIOR DELTA** | | | | |
| **PRESENT OBJECTIVES** | | | | | | | | |
| *D-1485* | *South Fork Mokelumne River at Terminous* | *C-13 RSMKL08* | *Electrical Conductivity (EC)* | *Maximum 14-day running average of mean daily, in mmhos* | *D-1485 (Water Year)* | | *0.45 EC April 1 to Date Shown* | *EC from Date Shown to Aug. 15 [5]* |
| | | | | | | *W* | *Aug. 15* | -- |
| | | | | | | *AN* | *Aug. 15* | -- |
| | | | | | | *BN* | *Aug. 15* | -- |
| | | | | | | *D* | *Aug. 15* | -- |
| | | | | | | *C* | -- | *0.54* |
| | *San Joaquin River at San Andreas Landing* | *C-4 RSAN032* | *Electrical Conductivity (EC)* | *Maximum 14-day running average of mean daily, in mmhos* | *D-1485 (Water Year)* | | *0.45 EC April 1 to Date Shown* | *EC from Date Shown to Aug. 15 [5]* |
| | | | | | | *W* | *Aug. 15* | -- |
| | | | | | | *AN* | *Aug. 15* | -- |
| | | | | | | *BN* | *Aug. 15* | -- |
| | | | | | | *D* | *Jun. 25* | *0.58* |
| | | | | | | *C* | -- | *0.87* |
| **ADVOCATED LEVELS** | | [6] | | | | | | |
| *NDWA/ DWR CONTRACT* | *Sacramento River at Emmaton* | *D-22 RSAC092* | *Electrical Conductivity (EC)* | *Maximum 14-day running average of mean daily, in mmhos* | *D-1485 (Water Year)* | *per contract* | *per contract* | *0.45-3.6 [7]* |
| | *South Fork Mokelumne River at Terminous* | *C-13 RSMLK08* | " | " | " | " | " | *0.45-1.1 [7]* |
| | *San Joaquin River at San Andreas Landing* | *C-4 RSAN032* | " | " | " | " | " | *0.45-1.2 [7]* |
| | *Sacramento River at Rio Vista Bridge* | *D-24 RSAC101* | " | " | " | " | " | " |
| | *North Fork Mokelumne River near Walnut Grove (exact location not specified)* | *RMKL020 (?)* | " | " | " | " | " | *0.45-0.6 [7]* |

# TABLE 5 – 5 (cont.) ALTERNATIVE WATER QUALITY OBJECTIVES

## B) AGRICULTURAL

### AREA

| ALTERNATIVES/ SOURCE | LOCATION | SAMPLING SITE NOs. (I-A/RKI) | PARAMETER | DESCRIPTION | INDEX TYPE | YEAR TYPE | DATES | VALUES |
|---|---|---|---|---|---|---|---|---|
| | | | 2) INTERIOR DELTA | | | | | |
| ADVOCATED LEVELS (cont.) | | [6] | | | | | | |
| NDWA/ DWR CONTRACT | Sacramento River at Walnut Grove -and- Steamboat Slough at Sutter Slough | - RSAC124 - SLSBT11 | Electrical Conductivity (EC) | Maximum 14-day running average of mean daily, in mmhos | D-1485 (Water Year) | not shown | not shown | 0.45-0.6 [7] |
| ECCID/DWR CONTRACT | Old River at Indian Slough | - ROLD32 | Electrical Conductivity (EC) | Maximum 14-day running average of mean daily, in mmhos | D-1485 (Water Year) | not shown | not shown | 0.45-1.2 [7] |
| DWR | South Fork Mokelumne River at Terminous<br>San Joaquin River at San Andreas Landing -and-<br>Cache Slough near Junction Point (proposed) | C-13 RSMLK08<br>C-4 RSAN032<br>CS-1(prop.) SLCCH00 | Electrical Conductivity (EC) | Maximum 14-day running average of mean daily, in mmhos | None Specified | ----- Based on Corn Study ----- | | |
| DTAC | Central Delta | - | Electrical Conductivity (EC) | Maximum 14-day running average of mean daily, in mmhos | None Specified | All except C | Apr 1-Aug 15 | 1.5-2.5 |
| | | | | | | C | " | None |
| CCCWA | Delta lowlands with organic soils | - | Electrical Conductivity (EC) | Maximum 14-day running average of mean daily, in mmhos | None Specified | All | Apr 1-Aug 15 | 0.45 |
| CDWA | San Joaquin River at San Andreas Landing | C-4 RSAN032 | Electrical Conductivity (EC) | Maximum monthly average of mean daily, in mmhos | None Specified | All | Apr 1-Mar 31 | 0.45 |
| | | | | | | | ------ except for ------ | |
| | | | | | | | Aug Sep Oct | |
| | | | | | | D | --- 0.65 0.60 | |
| | | | | | | C | 0.54 0.80 0.90 | |

# TABLE 5 – 5 (cont.) ALTERNATIVE WATER QUALITY OBJECTIVES

## B) AGRICULTURAL

### AREA

| ALTERNATIVES/ SOURCE | LOCATION | SAMPLING SITE NOs. (I-A/RKI) | PARAMETER | DESCRIPTION | INDEX TYPE | YEAR TYPE | DATES | VALUES |
|---|---|---|---|---|---|---|---|---|
| **2) INTERIOR DELTA (cont.)** | | | | | | | | |
| **ADVOCATED LEVELS (cont.)** | | [6] | | | | | | |
| *CDWA* | *South Fork Mokelumne River at Terminous* | *C-13 RSMLK08* | *Electrical Conductivity (EC)* | *Maximum monthly average of mean daily, in mmhos* | *None Specified* | *All* | *Apr 1-Mar 31* | *0.45* |
| | | | | | | ------ adjustments not quantified ------ | | |
| | *Old River near Holland Tract (exact loc. not spec.) -or- Old River near Rancho Del Rio* | *- ROLD19(?) D-28A ROLD21* | *Electrical Conductivity (EC)* | *Maximum monthly average of mean daily, in mmhos* | *None Specified* | *All* | *Apr 1-Mar 31* | *0.45* |
| | | | | | | ------ adjustments not quantified ------ | | |
| | | | | | *None Specified* | *All* | *Apr 1-Mar 31* | *0.45* |
| | | | | | | ------ adjustments not quantified ------ | | |
| | *Turner Cut near McDonald Island Bridge* | *MD-4 CFTRN1* | *Electrical Conductivity (EC)* | *Maximum monthly average of mean daily, in mmhos* | *None Specified* | *All* | *Apr 1-Mar 31* | *0.45* |
| | | | | | | ------ adjustments not quantified ------ | | |
| **POTENTIAL OBJECTIVES** | | | | | | | | |
| | *South Fork Mokelumne River at Terminous* | *C-13 RSMKL08* | *Electrical Conductivity (EC)* | *Maximum 14-day running average of mean daily, in mmhos* | *Sac R 40-30-30* | | *0.45 EC April 1 to Date Shown* | *EC from Date Shown to Aug. 15 [5]* |
| | | | | | | *W* | *Aug. 15* | -- |
| | | | | | | *AN* | *Aug. 15* | -- |
| | | | | | | *BN* | *Aug. 15* | -- |
| | | | | | | *D* | *Aug. 15* | -- |
| | | | | | | *C* | -- | *0.54* |
| | *San Joaquin River at San Andreas Landing* | *C-4 RSAN032* | *Electrical Conductivity (EC)* | *Maximum 14-day running average of mean daily, in mmhos* | *Sac R 40-30-30* | | *0.45 EC April 1 to Date Shown* | *EC from Date Shown to Aug. 15 [5]* |
| | | | | | | *W* | *Aug. 15* | -- |
| | | | | | | *AN* | *Aug. 15* | -- |
| | | | | | | *BN* | *Aug. 15* | -- |
| | | | | | | *D* | *Jun. 25* | *0.58* |
| | | | | | | *C* | -- | *0.87* |

# TABLE 5 – 5 (cont.) ALTERNATIVE WATER QUALITY OBJECTIVES

## B) AGRICULTURAL

### AREA

| ALTERNATIVES/ SOURCE | LOCATION | SAMPLING SITE NOs. (I-A/RKI) | PARAMETER | DESCRIPTION | INDEX TYPE | YEAR TYPE | DATES | VALUES |
|---|---|---|---|---|---|---|---|---|
| | | | | 3) SOUTH DELTA | | | | |
| PRESENT OBJECTIVES | | | | | | | | |
| D-1422 [8] | San Joaquin River at Airport Way Bridge, Vernalis | C-10 RSAN112 | Total Dissolved Solids (TDS) | Mean monthly, in mg/l | Not Applicable | All | Oct-Sep | 500 |
| Region 5 Water Quality Control Plan | San Joaquin River at Airport Way Bridge, Vernalis | C-10 RSAN112 | Total Dissolved Solids (TDS) | Maximum 30-day running average of mean daily, in mg/l | Not Applicable | All | Oct-Sep | 500 |
| USBR/SDWA AGREEMENT | San Joaquin River at Airport Way Bridge, Vernalis | C-10 RSAN112 | Total Dissolved Solids (TDS) | Maximum 14-day running average of mean daily EC, in mmhos | Not Applicable | All | Apr 1-Oct 31<br>Nov 1-Mar 31 | 450 *<br>500 * |
| | | | | * May be modified by agreement of parties or because of emergency conditions. Releases from New Melones Reservoir will be limited to a maximum of 150,000 AF/water year in addition to releases to maintain Fish & Water Quality in accordance with D-1422 | | | | |
| ADVOCATED LEVELS | | [6] | | | | | | |
| SDWA | San Joaquin River at Airport Way Bridge, Vernalis | C-10 RSAN112 | Total Dissolved Solids (TDS) | Maximum monthly average of mean daily, in mg/l | None Specified | All | Mar 1-Sep 30 | 400 [9] |
| | Old River at Tracy Road Bridge | P-12 ROLD59 | | Maximum 7-day running average of mean daily, in mg/l | None Specified | All | Mar 1-Jun 30 | 400 [9] |
| | Old River near Middle River | C-8 ROLD69 | | Maximum 7-day running average of mean daily, in mg/l | None Specified | All | Jul 1-Oct 31 | 500 [9] |
| | San Joaquin River at Brandt Bridge [site] | C-6 RSAN073 | | Maximum 7-day running average of mean daily, in mg/l | None Specified | All | Nov 1-Feb 28 | 500 [9] |
| | San Joaquin River at Mossdale Bridge | C-7 RSAN087 | | | | | | |
| | Middle River at Howard Road Bridge | P-11 RMID34 | | | | | | |
| | Old River at Westside ID Intake | -- ROLD51 | | | | | | |

# TABLE 5 – 5 (cont.) ALTERNATIVE WATER QUALITY OBJECTIVES

## B) AGRICULTURAL

### AREA

| ALTERNATIVES/ SOURCE | LOCATION | SAMPLING SITE NOs. (I-A/RKI) | PARAMETER | DESCRIPTION | INDEX TYPE | YEAR TYPE | DATES | VALUES |
|---|---|---|---|---|---|---|---|---|
| **3) SOUTH DELTA (cont.)** | | | | | | | | |
| ADVOCATED LEVELS (cont.) | | | | | | | | |
| *USBR* | *Delta Uplands* | -- | *Total Dissolved Solids (TDS)* | *Maximum monthly average of mean daily, in mg/l* | *None Specified* | *Normal* | *Apr 1-Mar 31* | *800* |
| | | | | | | *C* | *"* | *600* |
| | | | | | | *All* | *Oct-Sep* | *500* |
| *CVWPA* | *San Joaquin River at Airport Way Bridge, Vernalis* | *C-10 RSAN112* | *Total Dissolved Solids (TDS)* | *Maximum 30-day running average of mean daily, in mg/l* | *None Specified* | | | |
| POTENTIAL OBJECTIVES | | *(To be implemented by 1996) [10]* | | | | | | |
| | *San Joaquin River at Airport Way Bridge, Vernalis* | *C-10 RSAN112* | *Electrical Conductivity (EC)* | *Maximum 30-day running average of mean daily EC,in mmhos* | *Not Applicable* | *All* | *Apr 1-Aug 31* | *0.7* |
| | | | | | | | *Sep 1-Mar 31* | *1.0* |
| | *Old River near Middle River* | *C-8 ROLD69* | | | | | *or* | |
| | *Old River at Tracy Road Bridge* | *P-12 ROLD59* | | | | | | |
| | *San Joaquin River at Brandt Bridge [site]* | *C-6 RSAN073* | | | | | | |
| | | | | | *If a three-party contract has been implemented among DWR, USBR and the SDWA, that constract wil be reviewed prior to implementation of the above and, after also considering the needs of other beneficial uses, revisions will be made to the objectives and compliance/monitoring locations noted above, as appropriate.* | | | |
| **4) EXPORT** | | | | | | | | |
| PRESENT OBJECTIVES | | | | | | | | |
| | *None specified for export agriculture.* | | | | | | | |
| ADVOCATED LEVELS | | | | | | | | |
| | *None advocated for export agriculture.* | | | | | | | |
| POTENTIAL OBJECTIVES | | | | | | | | |
| | *West Canal at mouth of Clifton Court Forebay -and- Delta Mendota Canal at Tracy Pumping Plant* | *C-9 CHWST0 DMC-1 CHDMC004* | *Electrical Conductivity (EC)* | *Maximum monthly average of mean daily EC,in mmhos* | *Not Applicable* | *All* | *Oct-Sep* | *1.0* |

# TABLE 5 – 5 (cont.) ALTERNATIVE WATER QUALITY OBJECTIVES

## C) FISH AND WILDLIFE

### HABITAT/SPECIES

| ALTERNATIVES/ SOURCE | LOCATION | SAMPLING SITE NOs. (I-A/RKI) | PARAMETER | DESCRIPTION | INDEX TYPE | YEAR TYPE | DATES | VALUES |
|---|---|---|---|---|---|---|---|---|
| **FISHERY HABITAT PROTECTION (ENTRAPMENT ZONE)** | | | | | | | | |
| **PRESENT OBJECTIVES** | | | | | | | | |
| *None specified* | | | | | | | | |
| **ADVOCATED LEVELS** | | | | | | | | |
| *CCCWA/ EDF* | *Sacramento River at Chipps Island* | *D-10 RSAC075* | *Electrical Conductivity (EC)* | *28-day tidally averaged mean bottom salinity less than value shown in mmhos* | *D-1485 (Water Year)* | *All except C* | *Apr 1-Sep 30* | *2.0* |
| *CCCWA/ EDF* | *Suisun Bay at Martinez* | *D-6 RSAC056* | *Salinity (TDS)* | *Tidally averaged bottom salinity less than value shown in parts per thousand (ppt) over at least a 28-day period between dates shown* | *D-1485 (Water Year)* | *All except C* | *Oct 1-Apr 30* | *5.0* |
| **POTENTIAL OBJECTIVES** | | | | | | | | |
| *None Specified* | | | | | | | | |
| **CHINOOK SALMON** | | | | | | | | |
| **PRESENT OBJECTIVES - DISSOLVED OXYGEN** | | | | | | | | |
| *Region 5 Water Quality Control Plan* | *Sacramento River and all Delta waters west of the Antioch Bridge* | *All* | *Dissolved Oxygen (DO)* | *Minimum dissolved oxygen, in mg/l* | *None Specified* | *All* | *All year* | *7.0* |
| | *All other Delta waters except:<br>- Man-made bodies of water<br>- Sites where fishery is not a beneficial use* | *All* | *Dissolved Oxygen (DO)* | *Minimum dissolved oxygen, in mg/l* | *None Specified* | *All* | *All year* | *5.0* |
| *DFG, USFWS DWR & USBR Agreement* | *San Joaquin River between Turner Cut & Stockton* | *RSAN050-RSAN061* | *Dissolved Oxygen (DO)* | *Minimum dissolved oxygen, in mg/l* | *None Specified* | *All* | *All year* | *6.0* |
| **ADVOCATED LEVELS - DISSOLVED OXYGEN** | | | | | | | | |
| *USFWS, DFG* | *San Joaquin River between Turner Cut and Stockton* | *RSAN050-RSAN061* | *Dissolved Oxygen (DO)* | *Minimum dissolved oxygen, in mg/l* | *None Specified* | *All* | *Sep 1-Nov 30* | *6.0* |

# TABLE 5 - 5 (cont.) ALTERNATIVE WATER QUALITY OBJECTIVES

## C) FISH AND WILDLIFE

### HABITAT/SPECIES

| ALTERNATIVES/ SOURCE | LOCATION | SAMPLING SITE NOs. (I-A/RKI) | PARAMETER | DESCRIPTION | INDEX TYPE | YEAR TYPE | DATES | VALUES |
|---|---|---|---|---|---|---|---|---|
| **CHINOOK SALMON (cont.)** | | | | | | | | |
| **POTENTIAL OBJECTIVES - DISSOLVED OXYGEN** | | | | | | | | |
| | *San Joaquin River between Turner Cut & Stockton* | *RSAN050-RSAN061* | *Dissolved Oxygen (DO)* | *Minimum dissolved oxygen, in mg/l* | *None Specified* | *All* | *Sep 1-Nov 30* | *6.0* |
| **PRESENT OBJECTIVES - TEMPERATURE** | | | | | | | | |
| *Regional Water Quality Control Board Basin Plan 5* | *Sacramento River from Hamilton City to I Street Bridge* | | *Temperature* | *Narrative Objective* | | *All* | | * |
| | | | | * *The temperature shall not be elevated above 68 degrees F in the reach from Hamilton City to the I Street Bridge during periods when temperature increases will be detrimental to the fishery (also see page III-6 of Basin Plan 5).* | | | | |
| *Regional Water Quality Control Board Basin Plans 2 & 5* | *All Delta waters* | - | *Temperature* | *Narrative Objective* | | *All* | | ** |
| | | | | ** *The natural receiving water temperature of intrastate waters shall not be altered unless it can be demonstrated to the satisfaction of the Regional Board that such alteration in temperature does not adversely affect beneficial uses.* | | | | |
| *Thermal Plan* | *Estuary Waters* | - | *Temperature* | *Narrative Objective* | | *All* | | *** |
| | | | | *** *The plan specifies limiting conditions of temperature in wastewaters discharged into interstate and coastal waters, estuaries and enclosed bays. For example, elevated temperature waste discharges into interstate waters designated as "cold" waters are prohibited while this type of discharge into "warm" interstate waters cannot be more than 5 degrees F warmer than the receiving water and shall not cause the temperature in the receiving water to rise more than 5 degrees F. Existing thermal discharges into coastal waters, estuaries and enclosed bays shall comply with limitations necessary to assure protection of the beneficial uses and, for coastal waters, areas of special biological significance.* | | | | |
| **ADVOCATED LEVELS - TEMPERATURE** | | | | | | | | |
| *USFWS* | *Sacramento River at Freeport* | *RSAC155* | *Temperature* | *When temperature increases are controllable, they shall be limited to a maximum 7 day surface temperature.* | *W* | *May 1-Jun 15* | *66 degrees F* | |
| | | | | | *AN* | *May 1-Jun 15* | *66 degrees F* | |
| | | | | | *BN* | *May 1-Jun 15* | *66 degrees F* | |
| | | | | | *D* | *May 1-May 31* | *66 degrees F* | |
| | *San Joaquin River at Airport Way Bridge, Vernalis and (Other locations, e.g., Isleton and Jersey Point)* | *C-10 RSAN112* | *Temperature* | | *C* | *May 1-May 31* | *66 degrees F* | |

# TABLE 5 – 5 (cont.) ALTERNATIVE WATER QUALITY OBJECTIVES

## C) FISH AND WILDLIFE

### HABITAT/SPECIES

| ALTERNATIVES/ *SOURCE* | LOCATION | SAMPLING SITE NOs. (I-A/RKI) | PARAMETER | DESCRIPTION | INDEX TYPE | YEAR TYPE | DATES | VALUES |
|---|---|---|---|---|---|---|---|---|
| | | | | CHINOOK SALMON (cont.) | | | | |
| **ADVOCATED LEVELS - TEMPERATURE (cont.)** | | | | | | | | |
| *DFG* | *Sacramento River at Freeport and* | *RSAC155* | *Temperature* | *Narrative Objective* | | *All* | | *The temperaure shall not be elevated above 68 degrees F during periods when temperature increases will be detrimental to the fishery.* |
| | *San Joaquin River at Airport Way Bridge, Vernalis* | *C-10 RSAN112* | *Temperature* | *Narrative Objective* | | *All* | | |
| *SWC* | *Sacramento River at Freeport and* | *RSAC155* | *Temperature* | *7-day average of maximum mean daily surface temperatures* | | *All* | *Oct-Sep* | *An objective of 68 degrees F at Freeport and Vernalis would be acceptable as long as the plan states clearly that an objective cannot be met with flows.* |
| | *San Joaquin River at Airport Way Bridge, Vernalis* | *C-10 RSAN112* | *Temperature* | *7-day average of maximum mean daily surface temperatures* | | *All* | | |
| *CVPWA* | *Sacramento River at Freeport and* | *RSAC155* | *Temperature* | *Narrative Objective* | | *"During the months of May and June, the water temperature to which juvenile chinook are exposed should not exceed temperatures which are reasonable, taking into account all demands on water supplies, the total values involved, and the limited ability to implement specific objectives."* | | |
| | *San Joaquin River at Airport Way Bridge, Vernalis* | *C-10 RSAN112* | *Temperature* | *Narrative Objective* | | | | |
| **POTENTIAL OBJECTIVES - TEMPERATURE** | | | | | | | | |
| | *Sacramento River at Freeport and* | *RSAC155* | *Temperature* | *Narrative Objective* | *Not Applicable* | All | | *The daily average water temperature shall not be elevated by controllable factors above 68 degrees F from the I Street Bridge to Freeport on the Sacramento River, and at Vernalis on the San Joaquin River between April 1 through June 30 and September 1 through November 30 in all year types. [11]* |
| | *San Joaquin River at Airport Way Bridge, Vernalis* | *C-10 RSAN112* | *Temperature* | *Narrative Objective* | *Not Applicable* | All | | |

# TABLE 5 - 5 (cont.) ALTERNATIVE WATER QUALITY OBJECTIVES

## C) FISH AND WILDLIFE

### HABITAT/SPECIES

| ALTERNATIVES/ *SOURCE* | LOCATION | SAMPLING SITE NOs. (I-A/RKI) | PARAMETER | DESCRIPTION | INDEX TYPE | YEAR TYPE | DATES | VALUES |
|---|---|---|---|---|---|---|---|---|
| | | | CHINOOK SALMON (cont.) | | | | | |
| **POTENTIAL OBJECTIVES - TEMPERATURE (cont.)** | | | | | | | | |
| | *Sacramento River at Freeport* | *RSAC155* | *Temperature* | *Narrative Objective* | *Not Applicable* | *All* | *The daily avearge water temperature shall not be elevated by controllable factors above 66 degrees F from the I Street Bridge to Freeport on the Sacramento River between January 1 through March 31. [11]* | |
| | | | STRIPED BASS-SALINITY: 1.ANTIOCH-SPAWNING | | | | | |
| **PRESENT OBJECTIVES** | | | | | | | | |
| *D-1485* | *Sacramento River at Chipps Island* | *D-10 RSAC075* | *Delta outflow Index (DOI)* | *Average for the period not less than the value shown, in cfs* | *D-1485 (Water Year)* | *All* | *Apr 1-Apr 14* | *6,700* |
| *D-1485* | *San Joaquin River at Antioch Water Works Intake* | *D-12 (near) RSAN007* | *Electrical Conductivity (EC)* | *Average of mean daily for the period not more than the value shown, in mmhos* | *D-1485 (Water Year)* | *All* | *Apr 15-May 5* | *1.5* |
| **ADVOCATED LEVELS** | | | | | | | | |
| | *None other than above* | | | | | | | |
| **POTENTIAL OBJECTIVES** | | | | | | | | |
| *1-A* | *San Joaquin River at Antioch Water Works Intake* | *D-12 (near) RSAN007* | *Electrical Conductivity (EC)* | *14-day running average of mean daily for the period not more than value shown, in mmhos* | *Not Applicable* | *All* | *Apr 1-May 31 (or until spawning has ended)* | *1.5* |
| *1-B* | *Sacramento River at Chipps Island* | *D-10 RSAC075* | *Delta outflow Index (DOI)* | *Average for the period not less than the value shown, in cfs* | *Not Applicable* | *All* | *Apr 1-Apr 14* | *6,700* |

# TABLE 5 – 5 (cont.) ALTERNATIVE WATER QUALITY OBJECTIVES

## C) FISH AND WILDLIFE

### HABITAT/SPECIES

| ALTERNATIVES/ SOURCE | LOCATION | SAMPLING SITE NOs. (I-A/RKI) | PARAMETER | DESCRIPTION | INDEX TYPE | YEAR TYPE | DATES | VALUES |
|---|---|---|---|---|---|---|---|---|
| **STRIPED BASS - SALINITY: 1. ANTIOCH - SPAWNING (cont.)** | | | | | | | | |
| **POTENTIAL OBJECTIVES (cont.)** | | | | | | | | |
| | *San Joaquin River at Antioch Water Works Intake* | *D-12 (near) RSAN007* | *Electrical Conductivity (EC)* | *14-day running average of mean daily for the period not more than value shown, in mmhos.* | *Not Applicable* | *All* | *Apr 15-May 31 (or until spawning has ended)* | *1.5* |
| *1-C* | *Sacramento River at Chipps Island* | *D-10 RSAC075* | *Delta outflow Index (DOI)* | *Average for the period not less than the value shown, in cfs* | *Not Applicable* | *All* | *Apr 1-Apr 14* | *6,700* |
| | *San Joaquin River at Antioch Water Works Intake* | *D-12 (near) RSAN007* | *Electrical Conductivity (EC)* | *14-day running average of mean daily for the period not more than value shown, in mmhos* | *Not Applicable* | *W,AN&BN* | *Apr 15-May 31 (or until spawning has ended)* | *1.5* |
| | | | | | | *D&C* | *Apr 15-May 21 (or until spawning has ended)* | *1.5* |
| **STRIPED BASS - SALINITY: 2. ANTIOCH - SPAWNING - RELAXATION PROVISION** | | | | | | | | |
| **PRESENT OBJECTIVES** | | | | | | | | |
| *D-1485* | *San Joaquin River at Antioch Water Works Intake* | *D-12 (near) RSAN007* | *Electrical Conductivity (EC)* | *Average of mean daily for the period, not more than the values shown corresponding to the deficiencies taken by the SWP and CVP, in mmhos* | *D-1485 (Water Year)* | *All* | *Apr 1-May 5* | -- |
| | *This relaxation provision replaces the above Antioch & Chipps Island standard whenever the projects impose deficiencies in firm supplies.* | | | | | *Total Annual Imposed Deficiency in Firm Supplies (MAF)* | | *EC* |
| | | | | | | *0.0* | | *1.5* |
| | | | | | | *0.5* | | *1.9* |
| | | | | | | *1.0* | | *2.5* |
| | | | | | | *1.5* | | *3.4* |
| | | | | | | *2.0* | | *4.4* |
| | | | | | | *3.0* | | *10.3* |
| | | | | | | *4.0* | *or more* | *25.2* |

# TABLE 5 – 5 (cont.) ALTERNATIVE WATER QUALITY OBJECTIVES

## C) FISH AND WILDLIFE

### HABITAT/SPECIES

| ALTERNATIVES/ *SOURCE* | LOCATION | SAMPLING SITE NOs. (I-A/RKI) | PARAMETER | DESCRIPTION | INDEX TYPE | YEAR TYPE | DATES | VALUES |
|---|---|---|---|---|---|---|---|---|
| **STRIPED BASS - SALINITY 2 ANTIOCH - SPAWNING - RELAXATION PROVISION (cont.)** | | | | | | | | |
| **ADVOCATED LEVELS** | | | | | | | | |
| | *None other than above* | | | | | | | |
| **POTENTIAL OBJECTIVES** | | | | | | | | |
| *2-A* | *No relaxation provision* | | | | | | | |
| *2-B* | *San Joaquin River at Antioch Water Works Intake* | *D-12 (near) RSAN007* | *Electrical Conductivity (EC)* | *14-day running average of mean daily not more than values shown corresponding to deficiencies in firm supplies declared by the SWP & CVP for the period shown, or until spawning has ended.* | *Total Annual Declared Deficiencies (MAF)* | | *Apr 1-May 31 EC, in mmhos* | |
| | | | | | | | *Dry* | *Critical* |
| | *This relaxation provision replaces the above Antioch & Chipps Island standard whenever the projects impose deficiencies in firm supplies.* | | | | *0.0* | | *1.5* | *1.5* |
| | | | | | *0.5* | | *1.8* | *1.9* |
| | | | | | *1.0* | | *1.8* | *2.5* |
| | | | | | *1.5* | | *1.8* | *3.4* |
| | | | | | *2.0 or more* | | *1.8* | *3.7* |
| | | | | | *Linear interpolation is to be used to determine values between those shown.* | | | |
| *2-C* | *Same as 2-B, except that deficiencies are defined as deficiencies in firm supplies declared by a set of water projects representative of the Sacramento River and San Joaquin River watersheds. The specific representative projects and amounts of deficiencies will be defined in subsequent phases of the proceedings.* | | | | | | | |

# TABLE 5 - 5 (cont.) ALTERNATIVE WATER QUALITY OBJECTIVES

## C) FISH AND WILDLIFE

### HABITAT/SPECIES

| ALTERNATIVES/ SOURCE | LOCATION | SAMPLING SITE NOs. (I-A/RKI) | PARAMETER | DESCRIPTION | INDEX TYPE | YEAR TYPE | DATES | VALUES |
|---|---|---|---|---|---|---|---|---|
| **STRIPED BASS - SALINITY: 2. ANTIOCH - SPAWNING - RELAXATION PROVISION (cont.)** | | | | | | | | |
| **POTENTIAL OBJECTIVES (cont.)** | | | | | | | | |
| *2-D* | *Same as Objective 2-B except the period of protection is April 1 to May 21.* | | | | | | | |
| *2-E* | *San Joaquin River at Antioch Water Works Intake* | *D-12 (near) RSAN007* | *Electrical Conductivity (EC)* | *14-day running average of mean daily for the period not more than value shown, in mmhos, when the April 1, 40-30-30 Sacramento Basin Index is equal to or less than 4.8 MAF. [12]* | *Sac R 40-30-30* | | *Apr 1-May 31 (or until spawning has ended)* | *3.7* |
| **STRIPED BASS - SALINITY: 3. PRISONERS POINT - SPAWNING** | | | | | | | | |
| **PRESENT OBJECTIVES** | | | | | | | | |
| *D-1485* | *San Joaquin River at Prisoners Point* | *D-29 RSAN038* | *Electrical Conductivity (EC)* | *Average of mean daily for the period not more than value shown, in mmhos* | *D-1485 (Water Year)* | *All* | *Apr 1-May 5* | *0.55* |
| **ADVOCATED LEVELS** | | | | | | | | |
| | *None other than above* | | | | | | | |
| **POTENTIAL OBJECTIVES** | | | | | | | | |
| *3-A* | *San Joaquin River at:* | | *Electrical Conductivity (EC)* | *14-day running average of mean daily for the period not more than value shown, in mmhos* | *Not Applicable* | *All* | *Apr 1-May 31 (or until spawning has ended)* | *0.30* |
| | *Prisoners Point* | *D-29 RSAN038* | | | | | | |
| | *Buckley Cove* | *P-8 RSAN056* | | | | | | |
| | *Rough and Ready Island* | *- RSAN062* | | | | | | |
| | *Brandt Bridge [site]* | *C-6 RSAN073* | | | | | | |
| | *Mossdale Bridge* | *C-7 RSAN087* | | | | | | |
| | *Airport Way Bridge, Vernalis* | *C-10 RSAN112* | | | | | | |

# TABLE 5 – 5 (cont.) ALTERNATIVE WATER QUALITY OBJECTIVES

## C) FISH AND WILDLIFE

### HABITAT/SPECIES

| ALTERNATIVES/ SOURCE | LOCATION | SAMPLING SITE NOs. (I-A/RKI) | PARAMETER | DESCRIPTION | INDEX TYPE | YEAR TYPE | DATES | VALUES |
|---|---|---|---|---|---|---|---|---|
| **STRIPED BASS-SALINITY: 3. PRISONERS POINT-SPAWNING (cont.)** | | | | | | | | |
| POTENTIAL OBJECTIVES (cont.) | | | | | | | | |
| *3-B* | *San Joaquin River at:* | | *Electrical Conductivity (EC)* | *14-day running average of mean daily for the period not more than value shown, in mmhos* | *Not Applicable* | *All* | *Apr 1-May 31 (or until spawning has ended)* | *0.44* |
| | *Prisoners Point* | *D-29 RSAN038* | | | | | | |
| | *Buckley Cove* | *P-8 RSAN056* | | | | | | |
| | *Rough and Ready Island* | *RSAN062* | | | | | | |
| | *Brandt Bridge [site]* | *C-6 RSAN073* | | | | | | |
| | *Mossdale Bridge* | *C-7 RSAN087* | | | | | | |
| | *Airport Way Bridge, Vernalis* | *C-10 RSAN112* | | | | | | |
| *3-C* | *San Joaquin River at:* | | *Electrical Conductivity (EC)* | *14-day running average of mean daily for the period not more than value shown, in mmhos* | *SJ River (when developed)* | *W,AN, &BN* | *Apr 1-May 31 (or until spawning has ended)* | *0.44* |
| | *Prisoners Point* | *D-29 RSAN038* | | | | | | |
| | *Buckley Cove* | *P-8 RSAN056* | | | | *D&C* | *Apr 1-May 21 (or until spawning has ended)* | *0.44* |
| | *Rough and Ready Island* | *RSAN062* | | | | | | |
| | *Brandt Bridge [site]* | *C-6 RSAN073* | | | | | | |
| | *Mossdale Bridge* | *C-7 RSAN087* | | | | | | |
| | *Airport Way Bridge, Vernalis* | *C-10 RSAN112* | | | | | | |

# TABLE 5 – 5 (cont.) ALTERNATIVE WATER QUALITY OBJECTIVES

## C) FISH AND WILDLIFE

### HABITAT/SPECIES

| ALTERNATIVES/ SOURCE | LOCATION | SAMPLING SITE NOs. (I-A/RKI) | PARAMETER | DESCRIPTION | INDEX TYPE | YEAR TYPE | DATES | VALUES |
|---|---|---|---|---|---|---|---|---|
| **STRIPED BASS-SALINITY:3. PRISONERS POINT-SPAWNING (cont.)** | | | | | | | | |
| POTENTIAL OBJECTIVES (cont.) | | | | | | | | |
| *3-D* | *San Joaquin River at:* | | *Electrical Conductivity (EC)* | *14-day running average of mean daily for the period not more than value shown, in mmhos* | *SJ River (when developed)* | *W,AN, &BN* | *Apr 1-May 31 (or until spawning has ended)* | *0.44* |
| | *Prisoners Point* | *D-29 RSAN038* | | | | *D&C (EC would only be met at Prisoners Point)* | *Apr 1-May 31 (or until spawning has ended)* | *0.44* |
| | *Buckley Cove* | *P-8 RSAN056* | | | | | | |
| | *Rough and Ready Island* | *RSAN062* | | | | | | |
| | *Brandt Bridge [site]* | *C-6 RSAN073* | | | | | | |
| | *Mossdale Bridge* | *C-7 RSAN087* | | | | | | |
| | *Airport Way Bridge, Vernalis* | *C-10 RSAN112* | | | | | | |
| *3-E* | *San Joaquin River at:* | | *Electrical Conductivity (EC)* | *14-day running average of mean daily for the period not more than value shown, in mmhos* | *SJ River (when developed)* | | *Apr 1-May 31 (or until spawning has ended)* | *0.44* |
| | *Prisoners Point* | *D-29 RSAN038* | | | | | | |
| | *Buckley Cove* | *P-8 RSAN056* | | | | | | |
| | *Rough and Ready Island* | *RSAN062* | | | | | | |
| | *Brandt Bridge [site]* | *C-6 RSAN073* | | | | | | |
| | *Mossdale Bridge* | *C-7 RSAN087* | | | | | | |
| | *Airport Way Bridge, Vernalis* | *C-10 RSAN112* | | | | | | |

*W - Prisoners Point to Vernalis*
*AN - Prisoners Point to Mossdale*
*BN - Prisoners Point to Rough and Ready Island*
*D - Prisoners Point to Buckley Cove*
*C - Prisoners Point only*

# TABLE 5 – 5 (cont.) ALTERNATIVE WATER QUALITY OBJECTIVES

## C) FISH AND WILDLIFE

### HABITAT/SPECIES

| ALTERNATIVES/ *SOURCE* | LOCATION | SAMPLING SITE NOs. (I-A/RKI) | PARAMETER | DESCRIPTION | INDEX TYPE | YEAR TYPE | DATES | VALUES |
|---|---|---|---|---|---|---|---|---|
| **STRIPED BASS-SALINITY-3. PRISONERS POINT-SPAWNING (cont.)** | | | | | | | | |
| POTENTIAL OBJECTIVES (cont.) | | | | | | | | |
| *3-F* | *San Joaquin River at Prisoners Point* | *D-29 RSAN038* | *Electrical Conductivity (EC)* | *14-day running average of mean daily for the period not more than value shown, in mmhos* | *Not Applicable* | *All* | *Apr 1-May 31 (or until spawning has ended)* | *0.44* |
| **STRIPED BASS-SALINITY-4. PRISONERS POINT-SPAWNING RELAXATION PROVISION** | | | | | | | | |
| *4-A* | *No relaxation for Prisoners Point when the Antioch relaxation provision for spawning protection is in effect.* | | | | | | | |
| | | | | *When the Antioch relaxation provision for spawning protection is in effect:* | | | | |
| *4-B* | *San Joaquin River at Prisoners Point* | *D-29 RSAN038* | *Electrical Conductivity (EC)* | *14 day running average of mean daily for the period not more than value shown, in mmhos* | *Not Applicable* | *D,C* | *Apr 1-May 31 (or until spawning has ended)* | *0.55* |

CSPA-243

# TABLE 5 – 5 (cont.) ALTERNATIVE WATER QUALITY OBJECTIVES

## C) FISH AND WILDLIFE

### HABITAT/SPECIES

| ALTERNATIVES/ SOURCE | LOCATION | SAMPLING SITE NOs. (I-A/RKI) | PARAMETER | DESCRIPTION | INDEX TYPE | YEAR TYPE | DATES | VALUES |
|---|---|---|---|---|---|---|---|---|
| **SUISUN MARSH** | | | | | | | | |
| PRESENT OBJECTIVES | | | | | | | | |
| *D1485 (Interim)* | *Sacramento River at Chipps Island* | *D-10 RSAC075* | *Electrical Conductivity (EC)* | *Max 28-day running average of mean daily, in mmhos* | *D-1485 (Water Year)* | *All* | *Oct 1-May 31* | *12.5* |
| | | | | | | ------- except for --------- | | |
| | | | | | | *D/C only if projects are taking deficiencies in scheduled water supplies* | *Oct 1-Dec 31* | *15.6* |
| *D-1485* | *Sacramento River at Collinsville* | *C-2 RSAC081* | *Electrical Conductivity (EC)* | *Monthly average of both daily high tide values not to exceed the values shown, in mmhos (or demonstrate that equivalent or better protection will be provided at the location)* | *D-1485 (Water Year)* | *All (effective Oct 1,1984)* | *Oct* | *19.0* |
| | | | | | | | *Nov* | *15.5* |
| | *Montezuma Slough at Mieus Landing* | *S-64(old) SLMZU20* | | | | | *Dec* | *15.5* |
| | *Montezuma Slough at Cutoff Slough* | *S-48 SLMZU10* | | | | | *Jan* | *12.5* |
| | *Montezuma Slough near mouth* | *D-7(near) SLMZU01* | | | | | *Feb* | *8.0* |
| | *Suisun Slough 300 ft south of Volanti Slough* | *S-42 SLSUS12* | | | | | *Mar* | *8.0* |
| | *Suisun Slough near mouth* | *S-36 * SLSUS01* | | | | | *Apr* | *11.0* |
| | *Goodyear Slough south of Pierce Harbor* | *S-35(old) SLGYR02* | | | | | *May* | *11.0* |
| | *Cordelia Slough above S.P.R.R. crossing at Cygnus* | *S-33 * SLCRD05* | | | | | | |

* *Station numbers were incorrect in D-1485, these are the corrected numbers.*

# TABLE 5 - 5 (cont.) ALTERNATIVE WATER QUALITY OBJECTIVES

## C) FISH AND WILDLIFE

### HABITAT/SPECIES

| ALTERNATIVES/ SOURCE | LOCATION | SAMPLING SITE NOs. (I-A/RKI) | PARAMETER | DESCRIPTION | INDEX TYPE | YEAR TYPE | DATES | VALUES |
|---|---|---|---|---|---|---|---|---|
| | | | SUISUN MARSH (cont.) | | | | | |
| PRESENT OBJECTIVES (cont.) | | | | | | | | |
| *Amended D-1485* | *Sacramento River at Collinsville*<br>*Montezuma Slough at National Steel*<br>*Montezuma Slough near Beldon Landing* | *C-2*<br>*RSAC081*<br>*S-64(new)*<br>*SLMZU25*<br>*S-49*<br>*SLMZU11* | *Electrical Conductivity (EC)* | *Monthly average of both daily high tide values not to exceed the values shown, in mmhos (or demonstrate that equivalent or better protection will be provided at the location)* | *D-1485 (Water Year)* | *All (effective Oct 1, 1988)* | *Oct*<br>*Nov*<br>*Dec*<br>*Jan*<br>*Feb*<br>*Mar*<br>*Apr*<br>*May* | *19.0*<br>*15.5*<br>*15.5*<br>*12.5*<br>*8.0*<br>*8.0*<br>*11.0*<br>*11.0* |
| | *Chadbourne Slough at Chadbourne Road (proposed)*<br>*and*<br>*Cordelia Slough 500 ft west of S.P.R.R. crossing at Cygnus*<br>*or*<br>*Chadbourne Slough at Chadbourne Road (proposed)*<br>*and*<br>*Cordelia Slough at Cordelia Goodyear Ditch (proposed)* | *S-21(prop.)*<br>*SLCBN1*<br><br>*S-33*<br>*SLCRD04*<br><br>*S-21(prop.)*<br>*SLCBN1*<br><br>*S-97(prop.)*<br>*SLCRD06* | *Electrical Conductivity (EC)* | *Monthly average of both daily high tide values not to exceed the values shown, in mmhos (or demonstrate that equivalent or better protection will be provided at the location)* | *D-1485 (Water Year)* | *All (effective Oct 1, 1991)*<br>*or*<br>*All (effective Oct 1, 1993)* | *Oct*<br>*Nov*<br>*Dec*<br>*Jan*<br>*Feb*<br>*Mar*<br>*Apr*<br>*May* | *19.0*<br>*15.5*<br>*15.5*<br>*12.5*<br>*8.0*<br>*8.0*<br>*11.0*<br>*11.0* |
| | *Goodyear Slough at Morrow Island Clubhouse*<br>*or*<br>*Goodyear Slough, 1.3 mi south of Morrow Island [Drainage] Ditch at Pierce* | *S-35(new)*<br>*SLGYR03*<br><br>*S 75(old)*<br>*SLGYR04* | *Electrical Conductivity (EC)* | *Monthly average of both daily high tide values not to exceed the values shown, in mmhos (or demonstrate that equivalent or better protection will be provided at the location)* | *D-1485 (Water Year)* | *All (effective Oct 1, 1991)*<br>*or*<br>*All (effective Oct 1, 1994)* | *Oct*<br>*Nov*<br>*Dec*<br>*Jan*<br>*Feb*<br>*Mar*<br>*Apr*<br>*May* | *19.0*<br>*15.5*<br>*15.5*<br>*12.5*<br>*8.0*<br>*8.0*<br>*11.0*<br>*11.0* |

# TABLE 5 – 5 (cont.) ALTERNATIVE WATER QUALITY OBJECTIVES

## C) FISH AND WILDLIFE

### HABITAT/SPECIES

| ALTERNATIVES/ SOURCE | LOCATION | SAMPLING SITE NOs. (I-A/RKI) | PARAMETER | DESCRIPTION | INDEX TYPE | YEAR TYPE | DATES | VALUES |
|---|---|---|---|---|---|---|---|---|
| | | | SUISUN MARSH (cont.) | | | | | |
| PRESENT OBJECTIVES (cont.) | | | | | | | | |
| *Amended D-1485* | *Suisun Slough, 300 ft south of Volanti Slough* | *S-42 SLSUS12* | *Electrical Conductivity (EC)* | *Monthly average of both daily high tide values not to exceed the values shown, in mmhos (or demonstrate that equivalent or better protection will be provided at the location)* | *D-1485 (Water Year)* | *All (effective Oct 1,1997)* | *Oct* | *19.0* |
| | | | | | | | *Nov* | *15.5* |
| | | | | | | | *Dec* | *15.5* |
| | | | | | | | *Jan* | *12.5* |
| | | | | | | | *Feb* | *8.0* |
| | *Water Supply Intake locations for Water-fowl Manangement Areas on Van Sickle Island and Chipps Island* | *No Locations specified* | | | | | *Mar* | *8.0* |
| | | | | | | | *Apr* | *11.0* |
| | | | | | | | *May* | *11.0* |
| ADVOCATED LEVELS | | | | | | | | |
| *BCDC* | *Sacramento River at Chipps Island* | *D-10 RSAC075* | *Electrical Conductivity (EC)* | *Monthly average of daily higher high tide values not to exceed the values shown. in mmhos* | *D-1485 (Water Year)* | *All (effective Oct 1,1984)* | *Oct* | *19.0* |
| | *Sacramento River at Collinsville* | *C-2 RSAC081* | | | | | *Nov* | *16.5* |
| | *Montezuma Slough at Miens Landing* | *S-64(old) SLMZU20* | | | | | *Dec* | *15.5* |
| | *Montezuma Slough at Cutoff Slough* | *S-48 SLMZU10* | | | | | *Jan* | *12.5* |
| | *Montezuma Slough near mouth* | *D-7(near) SLMZU01* | | | | | *Feb* | *8.0* |
| | *Suisun Slough 300 ft south of Volanti Slough* | *S-42 SLSUS12* | | | | | *Mar* | *8.0* |
| | *Suisun Slough near mouth* | *S-36 SLSUS01* | | | | | *Apr* | *11.0* |
| | *Goodyear Slough south of Pierce Harbor* | *S-35(old) SLGYR02* | | | | | *May* | *11.0* |
| | *Cordelia Slough above S.P.R.R. crossing at Cygnus* | *S-33 SLCRD05* | | | | | | |

# TABLE 5 – 5 (cont.) ALTERNATIVE WATER QUALITY OBJECTIVES

## C) FISH AND WILDLIFE

### HABITAT/SPECIES

| ALTERNATIVES/ SOURCE | LOCATION | SAMPLING SITE NOs. (I-A/RKI) | PARAMETER | DESCRIPTION | INDEX TYPE | YEAR TYPE | DATES | VALUES |
|---|---|---|---|---|---|---|---|---|
| | | | | SUISUN MARSH (cont.) | | | | |
| ADVOCATED LEVELS (cont.) | | | | | | | | |
| *SMPA[13] "Normal Standards" and "Deficiency Standards"* | *Monitoring Stations same as for Amended D-1485* | | *Electrical Conductivity (EC)* | *Monthly mean of both daily high tide values in mmhos* | *D-1485 (Water Year)* | *Normal Standards* | *Oct* | *19.0* |
| | | | | | | | *Nov* | *16.5* |
| | | | | | | | *Dec* | *15.5* |
| | | | | | | | *Jan* | *12.5* |
| | | | | | | | *Feb* | *8.0* |
| | | | | | | | *Mar* | *8.0* |
| | | | | | | | *Apr* | *11.0* |
| | | | | | | | *May* | *11.0* |
| | | | | | | *Deficiency Standards* | *Oct* | *19.0* |
| | | | | | | | *Nov* | *16.5* |
| | | | | | | | *Dec* | *15.6* |
| | | | | | | | *Jan* | *15.6* |
| | | | | | | | *Feb* | *15.6* |
| | | | | | | | *Mar* | *15.6* |
| | | | | | | | *Apr* | *14.0* |
| | | | | | | | *May* | *12.5* |
| POTENTIAL OBJECTIVES | | | | | | | | |
| *Amended D-1485* | *Sacramento River at Collinsville* | *C-2 RSAC081* | *Electrical Conductivity (EC)* | *Monthly average of both daily high tide values not to exceed the values shown, in mmhos (or demonstrate that equivalent or better protection will be provided at the location)* | *Not applicable* | *All (effective Oct 1, 1988)* | *Oct* | *19.0* |
| | *Montezuma Slough at National Steel* | *S-64(new) SLMZU25* | | | | | *Nov* | *15.5* |
| | | | | | | | *Dec* | *15.5* |
| | | | | | | | *Jan* | *12.5* |
| | | | | | | | *Feb* | *8.0* |
| | *Montezuma Slough near Beldon Landing* | *S-49 SLMZU11* | | | | | *Mar* | *8.0* |
| | | | | | | | *Apr* | *11.0* |
| | | | | | | | *May* | *11.0* |

# TABLE 5 – 5 (cont.) ALTERNATIVE WATER QUALITY OBJECTIVES

## C) FISH AND WILDLIFE

### HABITAT/SPECIES

### SUISUN MARSH (cont.)

| ALTERNATIVES/ SOURCE | LOCATION | SAMPLING SITE NOs. (I-A/RKI) | PARAMETER | DESCRIPTION | INDEX TYPE | YEAR TYPE | DATES | VALUES |
|---|---|---|---|---|---|---|---|---|
| POTENTIAL OBJECTIVES (cont.) | | | | | | | | |
| *Amended D-1485* | *Chadbourne Slough at Chadbourne Road (proposed) and Cordelia Slough 500 ft west of S.P.R.R. crossing at Cygnus or Chadbourne Slough at Chadbourne Road (proposed) and Cordelia Slough at Cordelia Goodyear Ditch (proposed)* | *S-21(prop.) SLCBN1 and S-33 SLCRD04 or S-21(prop.) SLCBN1 and S-97(prop.) SLCRD06* | *Electrical Conductivity (EC)* | *Monthly average of both daily high tide values not to exceed the values shown, in mmhos (or demonstrate that equivalent or better protection will be provided at the location)* | *Not applicable* | *All (effective Oct 1,1991) or All (effective Oct 1,1993)* | *Oct Nov Dec Jan Feb Mar Apr May* | *19.0 15.5 15.5 12.5 8.0 8.0 11.0 11.0* |
| | *Goodyear Slough at Morrow Island Clubhouse or Goodyear Slough, 1.3 mi south of Morrow Island [Drainage] Ditch at Pierce* | *S-35(new) SLGYR03 or S-75(old) SLGYR04* | *Electrical Conductivity (EC)* | *Monthly average of both daily high tide values not to exceed the values shown, in mmhos (or demonstrate that equivalent or better protection will be provided at the location)* | *Not applicable* | *All (effective Oct 1,1991) or All (effective Oct 1,1994)* | *Oct Nov Dec Jan Feb Mar Apr May* | *19.0 15.5 15.5 12.5 8.0 8.0 11.0 11.0* |
| | *Suisun Slough, 300 ft south of Volanti Slough* | *S-42 SLSUS12* | *Electrical Conductivity (EC)* | *Monthly average of both daily high tide values not to exceed the values shown, in mmhos (or demonstrate that equivalent or better protection will be provided at the location)* | *Not applicable* | *All (effective Oct 1,1997)* | *Oct Nov Dec Jan Feb Mar Apr May* | *19.0 15.5 15.5 12.5 8.0 8.0 11.0 11.0* |
| | *Water Supply Intake locations for Water Iowl Management Areas on Van Sickle Island* | *No Locations specified* | | | | | | |

# TABLE 5 - 5 (cont.) ALTERNATIVE WATER QUALITY OBJECTIVES

## C) FISH AND WILDLIFE

### HABITAT/SPECIES

| ALTERNATIVES/ SOURCE | LOCATION | SAMPLING SITE NOs. (I-A/RKI) | PARAMETER | DESCRIPTION | INDEX TYPE | YEAR TYPE | DATES | VALUES |
|---|---|---|---|---|---|---|---|---|
| | | | OTHER TIDAL MARSHES | | | | | |
| **PRESENT OBJECTIVES** | | | | | | | | |
| | *None specified* | | | | | | | |
| **ADVOCATED LEVELS** | | | | | | | | |
| *BCDC* | *Suisun Bay at Martinez* | *D-6 RSAC056* | *Electrical Conductivity (EC)* | *Monthly average of daily higher high tide values not to exceed the values shown, in mmhos* | *D-1485 (Water Year)* | *All except C* | *Feb* | *15.0* |
| | | | | | | | *Mar* | *15.0* |
| | *Suisun Slough at mouth* | *S-36 SLSUS00* | | | | | *Apr* | *18.0* |
| | | | | | | | *May* | *20.0* |
| | *Suisun Bay at Seal Islands (Port Chicago)* | *D-2 RSAC063* | | | | | | |
| | *Sacramento River at Chipps Island* | *D-10 RSAC075* | | | | | | |
| **POTENTIAL OBJECTIVES** | | | | | | | | |
| | *Suisun Bay at Martinez* | *D-6 RSAC056* | *Electrical Conductivity (EC)* | *Monthly average of daily higher high tide values not to exceed the values shown, in mmhos* | *D-1485 (Water Year)* | *All except C* | *Feb* | *15.0* |
| | | | | | | | *Mar* | *15.0* |
| | | | | | | | *Apr* | *18.0* |
| | | | | | | | *May* | *20.0* |

## FOOTNOTES:

[1] Exact location of diversion point is yet to be determined; West Canal at mouth of Clifton Court Forebay is a possible alternate diversion point.

[2] The Cache Slough objective to be effective only when water is being diverted from this location.

[3] EPA safe drinking water maximum contaminant level.

[4] To prevent exacerbating potential problems with THMs and other DBPs.

[5] When no date is shown, EC limit continues from April 1.

[6] Many participants made recommendations that are not quantifiable.

[7] Exact value chosen in the indicated range depends on a number of factors and conditions, e.g., Sac. Basin Four-River Index, deficiencies in entitlement deliveries, season, etc.

[8] A water right permit term is a standard not an objective.

[9] Objective applies to all seven South Delta stations identified by SDWA.

[10] South Delta Agriculture objectives will be implemented in stages; two interim stages and one final stage. The first interim stage will be implemented with the adoption of the WQCP, the second interim stage by 1994, and the final stage by 1996. Interim Stage 1 -- 500 mg/l mean monthly TDS all year at Vernalis. Interim Stage 2 -- (to be implemented no later than 1994) 0.7 mmhos/cm EC April 1 to August 31, 1.0 mmhos/cm EC September 1 to March 31, 30-day running average, at Vernalis and Brandt Bridge; with water quality monitored at three current interior stations -- Mossdale, Old River, near Middle River and Tracy Road Bridge, and an additional interior monitoring station on Middle River at Howard Road Bridge. Final Stage -- (to be implemented no later than 1996) 0.7 mmhos/cm EC April 1 to August 31, 1.0 mmhos/cm EC September 1 to March 31, 30-day running average, at Vernalis and Brandt Bridge on the San Joaquin River; with two interior stations at Old River Near Middle River and Old River at Tracy Road Bridge. Monitoring stations will be at Mossdale at head of Old river and Middle River at Howard Road Bridge.

OR

If a three-party contract has been implemented among DWR, USBR and the SDWA, that contract will be reviewed prior to implementation of the above and, after also considering the needs of other beneficial uses, revisions will be made to the objectives and compliance/montioring locations noted above, as appropriate.

[11] Controllable water quality factors are those actions, conditions, or circumstances resulting from human activities that may influence the quality of the waters of the State, that are subject to the authority of the State Board, or the Regional Board, and that may be reasonably controlled. Based on the record in these proceedings, controlling temperature in the Delta utilizing reservoir releases does not appear to be reasonable, due to the distance of the Delta downstream of

reservoirs and uncontrollable factors such as ambient air temperature, water temperatures in the reservoir releases, etc. For these reasons, the State Board considers reservoir releases to control water temperatures in the Delta a waste of water; therefore, the State Board will require a test of reasonableness before consideration of reservoir releases for such a purpose.

[12] Only the April 1 Sacramento Valley 40-30-30 Index value shall be used to determine whether the relaxation provision will be in effect in any particular year. Determination of the April 1 Index value shall assume normal precipitation conditions for the calculation of the April to July Four River Unimpaired Flow.

[13] Suisun Marsh Preservation Agreement:

1(f)..."Deficiency Period" shall mean (1) a Critical year following a Dry or Critical Year; or (2) a Dry Year following a year in which the Four Basin Index was less than 11.35; or (3) the second consecutive Dry Year following a Critical Year.

1(r)... "Critical Year" and "Dry Year" are also defined as in Footnote 2 of Table II of D-1485 except that runoff for the remainder of the water year shall be assumed to be equal to the lower value of the 80 percent probability range, as shown in the most recent issue of Bulletin 120, "Water Conditions in California".