COMMENTS OF THE DEPARTMENT OF WATER RESOURCES AT THE THIRD PUBLIC WORKSHOP FOR THE REVIEW OF STANDARDS FOR THE SAN FRANCISCO BAY/SACRAMENTO-SAN JOAQUIN DELTA ESTUARY[1]

The Department's comments today will be divided into two parts. The first part will look briefly at Key Issues 1, 3, and 4. The second part, to be presented by Ed Winkler of the Division of Operations and Maintenance, will discuss the points raised in Key Issue 2 relating to the relationship of regulation under the Endangered Species Acts to water project operations, with specific reference to the experience of the past two water years.

In Issues 1, 3, and 4 of the May 13, 1994 Notice for this workshop, the Board has inquired into the effect of factors other than Delta diversions on the status and trends of the estuary's biological resources. While Delta diversions are quite properly a chief focus of the Board in terms of potential factors influencing biota which are both controllable and directly under Board jurisdiction, these other factors constitute a vital part of the Board's planning program.

Whether or not they lend themselves to direct Board regulation, and many likely do, these other factors also serve to define in great measure the reasonableness of the objectives and of the terms and conditions which the Board is looking to

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[1] Presented by David B. Anderson and Edward D. Winkler, June 14, 1994.

establish in this process for water use, including Delta diversions. For example: if dramatically curbing water use yields only a small or a questionable benefit -- because other factors are controlling biological abundances -- then we may conclude that severe regulation is not going to be reasonable; or, if regulation of other controllable factors can produce positive results at lower social, economic, or environmental cost -- such as controlling pollution, poaching, predation or exotic invasions -- then increased regulation of water use may not be a reasonable alternative.

In addition, a comprehensive look by the Board at all the factors that affect biological resources can form the basis for a comprehensive plan for the State that puts all planning, management, and regulatory options on the table. At a minimum, the role of water use regulation may be more clearly seen in the context of a broader policy program for the Delta.

The Board's first issue asks about all the other factors that affect fish and wildlife. The Department offers to the Board our exhibit WRINT DWR-30, "Bay/Delta Fish Resources", Dr. Randall Brown, July 1992, which we introduced in the D-1630 hearings. We strongly commend it to your re-reading. It contains a thorough summary of both project-related impacts and impacts of other factors such as introduced species, changes in the food chain, pollutants, unscreened diversions, and adverse upstream and downstream conditions. For the purposes of brevity here and

because we anticipate others will be providing updates on information which is largely in the Board's Bay-Delta files already, we will only list and briefly comment on these non-diversion factors that influence Bay-Delta biota.

1. **Introduced Species.** The estuary is a changed and constantly changing biological system. The project's fish salvage facilities are probably the best sampler of Delta biota, and they show that 90 to 98 percent of the organisms salvaged are from exotic species. Eight of the eleven most numerous fish species are introduced species, including the top five. Potomacorbula, the prolific filter feeding Asian clam, is but one of the most recent in a long line of benthic invaders. Species composition, as pervasively affected by introduced groups, not only defines the biological system whose protection we are concerned with, but also may limit the effectiveness of management or regulatory measures directed at particular species. In addition to WRINT DWR-30, we also recommend to the Board the Bay-Delta Oversight Council's recently prepared report on introduced species.

2. **Reduced Nutrients.** Building dams, leveeing of river channels, and diking and filling of tidal wetlands have reduced the loading of land-derived detritus which is believed to be an important primary nutrient source for the estuary. In addition, reduced loadings of urban organic waste through treatment over the past 40 years have also taken away what may have been an important nutrient source at the base of the estuary's food chain. Reductions in sewage outfall have been considered as a possible

cause of striped bass declines in Chesapeake Bay.

3. **Upstream Conditions.** Flood control dams and channelization have over the years reduced both spawning and rearing habitat of anadromous species. Flood Control and energy and water development projects have also reduced runoff to the estuary. In comments submitted to EPA, the Department showed that upstream development increased many fold in the 1940-1975 period, depleting and modifying flows to the Delta. In addition, unscreened direct diversions entrain organisms that use the rivers as migration corridors and nursery and spawning areas before they pass through the Delta.

4. **Climatic Conditions.** The major climatic conditions affecting biological resources in the estuary are drought and flood. The recent six-year drought unquestionably has been a factor in causing many of the suppressed populations of Delta species. Similarly, floods, such as those extreme flows that occurred in 1983 and 1986, can transport organisms beyond desirable nursery locations. El Niño is a climatic phenomenon which is suspected to be responsible in some substantial part for the difficulties that some anadromous and marine species have experienced over the entire West Coast for the past several years.

5. **Channel and Levee Systems.** The construction and maintenance of reclamation and flood control levees has, in addition to reducing detrital loading, also reduced riparian cover and shoal and wetland areas.

6. **Harvest.** Important game and food species of fish are

not only subject to the pressures of regulated harvest, they are also subject to substantial illegal poaching. Although the precise extent of illegal take is, by its nature, not amenable to quantification, some evidence suggests that its magnitude is considerable. It is also true that the legal harvest of fish comes to have a greater and greater impact on food and game species as human population and other sources of biological stress on these species increase. A high percentage of harvest may be tolerable when other factors influencing biological resources are not at play or are at reduced levels; but over time that must necessarily change with increasing population, growth, and development and greater demands placed upon resources.

7. **Pollutants**. Control of pollutants is one of the Board's primary functions, under its various authorities to regulate waste discharges. During the D-1630 hearings, the toxicity of agricultural drains was newly implicated in studies done under both State and Regional Board auspices. In particular, the pesticide diazinon has since been identified as having accute lethal effects on organisms in rivers and the upper estuary. The most serious problem appears to occur during initial high flows in the winter probably resulting from runoff from agricultural and urban lands. The Department would like to request that Board staff report on this issue and the entire question of the role of toxic pollutants for consideration in these workshops.

Having noted the several categories of "factors that affect

Bay-Delta biological resources," we further note that we have deliberately rephrased the issue from the Board's formulation in Issue 1, which speaks of factors "causing the decline of fish and wildlife." Concern about "declines" properly directs our attention to the general problems of the estuary's biological resources. Beyond that, however, the phrasing is unfortunate: it implies, wrongly, that there has been a uniform or homogeneous decline of species in the estuary; and it misdirects our attention from asking what **today** is affecting those resources and what **today** may be done to afford reasonable protection for them.

"The decline" sounds like all or most species have been declining, in similar fashion and from a similar starting point of previous abundance. This is not the case. On the one hand, different species manifest different trends. On the other hand, "decline" can be a very judgmental concept. Some say "the decline" has occurred since the late 1960's to early 1970's. Adult striped bass did not decline until after 1977; and the population has been relatively stable for the past twelve years. Delta smelt did not "decline" until 1982. Is this the same decline that is observed for striped bass? Some say the period since 1982 has been one of general smelt decline, while others look at the same abundance indices and say, to the contrary, that smelt have in fact been increasing since 1985, and strongly so. Yet others may say that smelt have always varied so greatly from year to year that there is no trend save perhaps a general reaction to the drought and to two extreme flood years (1983 and

1986).

Our point here is not to say that there are not matters of serious or general concern with the Bay-Delta ecosystem. Rather it is to urge the Board to look at each species and at all species to more carefully assess the trends and status of the estuary's biological resources.

The second problem with asking about the "causes of the decline" is that it may not be very relevant. What is relevant is what today adversely affects or limits the viability of fish and wildlife populations. What today limits a population may have nothing to do with what might have previously caused it to decline. Moreover, there may exist many options for addressing a problem irrespective of what caused that problem, and they all should be investigated.

Focusing on the "cause of the decline" has a further drawback. Declines which have several material causes may not occur until the factor most recent in time is added. It may then seem that the last cause is the only cause, whereas, in reality, it is merely the one that sparked the decline. And more importantly, this viewpoint does not help us to make the one essential decision: irrespective of chronology, how do we choose, as a matter of public policy, among the several factors that may together affect the estuary's biological resources, even as we balance the control of these factors against the need for greater protection of instream uses.

Issue 2. - What modifications have the SWP and CVP made to their operations to protect endangered species and other species of concern ?

Graphical illustrations of the 1993 and 1994 requirements of The National Marine Fisheries Service Biological Opinion for Winter Run Salmon and The U.S. Fish and Wildlife Service Biological Opinion for Delta Smelt are shown in Figures 1 and 2. We will first describe the requirements and changes made to project operations to comply with the requirements, and then will discuss the water supply impacts of the requirements. Note that this discussion is limited to Delta operational requirements only; the opinions contain a host of other measures such as reservoir carryover storage minimums, upper river flow and temperature criteria, and delivery forecasting procedures.

Winter Run Salmon Requirements

The requirements in place to protect Winter-run Salmon are mandated closures of the Delta Cross Channel, minimum QWEST (lower San Joaquin River) flow requirements, and export reductions to comply with the combined incidental take limits at the SWP and CVP pumping plants. Following is a summary of the requirements related to Delta operations (refer to Figures 1 and 2 for more detail).

a) Incidental Take Limits

The NMFS Biological Opinion mandates that the SWP/CVP projects limit their "take" of Winter-Run size salmon to 1% of the estimate of outmigrating Winter-Run salmon smolt population. The "take" total is accumulated from October 1 through May 31. For 1993 the limit was 2700, and for 1994 it was 905. The only direct way of managing the projects' operations to comply with this limit is to reduce exports when Winter-Run size smolts are counted at the pumping plant fish salvage facilities. This reduction in exports can be necessary any time during the October through May period, but experience over the past 3 years indicates that the peak migration is from February through April. This take limit has at times substantially restricted the Projects' capability to export high winter and Spring flows; which are used to fill existing storage reservoirs south of the Delta and to meet contractor deliveries. These restrictions severely limit the feasibility of future south-of-Delta storage and banking facilities.

b) QWEST Flow Requirements

The NMFS Biological Opinion requires the projects to maintain "QWEST" flow criteria, which is a calculated estimate of the flow from the south-central side of the Delta, during November through

April. From November through January the 14-day average must be greater than -2000 cfs, and from February through April the 14-day average must be greater than 0 cfs. Factors included in the QWEST calculation are Sacramento River flow at Freeport, the San Joaquin River flow at Vernalis, inflow to the Delta from the streams on the East side of the Delta, Delta rainfall and consumptive use, SWP/CVP project exports, and Delta Cross Channel gate position (open or closed). The operational variables which can affect QWEST are Freeport flow, exports, and the Cross Channel gate position. The Biological Opinion also mandates closure of the Cross Channel gates at certain times of the year (see description below), so use of the flow in the Cross Channel to help meet QWEST criteria is limited.

Cross channel gate operation critically affects the determination of QWEST. For a 1000 cfs increase in Freeport flow (the only Delta inflow the projects can functionally control) exports can only increase by about 300 cfs if the Cross Channel gates are open and all other conditions remain the same. If the gates are closed, then exports can only increase by about 130 cfs under this scenario. Under low flow conditions, QWEST is equivalent to an export restriction.

c) Delta Cross Channel Operations

The NMFS Biological Opinion requires the Delta Cross Channel gates to be closed from February 1 through April 30. It also states the gates should be closed from October 1 to January 31 if monitoring indicates the presence of winter-run salmon smolts in the Delta. Under low flow conditions this criteria impacts project operations because meeting the QWEST flow criteria is more difficult when the Cross Channel gates are closed (as mentioned above).

Delta Smelt Requirements

The requirements of the 1993 and 1994 USFWS Delta Smelt Biological Opinion impacting SWP/CVP operations are minimum Delta Outflows, minimum San Joaquin River at Vernalis flows, North Bay Aqueduct pumping restrictions, and pumping restrictions at the SWP and CVP pumping plants to comply with the incidental take limits. The discussion to follow is limited to the 1994 criteria (refer to figures 1 and to 2 for further details).

a) Incidental Take Limits

The USFWS Biological Opinion includes incidental take limits for Delta Smelt which cover every month of the year. The limit varies each month and is based on a 14-day average of smelt

salvage at the Projects' pumping plants. Smelt occurrence at the salvage facilities is at times random and unpredictable. The only direct operational action to reduce the smelt take at the pumping plants is to reduce pumping. While the Biological Opinion does not have absolute export limitations at the SWP and CVP pumping plants, the take limit has at times restricted exports. In fact, both projects are currently curtailed to minimum pumping due to the abundance of salvaged smelt at the facilities. Based on past salvage data the spring and early summer are the times when smelt salvage is likely to have the most impact on exports.

b) North Bay Aqueduct Pumping Restrictions

When monitoring indicates the presence of Delta smelt juveniles and larvae, diversions from Barker Slough shall be reduced within 48 hours to a 3-day running average rate of 65 cubic feet per second (to be maintained for a minimum of 2 weeks)

c) San Joaquin River at Vernalis Flow Requirements

The 1994 Opinion includes two minimum San Joaquin River at Vernalis flow requirements. The first is that the Delta Outflow required from February through June includes a minimum Vernalis component. This requirement varies by year type from 800 cfs in a critical year to 2000 cfs in a wet year. The second requirement

is a conditional 30 day Vernalis transport Flow that may be required from April 1 to May 15 depending on smelt monitoring results. The flow value varies by year type from 2400 cfs in a critical year to 5200 cfs in a wet year. The only way for the projects to meet this is by CVP releases from New Melones Reservoir.

d) Minimum Delta Outflows

The 1994 Opinion requires minimum daily Delta Outflow for a specified number of days between the period February 1 and June 30. The number of days and the amount of outflow required varies with the year type. The Projects meet this criteria by releases from upstream storage and by controlling exports.

Water Supply Impacts of ESA Requirements - 1993 and 1994

The Department's Division of Operations and Maintenance has performed an analysis to determine the impacts of the endangered species requirements on SWP/CVP 1993 and 1994 to-date operations. The analysis uses daily flows, exports, and export capacities to determine what the exports would have been without the ESA requirements. The analysis determines the amount of "pumping capacity foregone" as well as water supply impacts due to ESA criteria considering the Delta flows that were available after

meeting D1485 Delta protections. This "pumping capacity foregone" is the maximum potential water reallocated from Project uses to Delta Outflow. This is also water that would have been available to fill future south-of-Delta storage (including groundwater banking and conjunctive use facilities). The analysis for 1993 includes a calculation of actual water supply impacts.

Figure 3 shows the amount of 1993 pumping capacity foregone and water supply impact by month. The cumulative total pumping capacity foregone was about 1 MAF. The total water supply impact was about 600 TAF. Figure 4 shows the 1994 pumping capacity foregone to date, which totals about 1.3 MAF. The Department will compute the total water supply impact for 1994 when the year is over.

The criteria that affected the 1993 operations for January was the QWEST flow requirement; in February and March a combination of QWEST and Winter-run take controlled operations; in April a combination of QWEST, Winter-run take and Smelt take were controlling; in May and June Smelt take was controlling. There were no impacts for the remainder of the year.

The criteria that affected 1994 operations in January and February was the QWEST flow requirement; in March a combination of Qwest and Winter-Run take controlled operations; in April the combination of QWEST, Winter-Run Take, and Delta Smelt Outflow

requirements were controlling, and in May Delta Smelt Outflow, and Delta Smelt Take controlled operations. As mentioned previously, both projects are presently curtailed to minimum pumping due to Delta smelt incidental take considerations.

Water Supply Impacts of ESA Requirements - Modeling Studies

In addition, DWR's Modeling section have completed three operations studies to estimate the long-term water supply impacts associated with the protective measures for winter-run salmon and Delta smelt. The water supply impacts are measured by comparison with a base study using D-1485 standards for controlling project operations. The modeling assumptions used to perform the analysis are described in the attached appendices. The studies were made using the Department's Planning Simulation Model DWRSIM. It should be noted that additional project export reductions because of incidental take restrictions are not included in the estimates of water supply impacts.

Description of Studies

The three operations studies performed were:

Base D-1485

The base study with D-1485 criteria used for comparison of water supply impacts and project operations. A list of major assumptions incorporated in this study are presented in Appendix I.

Base + NMFS

This study combines NMFS criteria for winter-run chinook salmon with the requirements of the D-1485. Appendix II shows NMFS criteria as modeled in DWRSIM.

Base + NMFS + DS

This study combines USFWS criteria for Delta Smelt with the requirements of NMFS's winter-run and D-1485. Appendix III shows Delta smelt criteria as modeled in DWRSIM.

Summary of Results

The water supply impacts are measured by a comparison with a base study using D-1485 standards for controlling project operations. No attempt was made to split the water supply impacts between CVP and SWP. In addition, these water supply impacts do not include impacts due to "take limits".

CVP/SWP total water supply impacts during the critically dry period of 1928 - 1934 to meet NMFS's criteria are 607 TAF per year. Additional impacts of 201 TAF per year occur when USFWS's criteria to protect Delta Smelt is imposed on top of NMFS's criteria.

Seventy-one year (1922 - 1992) average water supply impact of NMFS's criteria alone are 162 TAF per year. Average impacts increase by 50 TAF per year when Delta Smelt criteria is superimposed on NMFS criteria. Table 1 and Figure 5 summarize additional information from the operations studies.

Overview of Impacts Caused By ESA Requirements

Provided below is a list of all of the factors relating to SWP operations which are directly impacted by the ESA requirements.

- Lower carryover storage at Lake Oroville at the end of each water year due to the higher Delta flow requirements. This results in a greater "risk" during an extended and/or severe drought period.

- Reduction in water deliveries to contractors during all levels of approval (initial through final).

- Less flexibility in scheduling project operations since "windows" for meeting demands south of the Delta are more limited.

- Reduced export capability has jeopardized future south-of-Delta water banking programs such as Los Banos Grandes and Kern Water Bank as well as other possible conjunctive use programs.

- Opportunities for water transfers are extremely limited.

- Uncertainty in daily and weekly operations due to incidental take limits affects the reliability of water supply projections and results in less efficient operations at a considerably higher cost.

- SWP and CVP coordinated operations are much more difficult, and at times, individual project responsibilities are undefined.

Effects of ESA Requirements On Targeted Species

a) Winter-Run Salmon

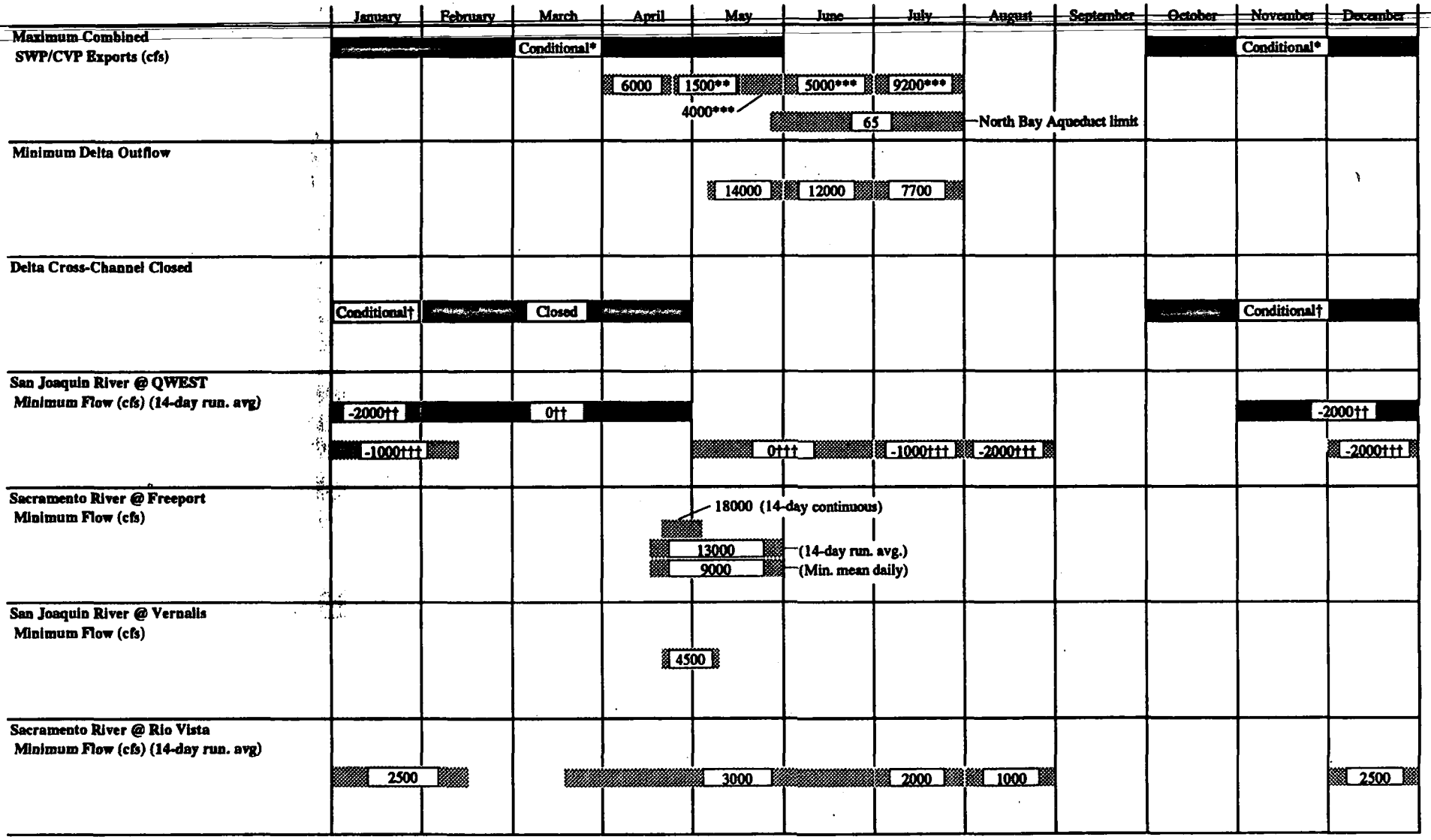
It is not presently possible to quantify the benefits of the requirements implemented to protect winter-run salmon. However, the resultant changes in diversions, outflow and QWEST have reduced the entrainment of winter-run and other fish during the late winter/early spring months of the drier years. Therefore, the winter-run requirements not only protect winter-run but are also likely to provide an umbrella of protection for other species in the spring.

b) Delta Smelt

It does not appear that the measures implemented under the ESA to protect Delta smelt have resulted in transporting delta smelt out of the Delta to the confluence or Suisun Bay area during March through May, 1994. However, the protective measures for smelt, in conjunction with protective measures for winter-run salmon may result in better survival of delta smelt. Whether these actions result in an increased adult abundance index and better geographical distribution remains to be seen.

FIGURE 1

Delta Endangered Species Criteria for 1993-94



LEGEND

NMFS Biological Opinion for Winter-Run Salmon

USFWS Biological Opinion for Delta Smelt

Notes

* Export reductions as necessary to comply with 1% take limit (limit was 2700 smolts in 1993)

** Limit during the period from April 26-May16 or coincident with arrival of San Joaquin pulse flows in the Delta

*** Export limits in these months will be reduced further if the 14-day running average salvage of 400 Delta Smelt is exceeded.

† Cross Channel closure based on real time monitoring for presence of winter-run salmon from Oct 1-Jan 31.

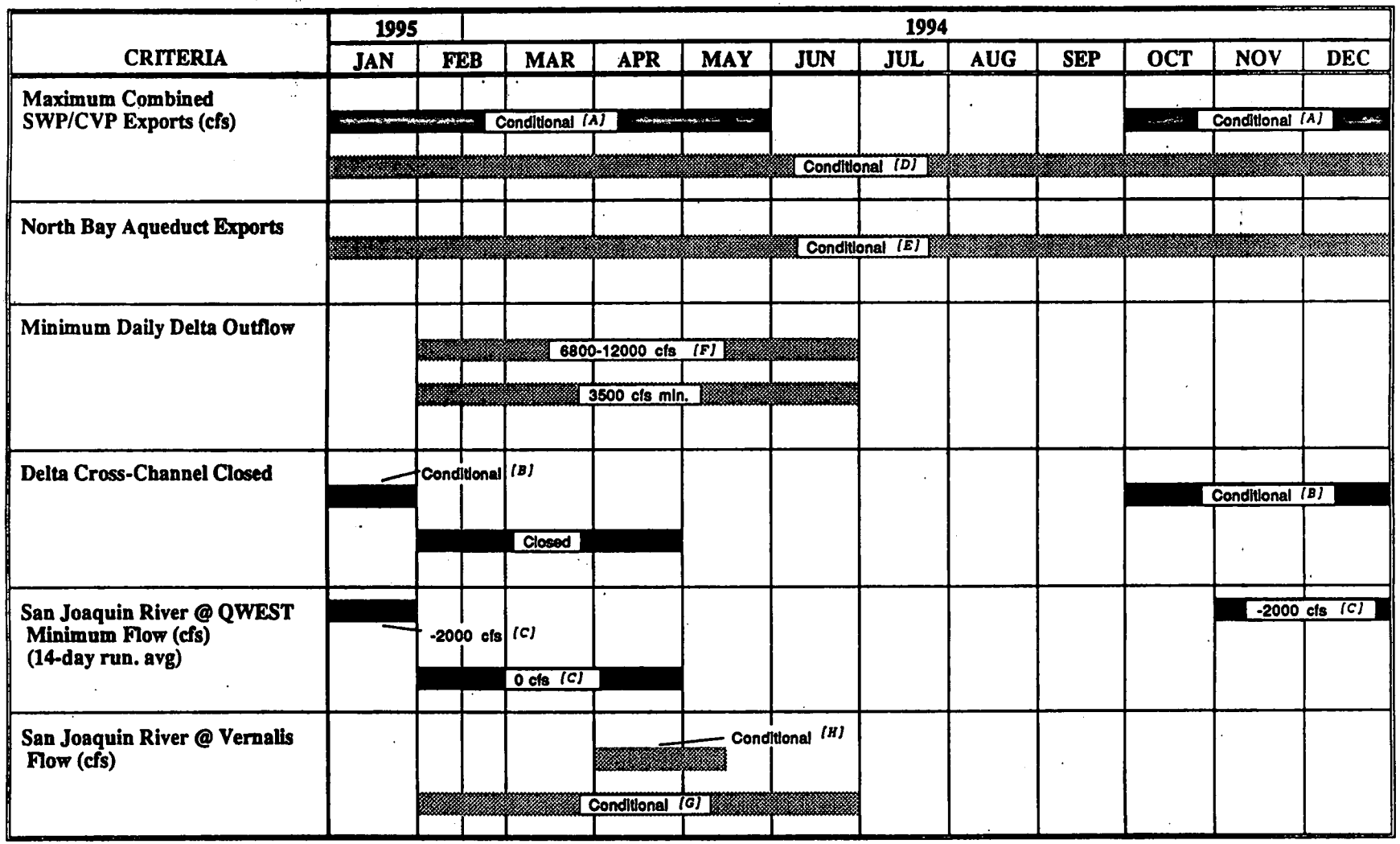
†† 7-day running average can be 1000 cfs less than applicable standard

††† QWEST limits do not apply when total CVP/SWP exports <2000 cfs

FIGURE 2

Delta Endangered Species Criteria

February 15, 1994 - February 14, 1995



LEGEND

NMFS Biological Opinion for Winter-Run Salmon

USFWS Biological Opinion for Delta Smelt

[*] See Attached Notes

FIGURE 2 (continued)

NMFS Biological Opinion for Winter-Run Salmon February 12, 1993

[A] Export reductions as necessary to comply with 1% take limit (limit is 905 smolts in 1994).

[B] Cross Channel closure based on real time monitoring for presence of winter-run salmon from Oct 1 - Jan 31.

[C] 7-day running average can not be more than 1000 cfs less than applicable standard.

USFWS Biological Opinion for Delta Smelt for 1994 February 4, 1994

[D] If 14-day running average of estimated combined SWP/CVP salvage exceeds values calculated below, modify operations to restore 14-day average. Take limits are:

	Wet, Above Normal, Below Normal	Dry, Critical	Likely 1994 Limit
Dec, Jan	1) 100 if FMTI is between 0 and 250; 2) 200 if preceeding FMTI is between 250 and 500; 3) 300 if between 500 and 1000; 4) 400 if between 1000 and 1500; 5) 500 if greater than 1500	1) 100 if FMTI is between 0 and 250; 2) 200 if preceeding FMTI is between 250 and 500; 3) 300 if between 500 and 1000; 4) 400 if between 1000 and 1500; 5) 500 if greater than 1500	[400]
Feb, Mar	Fall midwater trawl index (Latest Available) x 0.7	Fall midwater trawl index (Latest Available) x 0.7	[755]
Apr, May, Jun	Prev. year's FMTI x 0.7 (may not be greater than 755) or 600 (use greater)	Prev. year's FMTI x 0.7 (may not be greater than 755) or 400 (use greater)	[755]
July	Prev. year's FMTI or 600 (use greater). If this year's summer townet survey is less than mean of wet, above normal & below normal years, then use lesser value	Prev. year's FMTI or 300 (use lesser). If this year's summer townet survey is greater than mean for dry and critical dry years, then use greater value	[1078 or 300]
Aug	Prev. year's FMTI or 300 (use greater). If this year's summer townet survey is less than mean of wet, above normal & below normal years, then use lesser value	Prev. year's FMTI or 200 (use lesser). If this year's summer townet survey is greater than mean for dry and critical dry years, then use greater value	[1078 or 200]
Sep, Oct, Nov	The lesser value of: 1) Prev. year's FMTI, or 2) Latest value for this year's FMTI, but 3) >100	The greater value of: 1) 100 2) Latest value for this year's FMTI	conditional [>100]

FMTI - Fall Midwater Trawl Index

[E] When monitoring indicates the presence of Delta Smelt juveniles and larvae, diversions from Barker Slough shall be reduced within 48 hours to a 3-day running average rate of 65 cfs (to be maintained for a minimum of 2 weeks).

[F] Minimum Daily Delta Outflow for specified number of days between Feb 1 and June 30. Counting of days begins after 2 ppt downstream of Collinsville.

Year Type	At or above 12,000 cfs	At or above 6,800 cfs
Wet	150 days	150 days
Above Normal	150 days	150 days
Below Normal	85 days	114 days
Dry	64 days	109 days
Critical*	18 days	40 days

[G] Minimum required San Joaquin River flow component of Delta Outflow, Feb 1 - June 30:

Year Type	Vernalis Component
Wet	2,000 cfs
Above Normal	2,000 cfs
Below Normal	1,500 cfs
Dry	1,200 cfs
Critical	800 cfs

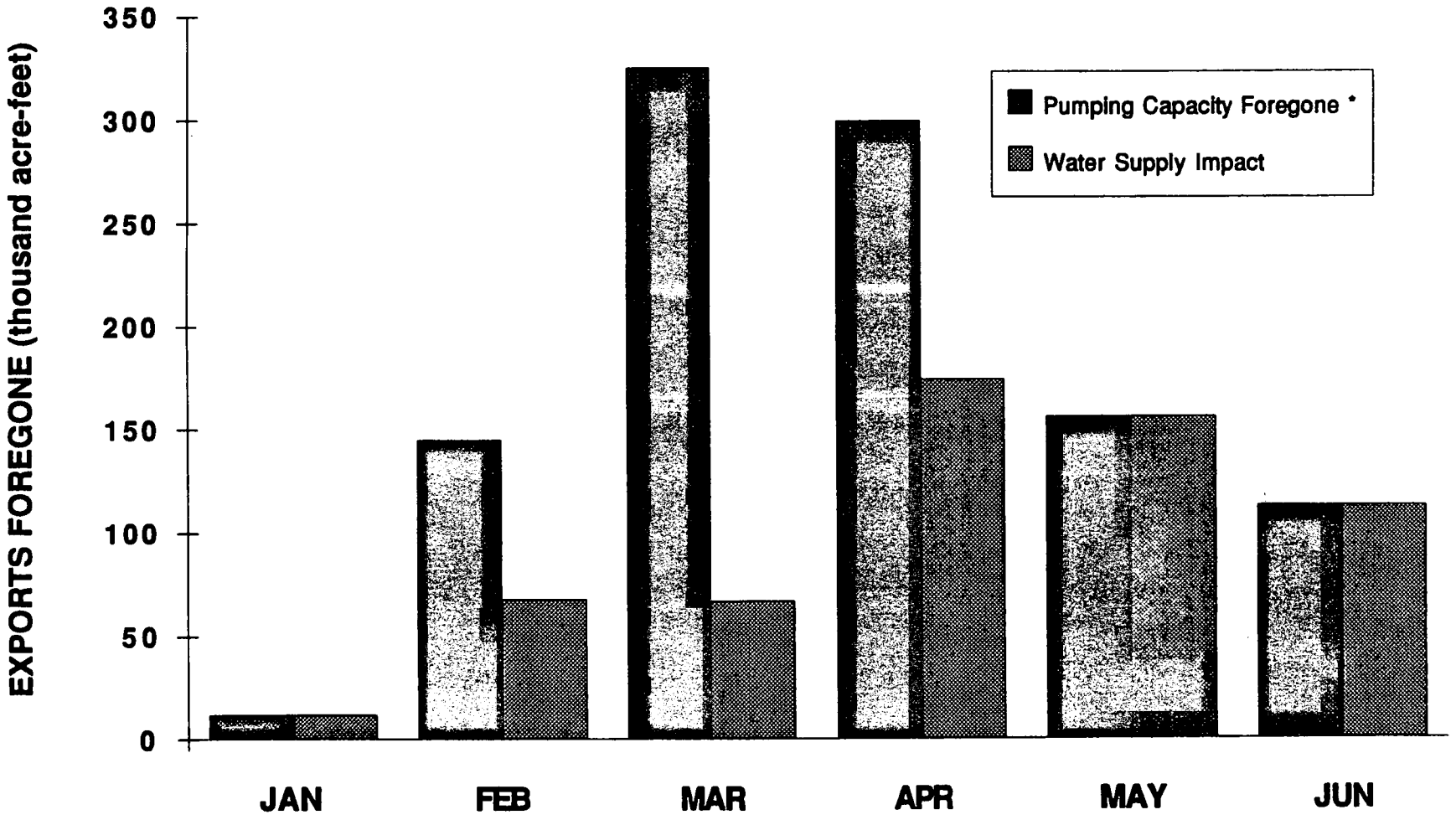
[H] 30-day average San Joaquin Transport Flows depending on monitoring results.

Year Type	Vernalis Transport Flow
Wet	5,200 cfs
Above Normal	3,600 cfs
Below Normal	3,200 cfs
Dry	2,600 cfs
Critical	2,400 cfs

* In critical dry years, counting of the required 18 days at 12,000 cfs may precede placement of the 2 ppt isohaline at Collinsville. 6,800 cfs outflow is required for a minimum of 40 days starting between April 1 and June 30 (after placement of 2 ppt isohaline).

FIGURE 3

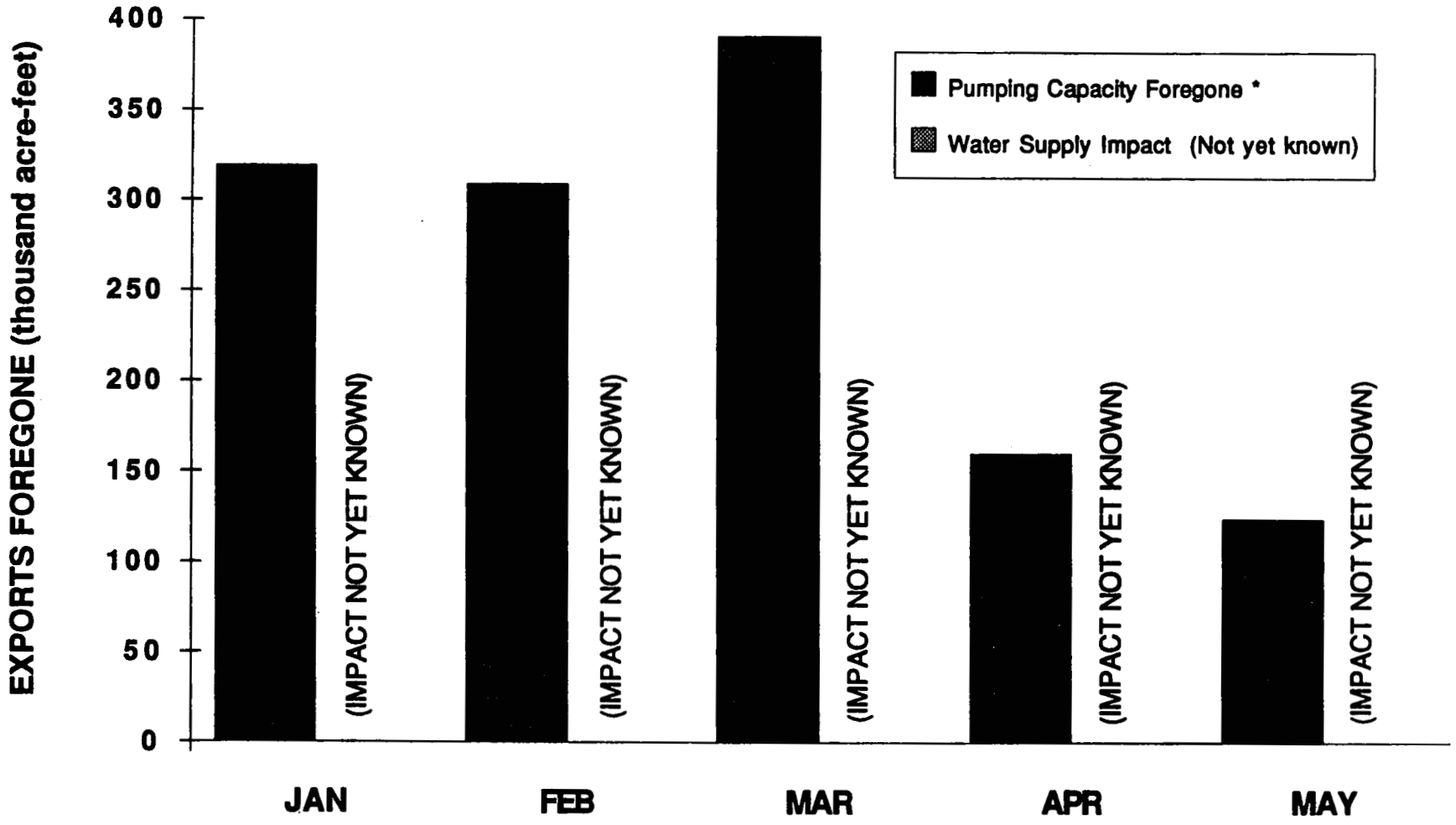
1993 SWP/CVP WATER SUPPLY IMPACTS DUE TO FEDERAL ENDANGERED SPECIES REQUIREMENTS



* Capacity foregone above actual water supply impact is water that would have been available to fill future south-of-Delta storage reservoirs.

FIGURE 4

1994 SWP/CVP WATER SUPPLY IMPACTS DUE TO FEDERAL ENDANGERED SPECIES REQUIREMENTS



* Capacity foregone above actual water supply impact is water that would have been available to fill future south-of-Delta storage reservoirs.

TABLE 1

SUMMARY OF COMPARATIVE WATER SUPPLY IMPACTS RELATIVE TO D-1485
(1000's AF/Year)

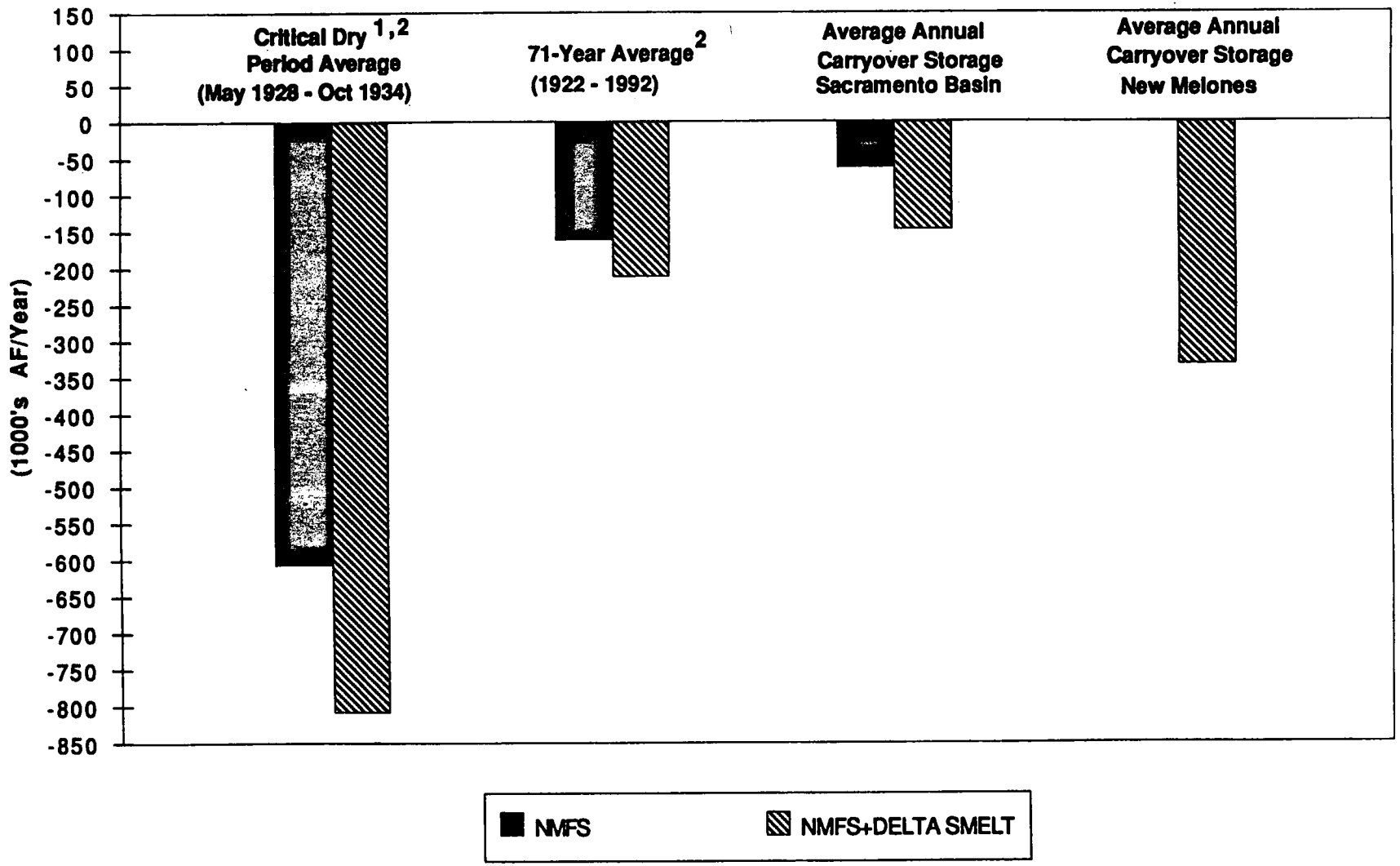
PRELIMINARY
6/10/94

STUDY	Critical Dry Period Average (May 1928 - October 1934)	71-Year Average (1922 - 1992)	Average Annual Carryover Storage Sacramento Basin	Average Annual Carryover Storage New Melones
NMFS	-607 [1,2]	-162 [2]	-63	0
NMFS + DELTA SMELT	-808 [1,2]	-212 [2]	-148	-333

1. Includes adjustments due to upstream net storage used.
2. Does not include potential water supply impacts for "Take Limits."

FIGURE 5

COMPARATIVE WATER SUPPLY IMPACTS RELATIVE TO D-1485



1. Includes adjustments due to upstream net storage used.
2. Does not include potential water supply impacts for "Take Limits."

APPENDIX I

D-1485 (Base) Study Assumptions

* New 1995 level hydrology and upstream depletions, based on Department of Water Resources Bulletin 160-93 land use projections (71 years: 1922 -1992).

* Minimum Delta outflow requirements are maintained to satisfy State Water Resources Control Board Decision D-1485, assuming Interim Suisun Marsh criteria.

* State Water Project Banks Pumping Plant average monthly capacity with 4 new pumps is 6,680 cfs (or 8,500 cfs in some winter months) in accordance with the United States Corps of Engineers permit criteria. Pumping is limited to 3,000 cfs in May and June, and 4,600 cfs in July to comply with D-1485 criteria for striped bass survival. Additionally, SWP pumping is limited to 2,000 cfs in any May or June in which storage withdrawals from Oroville Reservoir are required (per the January 5, 1987 Interim Agreement between DWR and the California Department of Fish & Game).

* Central Valley Project/State Water Project sharing of responsibility for the coordinated operation of the two projects is maintained per the Coordinated Operation Agreement; with storage withdrawals for in-basin use split 75 percent CVP/25 percent SWP, and unstored flow for storage and export split 55 percent CVP/45 percent SWP.

* Wheeling of CVP water through SWP facilities to San Luis Reservoir is permitted, as needed to offset the CVP Tracy Pumping Plant's compliance with D-1485 criteria in May and June. These studies assume that SWP pumping capacity will be made available so that CVP wheeling will be completed in October and November of each year. Additionally, 72 TAF/year of CVP water is wheeled to meet projected Cross Valley Canal demands when unused capacity is available to SWP Banks Pumping Plant.

* New Trinity River minimum fish flows below Lewiston Dam are maintained at 340 TAF/year for all years, based on the May, 1991 letter agreement between the USBR and the U. S. Fish and Wildlife Service.

* Sacramento River minimum fishery flows below Keswick Dam are maintained per the agreement between U. S. Bureau of Reclamation and California Department of Fish and Game

(as revised October, 1981). These flows range from 2,300 to 3,900 cfs, depending on the time of year per the USBR's Shasta criteria.

* Sacramento River navigation control point (NCP) flows are maintained at 4,000 cfs for all twelve months of all years type.

* Folsom Reservoir storage capacity has been reduced from 1,010 TAF down to 974 TAF due to sediment accumulation, as calculated from a recent 1992 reservoir capacity survey. Additionally, the flood control reservation has been revised to incorporate the flexible criteria, per the December, 1993 USCE report "Folsom Dam and Lake Operation Evaluation". This flood control criteria incorporates use of available reservoir storage space in upstream reservoirs, such that the maximum Folsom Lake flood control reservation will vary from 400 TAF to 670 TAF.

* Lower American River minimum fish and recreation flows are variable, and are determined based on the available storage in Folsom Lake per USBR operation criteria. Minimum flows can range from 250 cfs (when storage is less than 100 TAF) up to 2,000 cfs (when storage is above 600 TAF). Minimum flows of 1,250 to 1,500 cfs are normally maintained, during periods of average water storage conditions in Folsom Reservoir.

* Stanislaus River minimum fish flows below New Melones Reservoir range from 98 TAF/year up to 302 TAF/year, according to the interim agreement (dated June, 1987) between the USBR and the California Department of Fish & Game. The actual minimum fish flow for each year is determined based on the water supply available for that year.

* San Joaquin River water quality standards at Vernalis are maintained per SWRCB Decision 1422 (500 ppm TDS on an average basis). Additional water releases from New Melones Reservoir are made when necessary to maintain these standards at Vernalis, up to a maximum amount of 70 TAF/year.

* 1995 level CVP demands are as follows:

Contra Costa Canal	=	145 TAF/year
DMC and Exchange	=	1,496
CVP San Luis Unit	=	1,447
San Felipe Unit	=	135
Cross Valley Canal	=	72

Total CVP Delta Exports	=	3,295 TAF/year
Folsom South Canal	=	68 TAF/year

Note that certain wet years in the San Joaquin River Basin when "James" bypass flows are available in the Mendota Pool, Tracy export demand will be reduced significantly.

* Maximum SWP Contractor deliveries are designed to vary in response to local wetness indexes. As such, maximum deliveries are reduced in the wetter years, assuming greater availability of local water supplies.

  Deliveries to all San Joaquin Valley Agricultural Contractors are reduced in wetter years, using a wetness index developed from annual Kern River inflows to Lake Isabella, as follows:

	Dry-Avg.	Above Avg.	Wet Yrs.
Kern River flow (TAF/year)	below 1,000	1,000-1,400	above 1,400
Maximum SWP Total AG delivery	1,220 TAF	1,100 TAF	915 TAF

  M&I deliveries to Metropolitan Water District of Southern California are reduced in wetter years, using a 10-station Southern California two-year average precipitation index, as follows:

	Dry Yrs.	Avg. Yrs.	Above Avg.	Wet Yrs.
So. Calif. Precip. (Inches/yr.)	below 15	15-17.9	18-20.9	above 21
Maximum MWDSC M&I delivery	1,450 TAF	1,200 TAF	900 TAF	800 TAF

  Maximum deliveries to all other SWP M&I contractors are NOT adjusted for a wetness index, and are set at 840 TAF/year.

  As a result of the use of these wetness indexes, the total maximum delivery to all SWP Contractors will vary by year, ranging between the following limits:

	Dry-Avg.	Avg.	Above Avg.	Wet Yrs.
Max SWP AG				

delivery	1,220	1,220	1,100	915
Max MWDSC M&I delivery	1,450	1,200	900	800
Max Other SWP M&I delivery	840	840	840	840
Fixed Losses & Recreation	64	64	64	64
Total Maximum SWP Delivery	3,574	(Total	Varies)	2,619

*When needed, SWP Agricultural and M&I deficiencies are imposed per the standard Contract criteria, with deficiencies calculated from 1994 Table A Entitlements, summarized as follows:

	1994 Table A Entitlement
Agricultural entitlements	1,220 TAF/year
M & I entitlements	2,851
Recreation & Losses	64
Total Entitlements	4,135 TAF/year

APPENDIX II

NMFS' Winter-Run Chinook Salmon Criteria

On February 12, 1993, the National Marine Fisheries Service issued a biological opinion for operation of the CVP and SWP for winter-run chinook salmon. Not all of the 13 criteria required in NMFS's "Reasonable and Prudent Alternative" are modeled in DWRSIM. Those items that are included in DWRSIM (using the NMFS numbering sequence) are as follows:

(2) The end-of-water-year (September 30) carryover storage in Shasta Reservoir is maintained at 1.9 MAF in normal years. However, in some critical years, it is not possible to maintain a minimum carryover storage of 1.9 MAF.

(3) A minimum flow of 3,250 cfs from Keswick Dam to the Sacramento River is maintained from October 1 through March 31 of all water year types.

(7) The Delta Cross Channel Gates are maintained in the closed position from February 1 through April 30 of all water year types.

(9) The QWEST reverse flow is maintained at greater than or equal to 0 cfs from February 1 through April 30 of all water year types.

(10) The QWEST reverse flow is maintained at greater than -2,000 cfs from November 1 through January 31 of all water year types. This standard is not dropped whenever Mallard Slough water quality is better than or equal to 3.0 EC.

Note:

- The most significant NMFS criteria <u>not</u> modeled is the "take limit" at the SWP and CVP export pumps in the Delta, which has required significant reductions in exports this year even though all water quality and flow criteria was being met.

- The requirement to meet QWEST in these studies was shared by the CVP and SWP by allowing equal export capacity between the two projects, not according to existing COA percentages. This assumption affects the relative split of impacts between the CVP and SWP and reservoir storage levels. However, in this report, only the combined water supply impacts of the CVP and SWP are shown.

APPENDIX III

USFWS Delta Smelt Requirements for 1994

On February 4, 1994, USF&WS issued a biological opinion concerning operations of the CVP and SWP in relation to Delta smelt for year 1994. This biological opinion also indicated that the criteria specified for 1994 is for one year only, and will be re-evaluated for year 1995.

Not all of the criteria specified in the opinion can be modeled in DWRSIM. Delta smelt criteria that are modeled are described as follows:

(1) All SWRCB D-1485 Delta standards and NMFS Winter-Run salmon requirements are to be maintained.

(2) Transport and habitat flows are provided at Chipps Island per the table below within the February 1 to June 30 interval.

Year Type D-1485 Index	Number of days at 12,000 cfs	6,800 cfs
Wet	150	150
Above Normal	150	150
Below Normal	85	114
Dry	64	109
Critical	18	40

Except for Critical years, the number of days at 12,000 cfs and 6,800 cfs are maintained concurrently, starting on February 1 of each year.

In Critical years, 12,000 cfs is maintained from February 1 - 18; and 6,800 cfs is met from April 1 - May 10.

(3) From February 1 to June 30 of all year types, a minimum Delta outflow of 3,500 cfs is maintained.

(4) The 2ppt isohaline (X2) is maintained at or downstream of Collinsville (81.0 Km) on February 1 in all Wet, Above Normal, Below Normal and Dry years. For Critical years, the X2 requirement is met at Collinsville beginning on April 1.

(5) Minimum flows are provided on the San Joaquin River at Vernalis per the table below, starting

on February 1 of all but Critical years. In Critical years, the 40 day period starts on April 1, to coincide with Delta outflow requirement.

Year Type D-1485 Index	Required Flow (cfs)	Number of Days Maintained
Wet	2,000	150
Above Normal	2,000	150
Below Normal	1,500	114
Dry	1,200	109
Critical	800	40

(6) San Joaquin River transport flows are provided at Vernalis from April 1 through April 30, per table below. New Melones Reservoir storage is used to provide these flows.

Year Type D-1485 Index	Minimum Flow (cfs)
Wet	5,200
Above Normal	3,600
Below Normal	3,200
Dry	2,600
Critical	2,400