New Melones Operation Plan

Current Performance
and
Proposed Transitional Plan

Prepared by the
Oakdale Irrigation District
and
South San Joaquin Irrigation District
May 2006

Current Plan of Operation

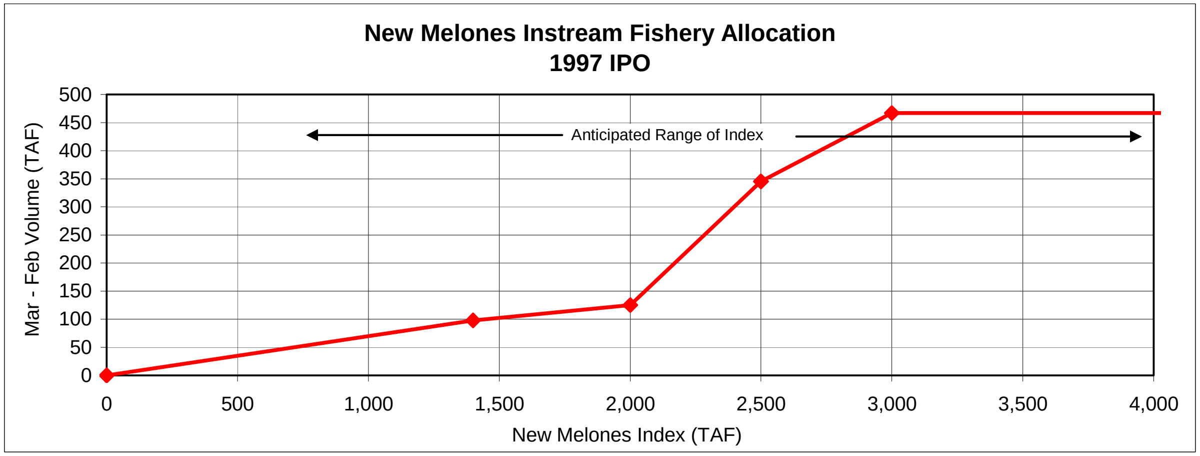
- New Melones Interim Plan of Operation, 1997

New Melones Storage Plus Inflow		Fishery		Vernalis Water Quality		Bay-Delta		CVP Contractors*	
From	To	From	To	From	To	From	To	From	To
0	1,400	0	98	0	70	0	0	0	0
1,400	2,000	98	125	70	80	0	0	0	0
2,000	2,500	125	345	80	175	0	0	0	59
2,500	3,000	345	467	175	250	75	75	90	90
3,000	6,000	467	467	250	250	75	75	90	90

* CVP Contractors: Stockton East Water District and Central San Joaquin Water Conservation District

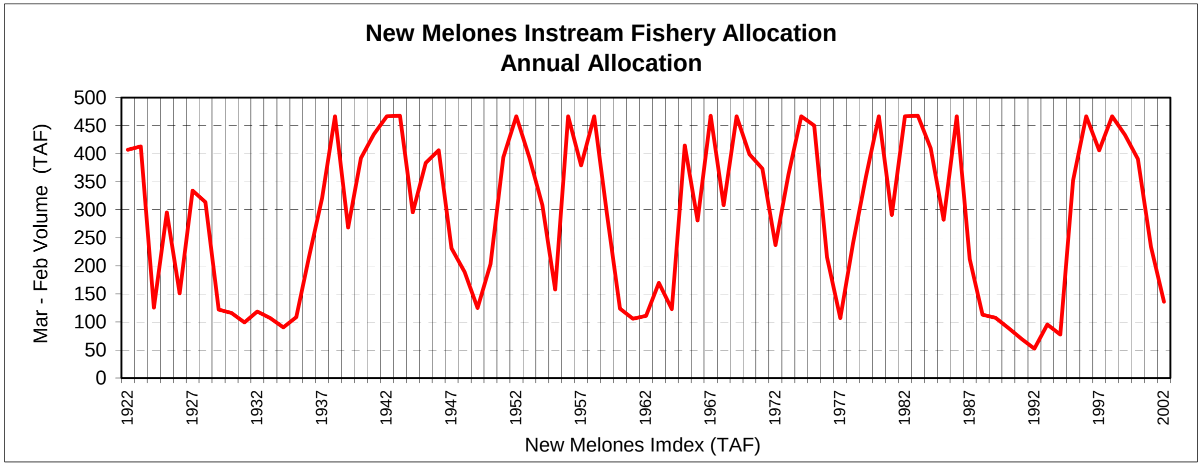
Current Performance

- New Melones modeled operation – Fishery



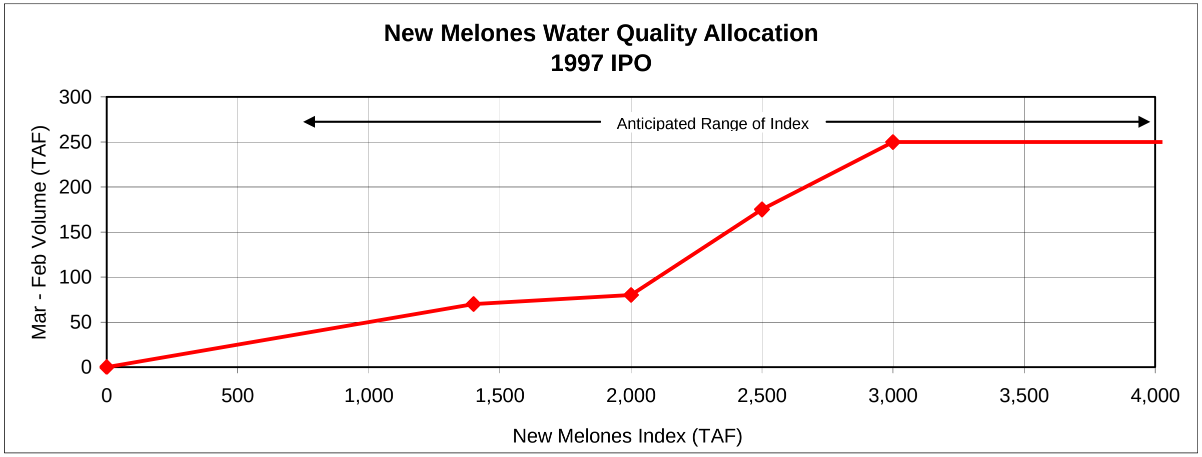
<u>Average Allocation</u>
288 TAF

Average Total
<u>River Release</u>
447 TAF
(Including fishery, water quality, Vernalis flow, dissolved oxygen and spills)



Current Performance

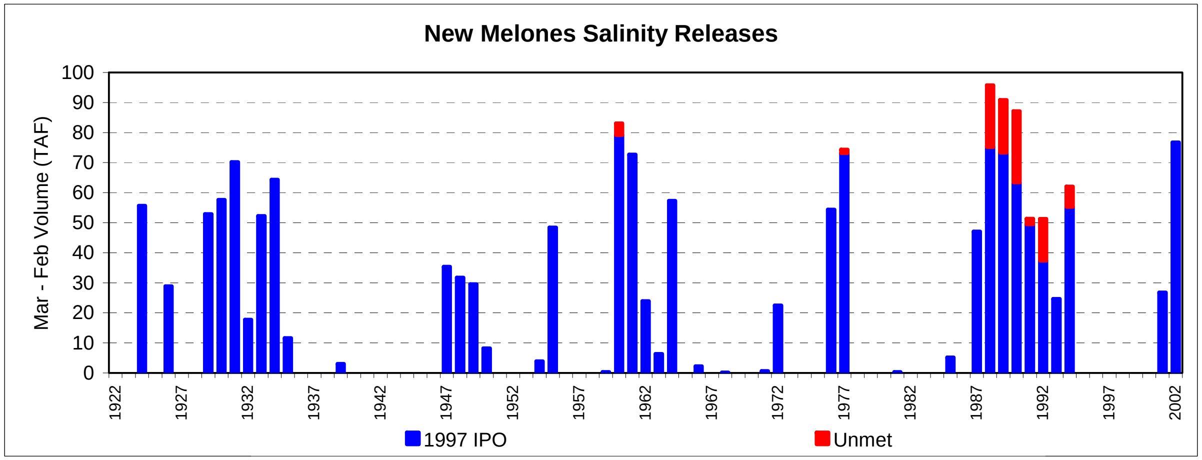
- New Melones modeled operation – Vernalis Water Quality



Average Allocation
156 TAF

Average Use
19 TAF

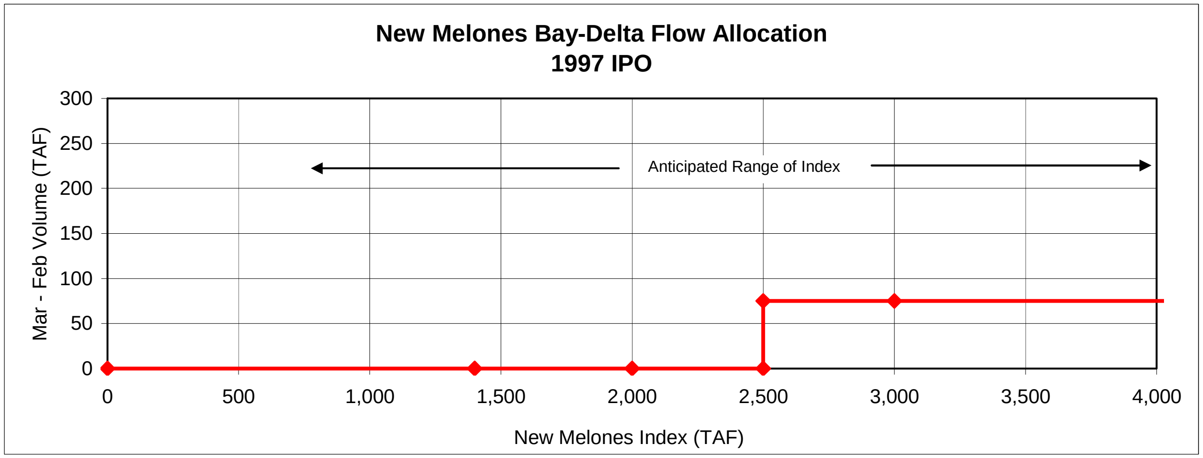
Average Unmet*
1 TAF



* "Unmet" represents the amount of additional release needed to fully comply with water quality objective, but Is not released due to modeled IPO annual constraint.

Current Performance

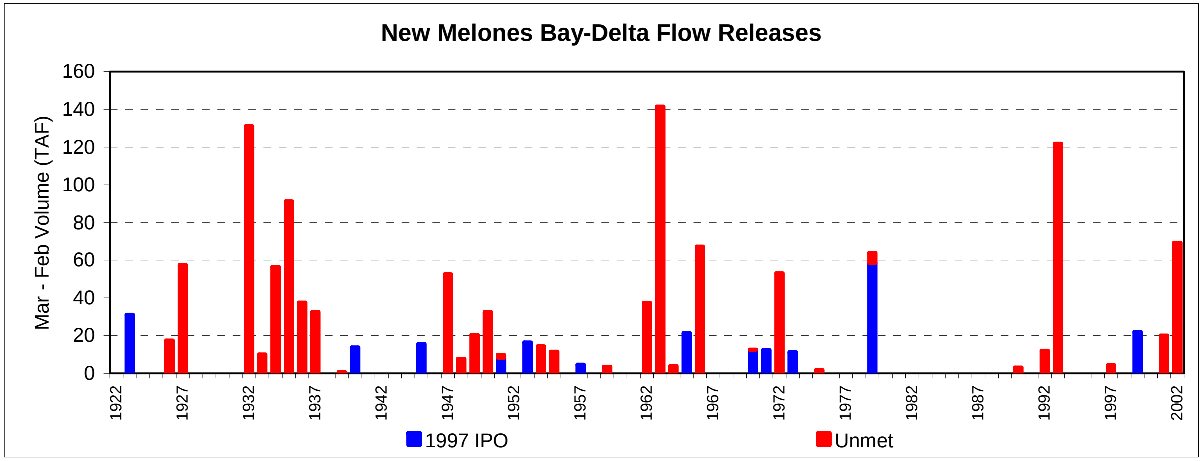
- New Melones modeled operation – Vernalis Bay-Delta Flow



Average Allocation
35 TAF

Average Use
3 TAF

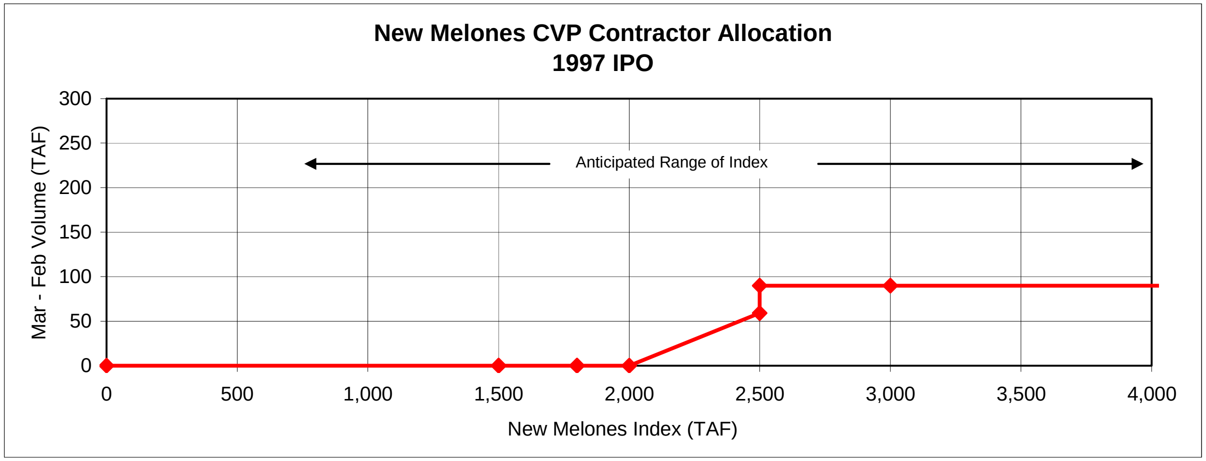
Average Unmet*
14 TAF



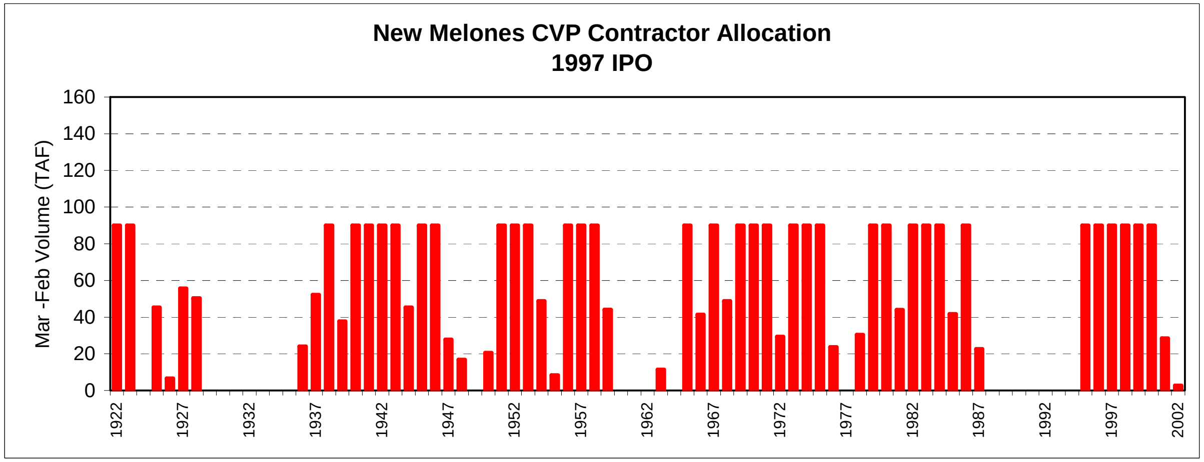
* "Unmet" represents the amount of additional release needed to fully comply with Vernalis Bay-Delta flow objective, but Is not released due to modeled IPO annual or Goodwin release constraint.

Current Performance

- New Melones modeled operation – CVP Contractors



Average Allocation
and Use
49 TAF



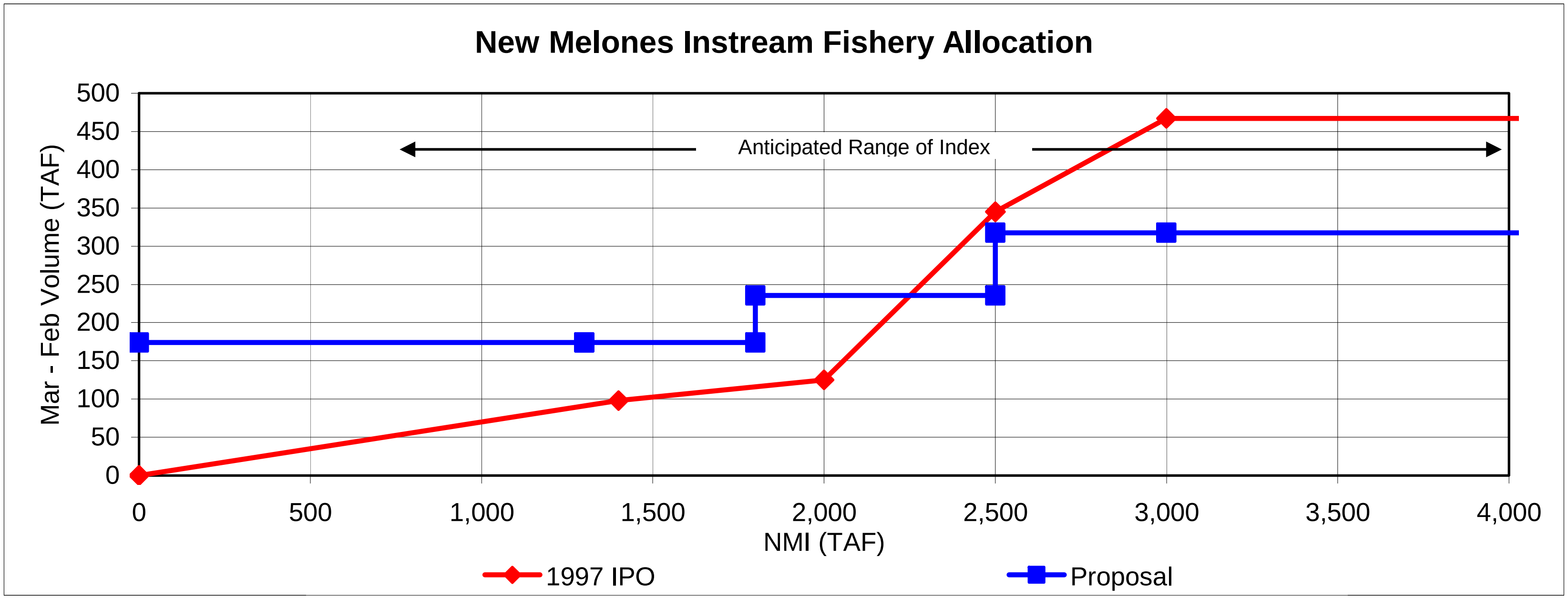
OID/SSJID Proposal

- New Melones Index Based Allocations
  - Operations are pivoted at three NMI points, 1,500, 1,800 and 2,500
- Instream Fishery Releases
  - When NMI > 2,500, 318 TAF
  - When NMI > 1,800 and < 2,500, 235 TAF
  - When NMI < 1,800, 174 TAF
- Water Quality Releases
  - Unconstrained
- Vernalis Bay-Delta Flow Releases
  - Unconstrained (except when Goodwin is limited to 1,500 cfs)
- Ripon Dissolved Oxygen Releases
  - Assumed to be subsumed by other objectives
- CVP Contractors
  - When NMI >1,500 and < 1,800, 49 TAF
  - When NMI > 1,800, 155 TAF

OID/SSJID Proposal

- Results and Comparison to Current IPO – Instream Fishery Allocation

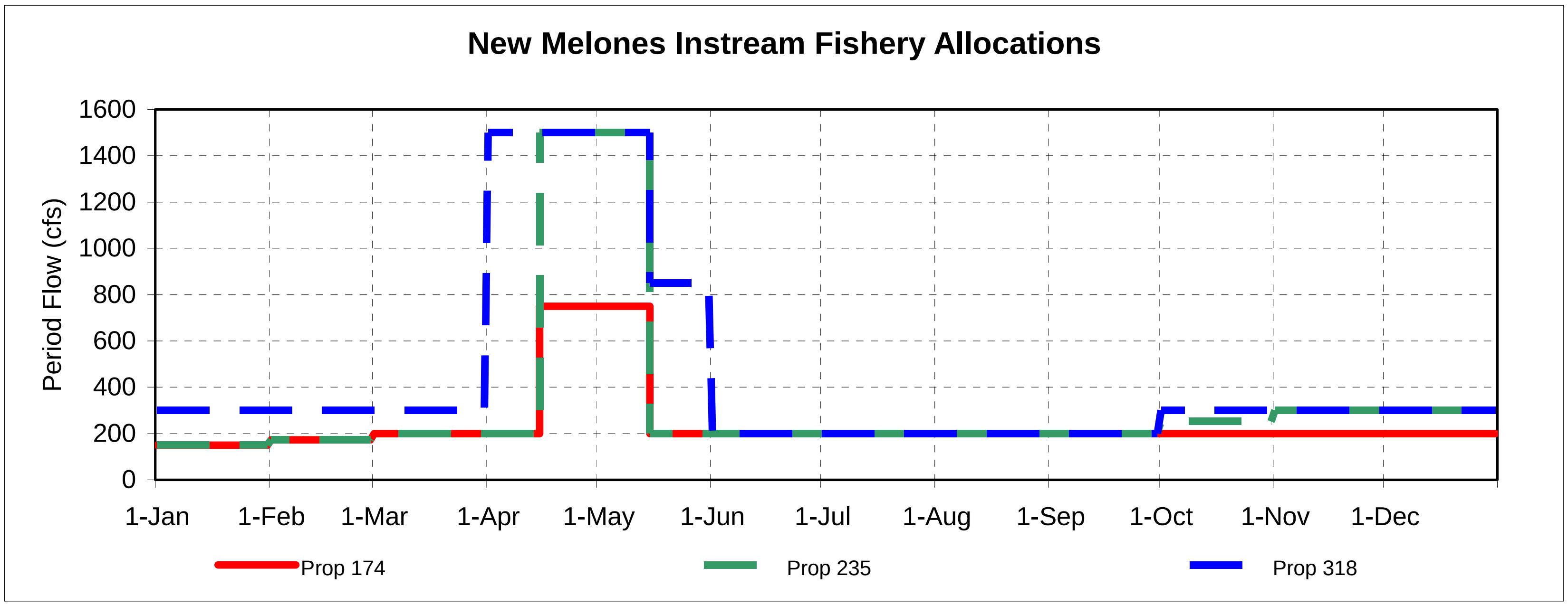
Annual Allocation



OID/SSJID Proposal

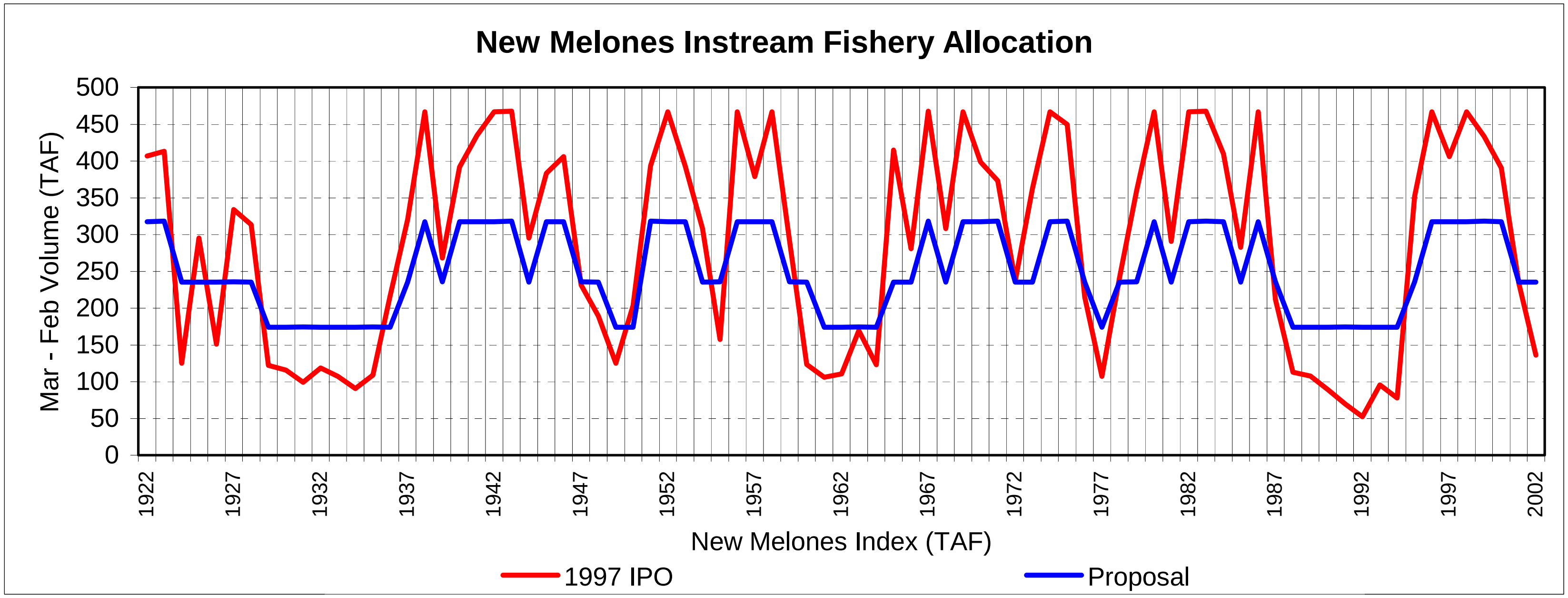
- Results and Comparison to Current IPO – Instream Fishery Allocation

Monthly Distribution



OID/SSJID Proposal

- Results and Comparison to Current IPO – Instream Fishery Allocation

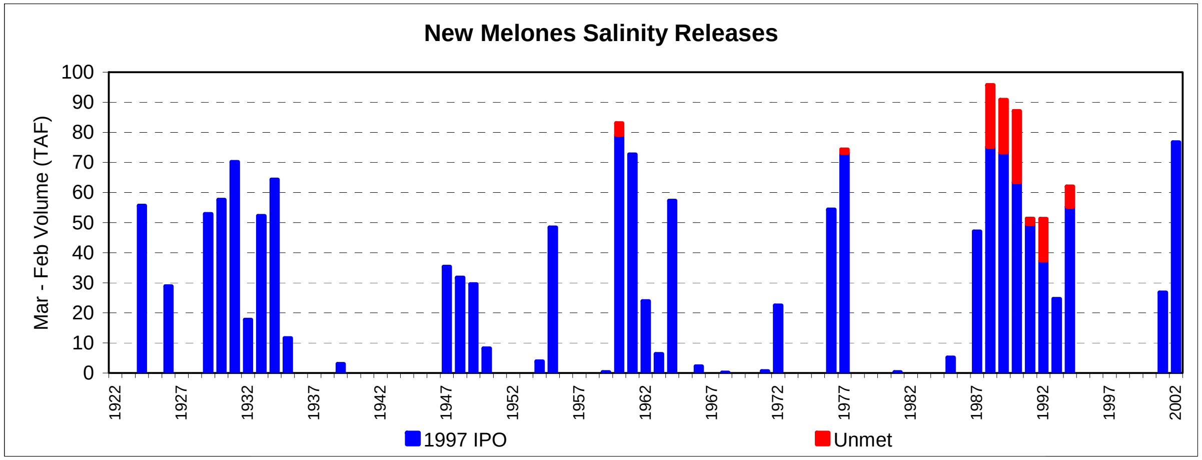


Average Allocation	Average Allocation
IPO	Proposal
288 TAF	250 TAF

(Does not include other releases adding to flow)

OID/SSJID Proposal

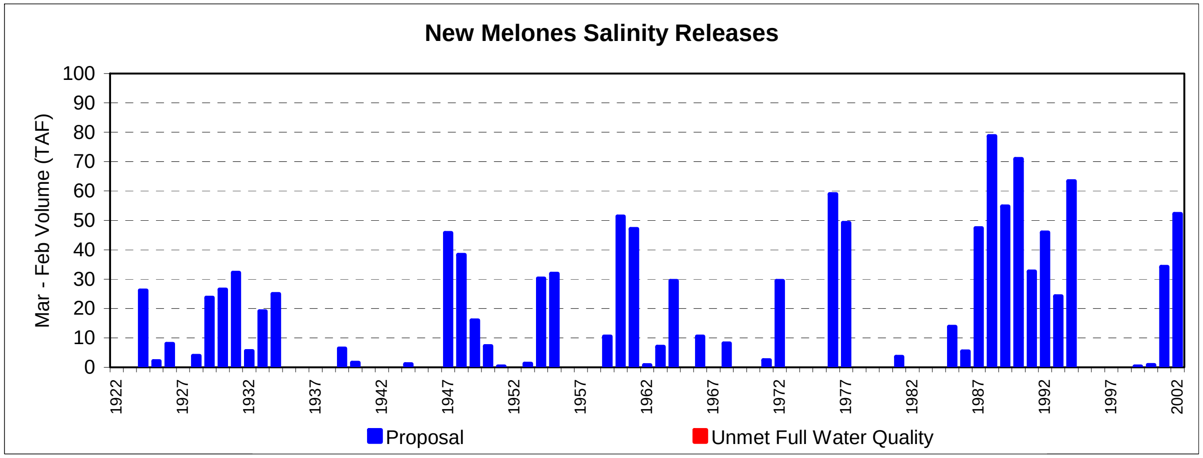
- Results and Comparison to Current IPO – Vernalis Water Quality



"Unmet" represents the amount of additional release needed to fully comply with water quality objective, but Is not released due to modeled IPO annual constraint. Average unmet: 1 TAF.

Average Release
<u>IPO</u>
19 TAF

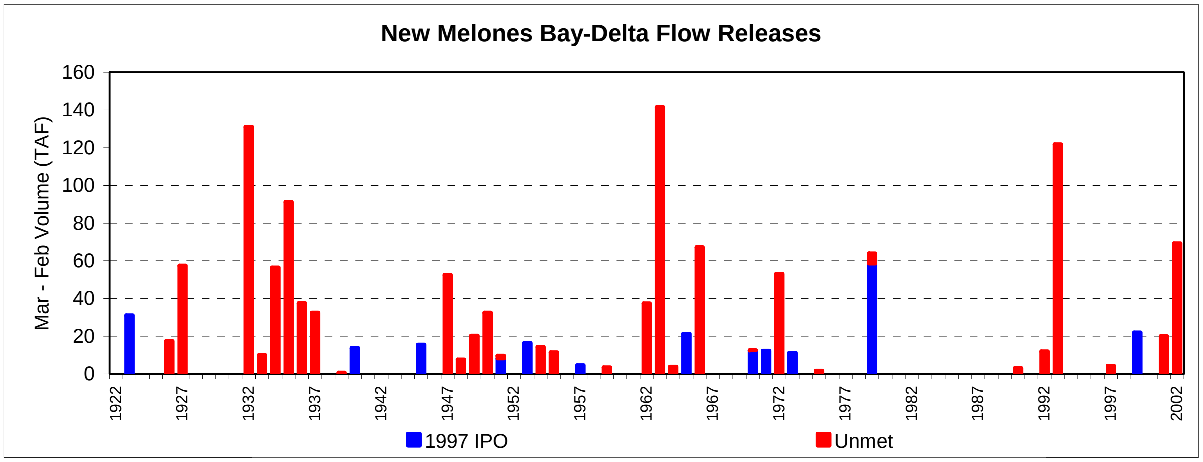
Average Release
<u>Proposal</u>
15 TAF



Water quality objective is met in all years.

OID/SSJID Proposal

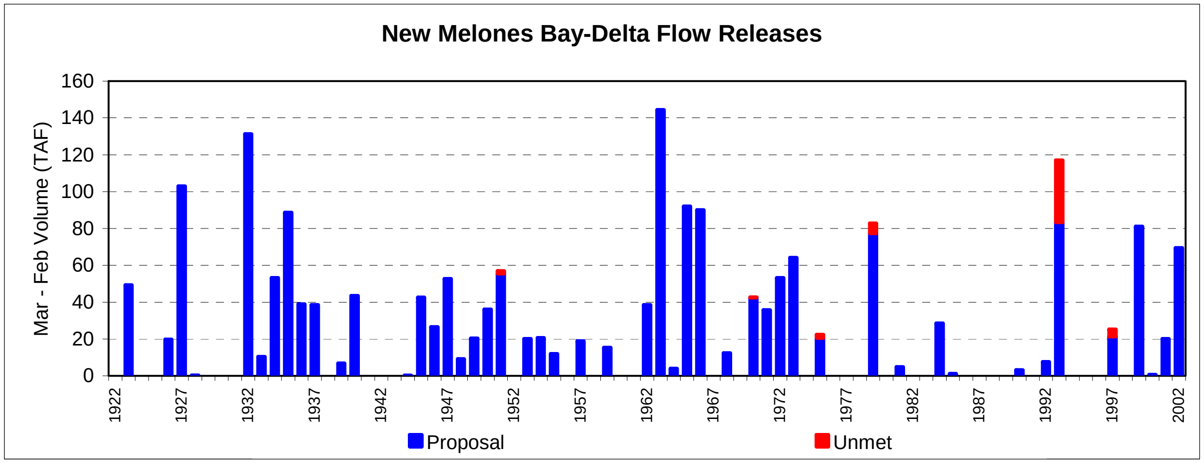
- Results and Comparison to Current IPO – Vernalis Bay-Delta Flow Release



"Unmet" represents the amount of additional release needed to fully comply with Vernalis Bay-Delta flow objective, but Is not released due to modeled IPO annual and Goodwin release constraint. Average unmet: 14 TAF.

Average Release
IPO
3 TAF

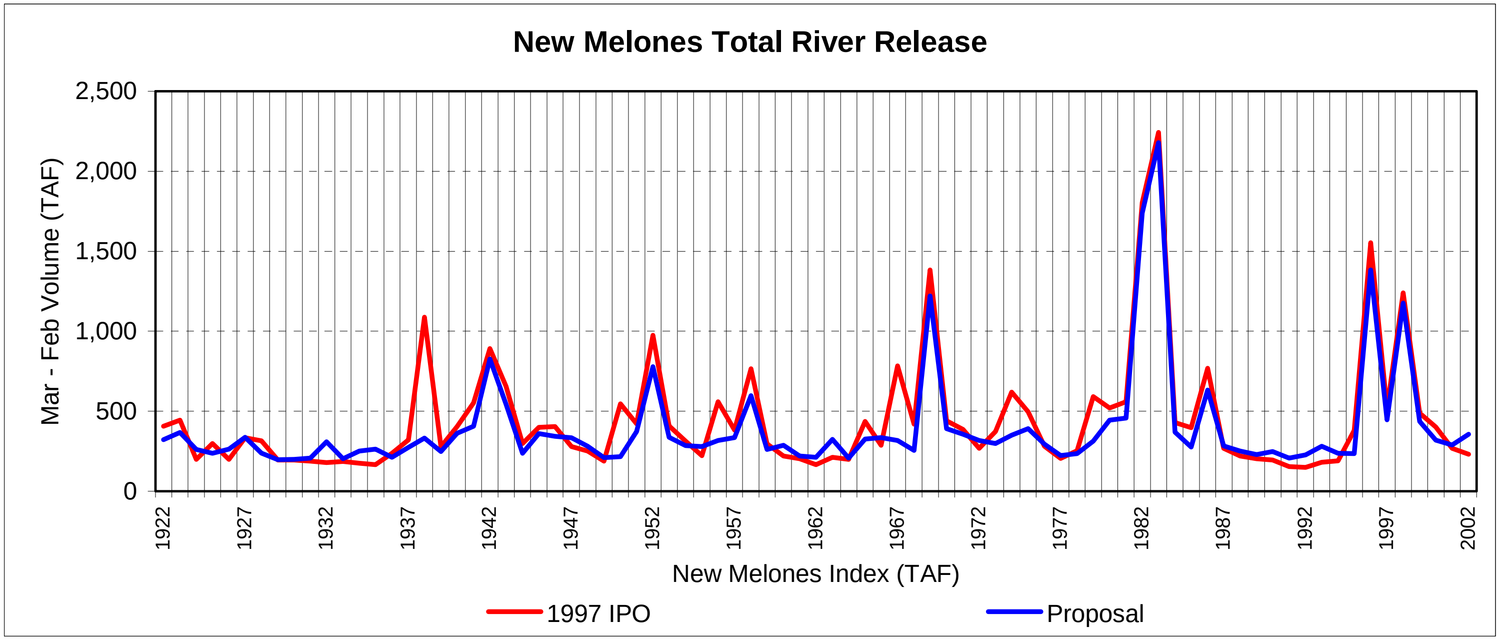
Average Release
Proposal
24 TAF



"Unmet" only occurs during conditions when Goodwin release is assumed to be constrained to 1,500 cfs.

OID/SSJID Proposal

- Results and Comparison to Current IPO – Total River Release



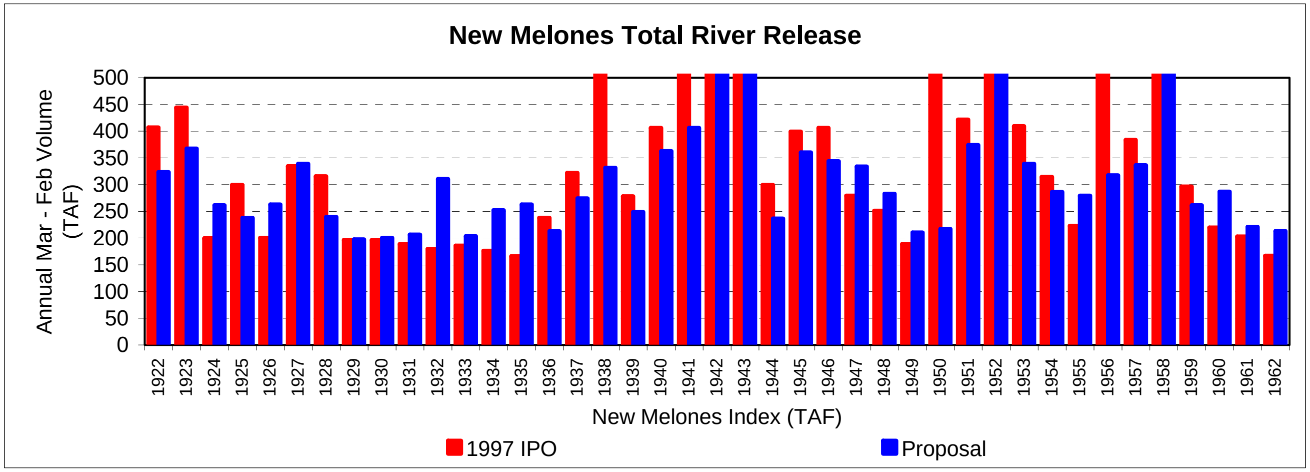
Average Release IPO 447 TAF	Average Release Proposal 395 TAF	Average Release IPO 321 TAF	Average Release Proposal 288 TAF

(Represents all releases including spills)

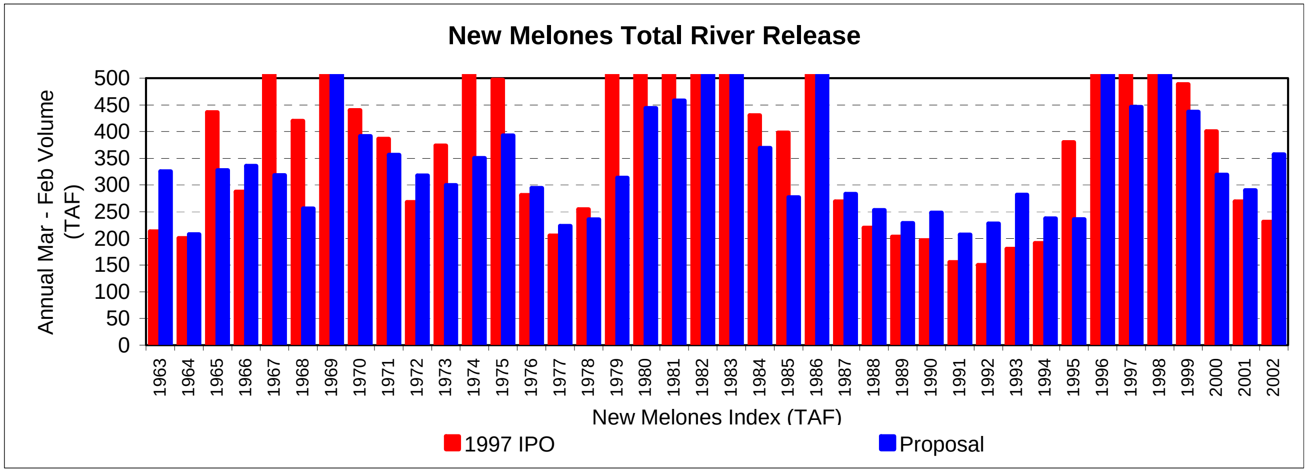
(Represents all releases excluding spills)

OID/SSJID Proposal

- Results and Comparison to Current IPO – Total River Release

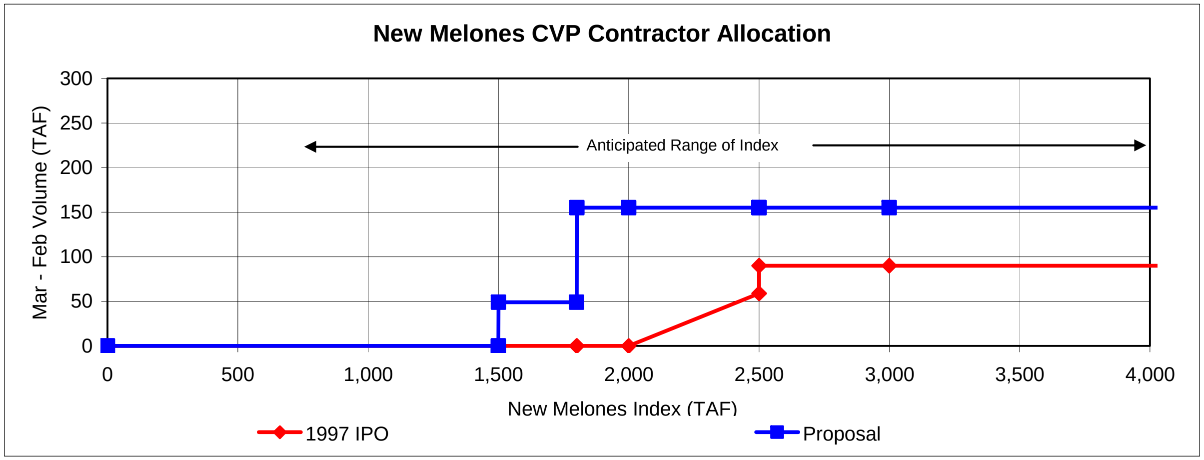


Scale limited to 500 TAF



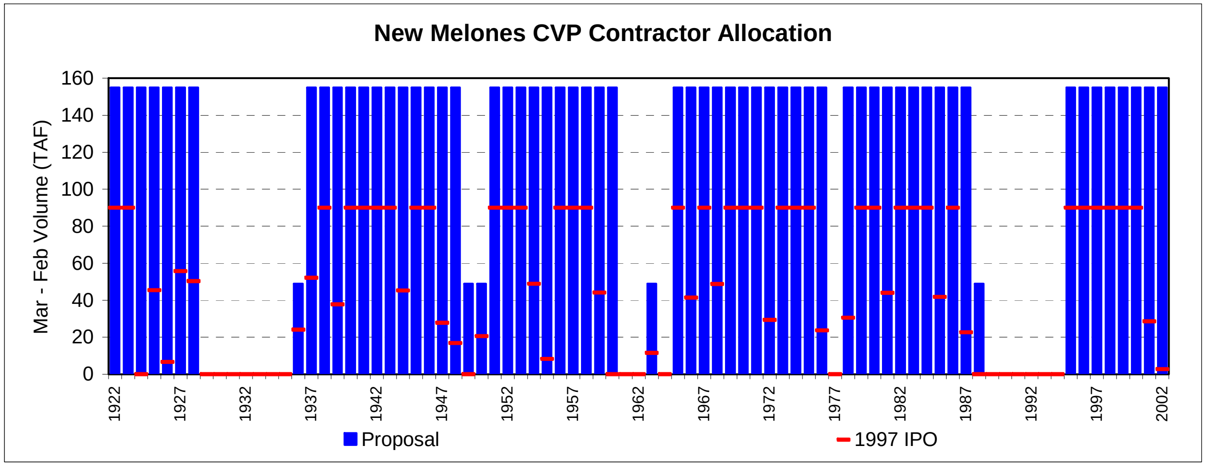
OID/SSJID Proposal

- Results and Comparison to Current IPO – CVP Contractors



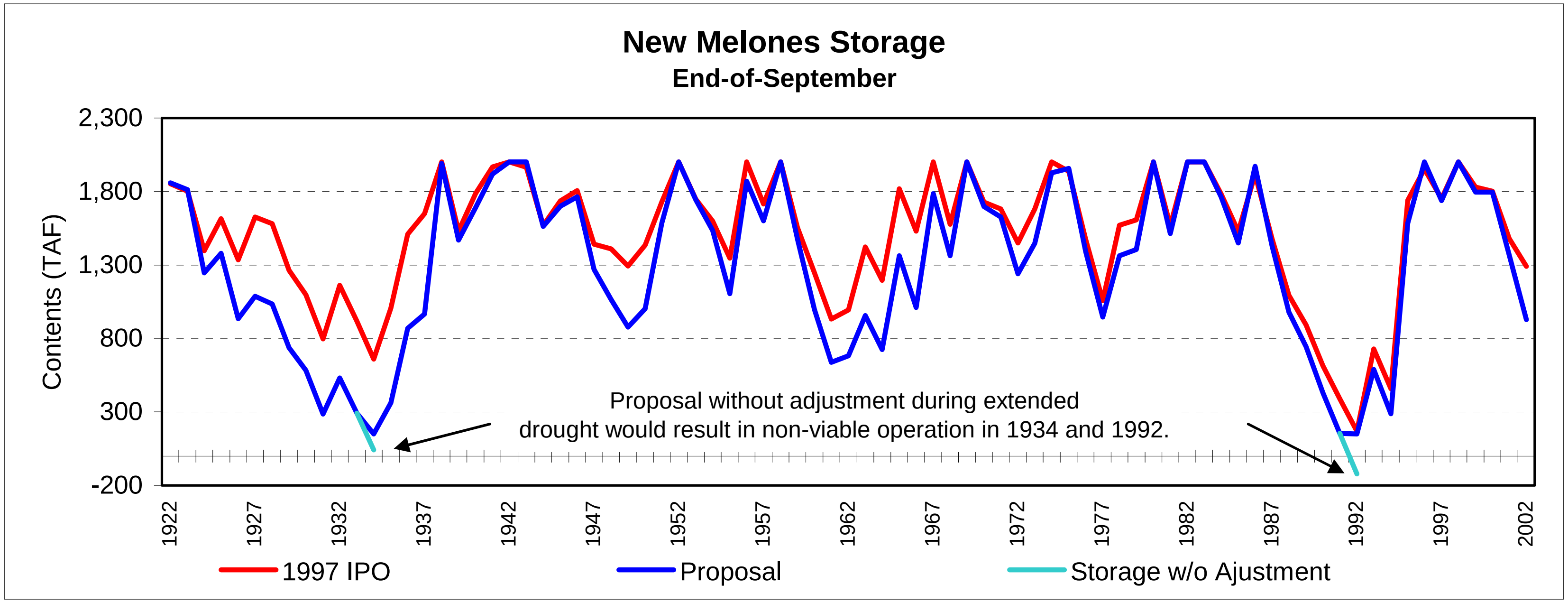
Average Allocation
<u>IPO</u>
49 TAF

Average Allocation
<u>Proposal</u>
116 TAF



OID/SSJID Proposal

- Results and Comparison to Current IPO – New Melones Storage



OID/SSJID Proposal

- Viable Operation
  - Temporary until Revised Plan of Operation
  - Can function through all periods except long-duration drought
- Other Actions Are Occurring Relieving Competition for New Melones Water
  - River betterment (Grassland Bypass Project)
  - Friant ?
  - Recirculation
  - Periodic Review of water quality and flow objectives at Vernalis
- Contingency Measures Are Available Should Extended Drought Occur

Introduction

The Interim Plan of Operations (IPO) for New Melones has been in place since 1997. Since development of the IPO the runoff and water quality in the San Joaquin River Basin has changed and so too has our ability to quantify and understand those changes. We now have an improved model, CALSIM II, which better depicts the hydrology, flow and water quality in the San Joaquin River Basin (Basin). Finally, the IPO through its operation over the last ten years has shown some significant operational deficiencies and disconnects. To address these changing conditions in the Basin and the operational deficiencies of the IPO, Reclamation has undertaken the task of implementing a transitional operating plan by 2007 and a long term plan by 2012. South San Joaquin Irrigation District (SSJID), Oakdale Irrigation District (OID) and Stockton East Water District (SEWD),[1] collectively referred to as Districts, support Reclamation in its endeavor to implement a transitional and long term plan. This paper is written in the hope of providing a catalyst for interested parties to engage in this process and have a new operational plan for New Melones.

1997 New Melones Interim Plan of Operations

The New Melones Interim Plan of Operations (IPO) was Reclamation's attempt to allocate supply to four purposes: fishery, water quality, Bay-Delta flow, and water supply. Table 1 below identifies the allocation of annual water supply to each of the purposes. The allocations are linearly interpolated based on the value of the end-of-February New Melones Storage, plus the March - September forecast of inflow to the reservoir. Water is provided to OID and SSJID in accordance with their settlement with Reclamation. Required and discretionary releases to the Stanislaus River below Goodwin Dam are accounted in a cumulative order, currently in the following order: 1) fishery releases; 2) releases to meet the Vernalis water quality requirement; and 3) D-1641 Bay-Delta flow requirement releases

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[1] SEWD is in litigation against Reclamation over New Melones operations [Court of Federal Claims No. 04-541 L Judge Christine Odell Cook Miller]. Nothing contained in this document shall constitute an admission or waiver of any claim, right or defense in the litigation. The proposed transitional plan of operations is for discussion purposes only.

Table 1. New Melones Interim Plan of Operation Allocations (1,000 AF)

New Melones Storage Plus Inflow		Fishery		Vernalis Water Quality		Bay-Delta		CVP Contractors	
From	To	From	To	From	To	From	To	From	To
0	1,400	0	98	0	70	0	0	0	0
1,400	2,000	98	125	70	80	0	0	0	0
2,000	2,500	125	345	80	175	0	0	0	59
2,500	3,000	345	467	175	250	75	75	90	90
3,000	6,000	467	467	250	250	75	75	90	90

Additional releases are made to the Stanislaus River below Goodwin Dam if necessary, to meet the Decision 1422 (D-1422) dissolved oxygen content objective. Releases from Goodwin Dam to the Stanislaus River (except for flood control) do not exceed 1,500 cfs.

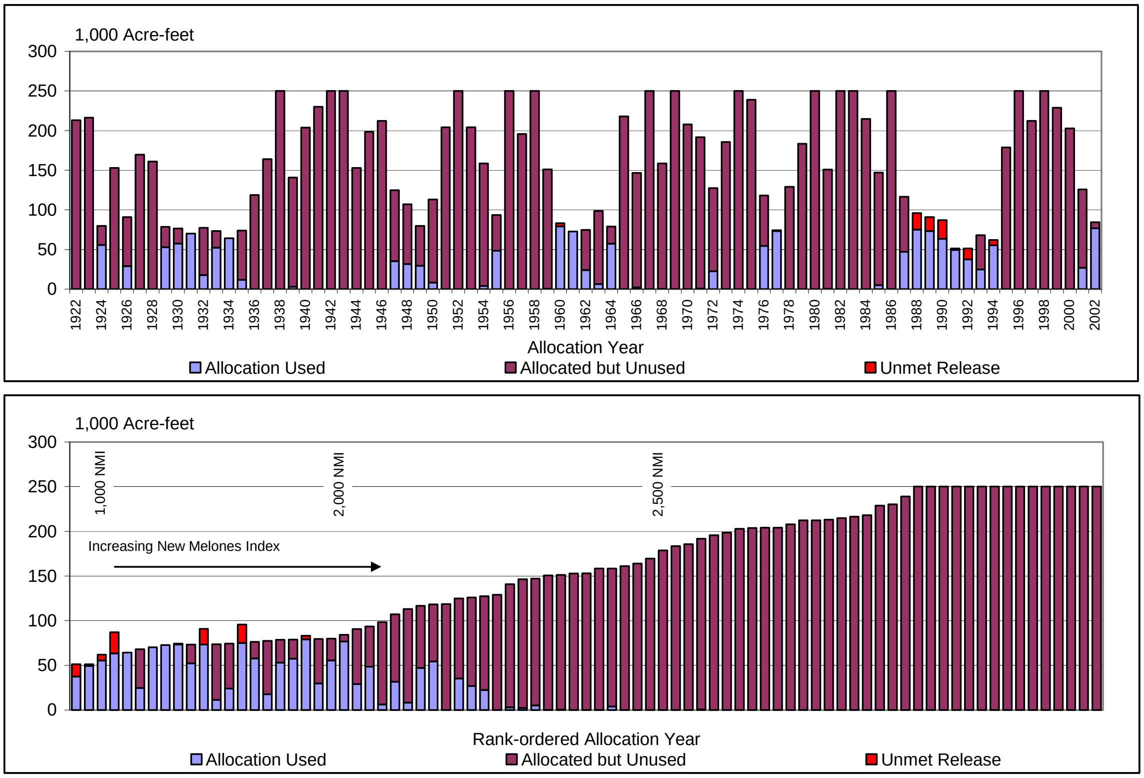
The IPO works as an integral part of D-1641's incorporation of the San Joaquin River Agreement's (SJRA) contribution towards meeting flow requirements at Vernalis. Although not requiring Reclamation's implementation of the IPO, the IPO provides the baseline hydrologic conditions upon which the flow contributions of the other signatories are based.

Deficiencies and Disconnect

Water Quality at Vernalis

Information for water quality allocation is set forth in Table 1. As can be seen water quality is allocated in an increasing manner up to 250,000 acre feet of water when the New Melones Index (designated in Table 1 as "New Melones Storage Plus Inflow") is equal to or greater than 3,000,000 acre-feet. The non-effectiveness of this approach is that the amount of water needed for water quality in wetter years is normally declining because there is good water quality in the San Joaquin River without any specific water quality release from New Melones. So while a water quality release is allocated, it is not used. This circumstance is shown in Figure 1 below where each year of modeled water quality operations is illustrated. The upper graphic shows the year-to-year used and unused water quality allocation of the IPO. In many years water is allocated but not needed. The lower graphic illustrates the same data with the results arranged in ascending order of the New Melones Index, driest conditions to wettest. It is seen how as wetter conditions prevail water is allocated but unneeded for release.

Figure 1. New Melones Water Quality Allocation, Use and Shortfall

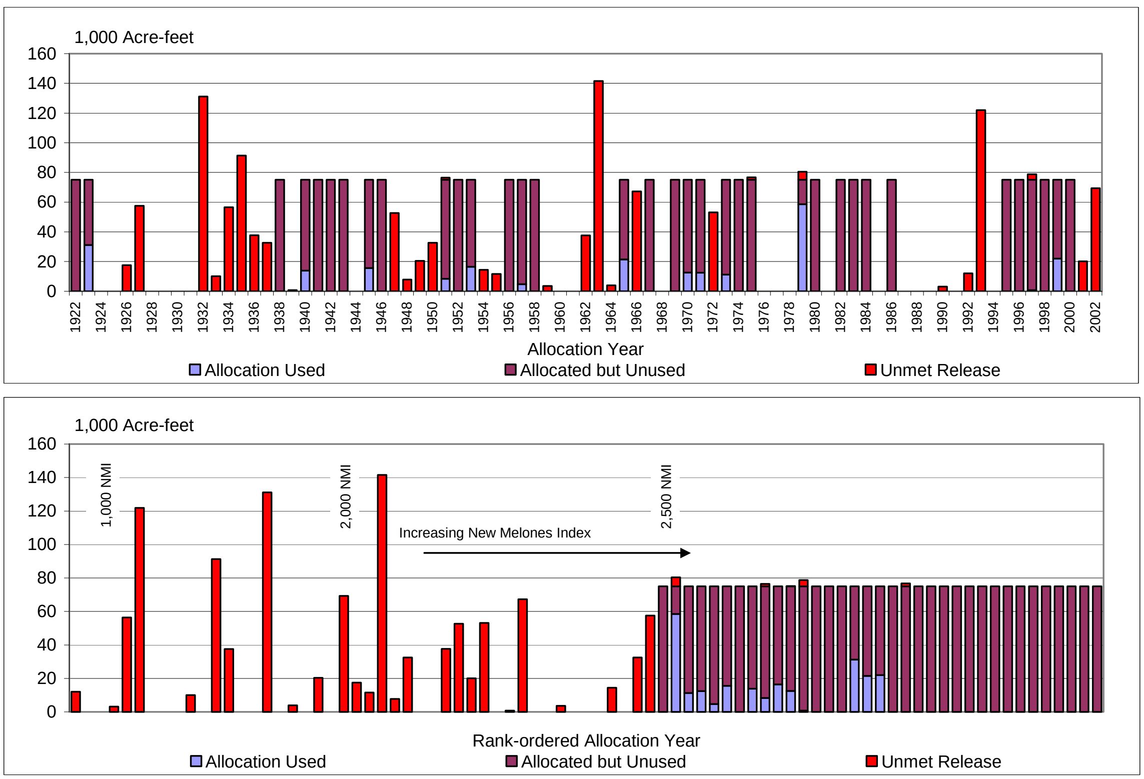


These graphs also depict a second undesired outcome of the water quality allocation under the IPO. When water is needed for water quality at Vernalis, it is sometimes constrained by the amount allocated. Thus in sequential droughts such as occurred during the 1987-1992 time period Reclamation would not meet water quality at Vernalis if the IPO was strictly adhered to. Also, while the shortfall is small on an average annual basis, 1,000 acre-feet per annum (afa), the impact in a given year can be substantial, 1988 20 TAF, and 1990 24 TAF.

Bay-Delta Releases (X2)

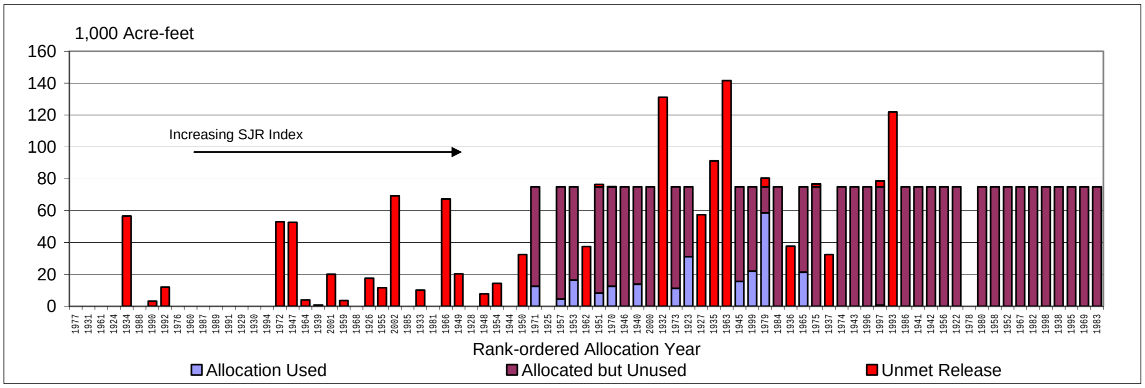
The IPO also allocates releases for compliance to the D-1641 San Joaquin River and Delta flow objectives at Vernalis. As seen in Table 1, an allocation to this purpose is limited to only wetter years when the New Melones Index exceeds 2,500,000 acre-feet. In effect, during the years when a release is allowed under the IPO the 75 TAF allocation is adequate to meet the flow objectives; however it is usually a moot point since there is not a significant call for this release during these years due to wet hydrologic conditions in the basin. Figure 2 below depicts the allocation and shortfall of the IPO in meeting the current Bay-Delta flow objective at Vernalis.

Figure 2. New Melones Bay-Delta Allocation, Use and Shortfall



The graphs show a disconnect between the IPO allocations and project demands. When the New Melones Index is high and water is allocated for Bay-Delta releases, not much if any is needed because there is already sufficient water in the system. During years when the IOP does not allow a release, the unmet release could be as much as 140 TAF. Figure 3 additionally illustrates the disconnection with the IOP allocation for Bay-Delta releases. The same data described above is shown in Figure 3, but is arranged by increasing San Joaquin River Basin Index.

Figure 3. New Melones Bay-Delta Allocation, Use and Shortfall by San Joaquin River Index

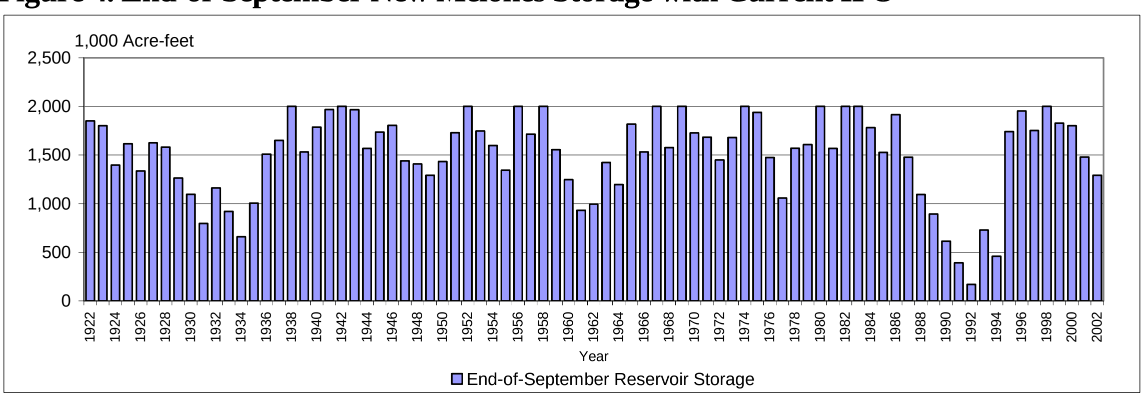


In Figure 3 above it can be seen that during drier years there is not water allocated for Bay-Delta releases, but there also in not much need for a release. It is normally within the range of dry to above normal years when the current Bay-Delta objectives require supplemental releases, sometimes with no allocation provided. With the allocation based on the New Melones Index, no allocation will be provided during certain wetter Delta conditions (e.g., 1932, 1963 and 1993) when the flow requirement is large but the San Joaquin Basin (including New Melones) is capturing significant runoff into storage.

<u>Drought Protection Planning Period</u>

The development of the IPO allocations was partially founded on the ability to sustain Reclamation's desired operation through sequences of years. Although intended to be an "interim" operation not likely required to experience a severe sequence of drought years, the allocations of the IPO proved to be viable if planning for a repeat of the 1987-1992 drought sequence. However, this ability to sustain an operation through the 1987-1992 drought sequence has a profound effect on other sequences of years, manifesting in the underutilization of New Melones storage. This circumstance can be seen in Figure 4 that illustrates the modeled end-of-September storage at New Melones.

Figure 4. End-of-September New Melones Storage with Current IPO



Except for the recurrence of the 1987-1992 drought sequence, storage is not exercised below 600,000 acre-feet. The conservatism of protecting against the recurrence of such an extreme drought sequence leads to lesser allocations in many other sequences, and likely needs to be revisited.

Lack of Water Deliveries to New Melones CVP Contractors

The IPO failed to adequately allocate contractual water supplies to the New Melones CVP Contractors. SEWD and Central San Joaquin Water Conservation District (CSJWCD) contracted with Reclamation in 1983 for 155,000 acre-feet annual water supply from New Melones. Reclamation built New Melones reservoir pursuant to water right permits issued by the State Water Resources Control Board (SWRCB). The SWRCB would not allow Reclamation to fill New Melones Reservoir to its' full capacity until it demonstrated that the water would be put to beneficial use.

Reclamation presented the contracts with SEWD and CSJWCD as this proof to the SWRCB, and only then was Reclamation allowed to fully exercise its New Melones water rights. As part of the IPO, contractual deliveries were artificially capped at 90,000 acre-feet even though the contractual amount is 155,000 acre feet, and the IPO provided water deliveries to the CVP contractors only in the wettest of year types. These deficiencies must be addressed in the proposed transitional operational plan.

Proposed Transitional Plan of Operation

Objective and Basic Structure

A new operational plan must have as a principle that the SWRCB permit terms and conditions must be met. This would include meeting salinity and flow requirements at Vernalis. The USBR permits at New Melones and other CVP and State Water Project reservoirs water right permits are conditioned to meet the salinity and flow requirement at Vernalis, and Reclamation has been given wide discretion as to how to meet the those requirements,[2] a has been directed to minimize the demand from New Melones for those purposes.[3]

This proposed plan of operation for New Melones is premised on water quality and flow requirements at Vernalis being met under all conditions. Water allocated to meet water quality and flow requirements is not constrained. The unconstrained allocation of water for water quality and flow purposes is conditioned on an important

[2] Other available options include releases from other CVP reservoirs such as Friant; releases from San Luis Reservoir; recirculation of water from the Delta Mendota Canal, through the Newman Wasteway; construction of a drain to eliminate saline discharge into the San Joaquin River; and purchases of water from willing sellers to release to meet these objectives.

[3] HR 2828 directed the Secretary of the Interior to meet San Joaquin River water quality objectives in a manner to reduce the demand on water from New Melones Reservoir used for that purpose and to assist the Secretary in meeting obligations to CVP contractors from the New Melones project.

change in the accounting methodology at New Melones. This proposal is premised on the condition that instream flows are the primary flows or foundation flows in the Stanislaus River. Any flows to meet water quality and Bay-Delta flows at Vernalis, or dissolved oxygen at Ripon, would be added to the fish flows when needed. Thus the current gaming between the USBR, USFWS and CDFG regarding whether a release is for water quality purposes ahead of a fishery release would be eliminated.

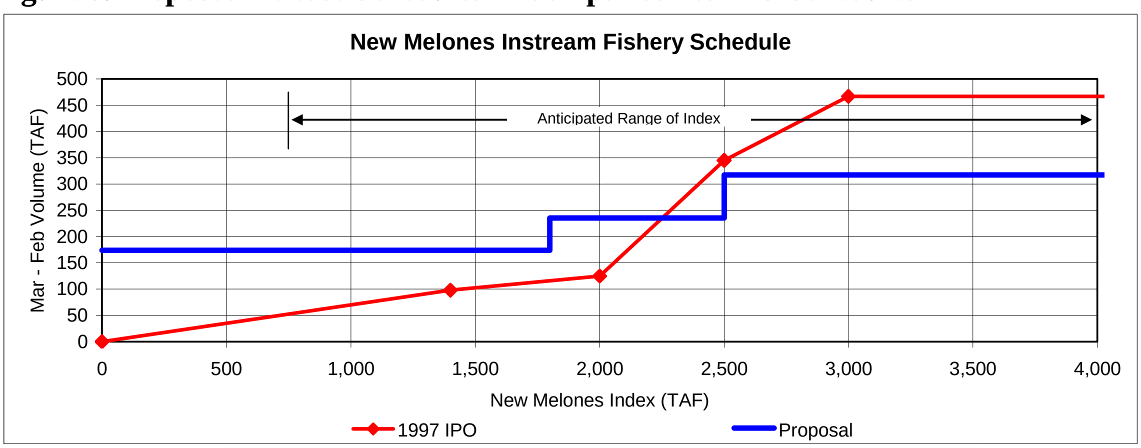
The release schedule for fishery purposes is determined by the New Melones Index. Three levels of releases have been identified, increasing with water availability at New Melones. Table 2 identifies these schedules and Figure 5 provides an illustration of the proposed schedules in comparison to the IPO.

Table 2. Proposed Release Schedule for Stanislaus River Fishery

New Melones Storage Plus Inflow		Fishery
From	To	
0	1,800	174
1,800	2,500	235
2,500	6,000	318

Units: 1,000 acre-feet

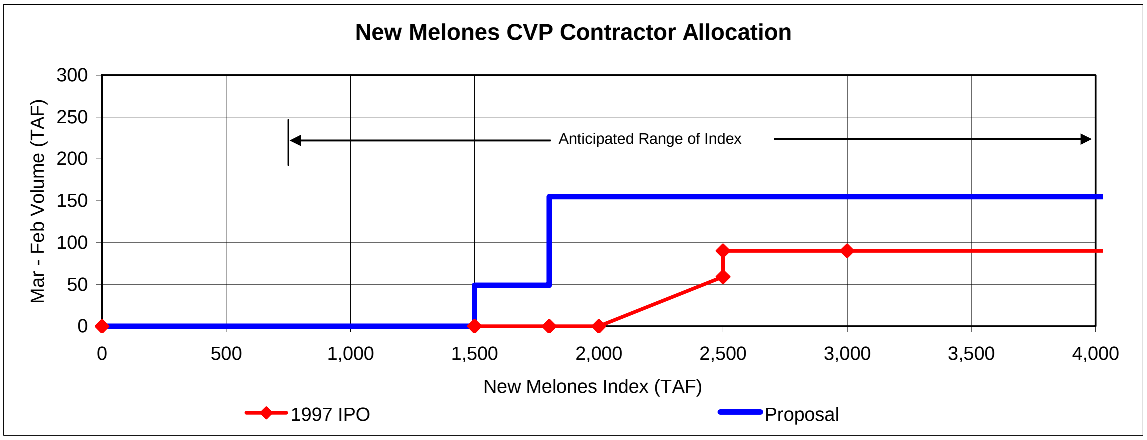
Figure 5. Proposed Release Schedules in Comparison to IPO Schedules



The proposed plan of operation anticipates a change to the DO objective at Ripon. The change would be a modification of the DO objective compliance point for June through September to Orange Blossom Bridge. The standard of 7 mg/l would remain.

The proposed plan of operation also provides increased deliveries to the CVP contractors based on the New Melones Index. Two levels of annual delivery are provided, 49 TAF for an index ranging from 1,500 TAF to 1,800 TAF, and 155 TAF for an index greater than 1,800 TAF. No deliveries would be provided when the index is less than 1,500 TAF. Figure 6 illustrates the proposed allocation, and provides a comparison to the allocation provided by the IPO.

Figure 6. Proposed CVP Contractor Allocations and IPO Allocations



A significant predicate of the transitional plan is that the water supply planning is changed from providing protection against highly infrequent droughts to providing water allocations that can better exercise New Melones storage. Reclamation's drought frequency analysis of the 1987-1992 period indicates the recurrence frequency of the 1987-92 drought is once every 250-400 years. Given the unlikely recurrence of the 1987-1992 drought, it appears the beneficial use of water from New Melones would be better served by basing allocations on a less severe drought. The next most severe drought occurs during the 1928-1934 period, with the Reclamation analysis indicating a recurrence frequency once every 40-50 years, but also takes several consecutive years of drought to occur. Given that New Melones will enter the 2006-07 water year with a full reservoir and the anticipation that the proposal is intended to be transitional, water allocations have been developed to increase utilization of New Melones storage while maintaining a lessened concern for extended severe drought.

Performance and Additional Considerations

Just as the 1997 IPO was developed with the aid of modeling and re-analyzed with subsequent modeling, the proposed plan has been developed and analyzed with modeling. A brief description of the model used for the projected operation of New Melones is included in Appendix A. Results described hereafter will primarily represent the performance of the proposed plan as if the 1922-2003 period of hydrology in the San Joaquin River Basin recurred again with the current demands, water systems and requirements within the basin.

Fishery

The proposed fishery schedule is designed to accomplish instream fishery protection on the Stanislaus River and is based on a fundamental principle that we need to manage water supplies better, particularly so that more water is made available in Dry and successive Dry years.

Special consideration was given to the following factors: meeting Fall Run Chinook Salmon (FRCS) spawning, egg incubation/fry rearing, and juvenile rearing flows identified by an instream flow study (IFS) conducted by the USFWS (Aceituno 1993; Table 3); meeting incidental take statement temperature requirements for over-summering steelhead identified by NMFS in the OCAP Section 7 biological opinion (NMFS 2004; Table 4); and meeting temperature objectives for all lifestages of FRCS identified by the CALFED sponsored Stanislaus River Temperature Criteria Peer Review (Deas and others 2004; Table 5). Although the Districts previously agreed to the temperature objectives put forth by the CALFED Peer Review Panel for purposes of Temperature Modeling, outside of the modeling exercises, the Districts do not agree with some of the recommended timing and compliance points as described in the discussion of water temperature beginning on page 9.

Table 3. Instream flows (cfs) which would provide the maximum weighted usable area of habitat for FRCS in the Stanislaus River between Goodwin and Riverbank, California (Aceituno 1993).

Lifestage	*Dates*	*# Days*	*Goodwin Dam Releases*
Spawning	Oct 15-Dec 31	78	300
Egg incubation/fry rearing	Jan 1-Feb 15	46	150
Juvenile rearing	Feb 15-Oct 15	241	200

Table 4. **NMFS incidental take statement temperature requirements for over-summering steelhead (NMFS 2004)**.

Dates	*Lifestage*	*Temperature Objective*	*Compliance Point*
Jun 1- Nov 30	Over-summering	≤65°F	Orange Blossom Bridge

Table 5. **CALFED Peer Review objectives for all lifestages of FRCS and steelhead (Deas and others 2004).**

Dates	*Lifestage*	*Temperature Objective*[1]	*Compliance Point*
Sep 4 - Oct 1	Adult migration	<64°F	Confluence[1]
Oct 2 - Dec31	Incubation	<55°F	Riverbank [1]
Jan 1 - Apr 15	Juvenile rearing	<61°F	Riverbank (all years)
Apr 16 - Jun 3	Smoltification	<57°F	Confluence (all years)
Jun 4 – Sep 3	Over-summering	<64°F	Orange Blossom Bridge (all years)

[1] CDFG proposed modifying the CALFED Peer Review objectives such that the compliance points for some lifestages dynamically change depending on hydrologic year type as follows: Adult migration= Confluence (Above Normal/Wet); Ripon (Below Normal); McHenry Bridge (Dry/Critical). Incubation= Riverbank (Above Normal/Wet); Oakdale (Below Normal); Valley Oak (Dry/Critical)

The following sections indicate the ability of the transitional plan flows to meet a variety of objectives/criteria including those for maximum weighted usable habitat, water temperature, adult upstream migration, and SJRA/VAMP April-May pulse flows. In addition, the transitional plan proposes to provide improved flow management for juvenile outmigration during Dry and CD years.

Maximum Weighted Usable Habitat

The proposed transitional flows meet the flow levels identified in the USFWS IFS (Aceituno 1993) for maximizing the weighted usable habitat for FRCS spawning, egg incubation/fry rearing, and juvenile rearing (Table 6). The IFS did not specifically address the flows necessary for juvenile outmigration or for adult upstream migration. Adult and juvenile migration flows are discussed in subsequent sections entitled *Adult Upstream Migration Flows* (see page 17) and *Juvenile Outmigration Flows* (see page 18), respectively.

Table 6. Comparison of instream flows (cfs) identified by the USFWS' IFS as providing the maximum weighted useable habitat for various lifestages of FRCS versus flows proposed for the transitional period.

Lifestage	Dates	Goodwin Dam Releases	
		IFS	Proposed Transitional
Spawning	Oct 15-Dec 31	300	200-300
Egg incubation/fry rearing	Jan 1-Feb 15	150	150-300
Juvenile rearing	Feb 15-Oct 15	200	173-300[1]

[1] Excludes outmigration flows of 750-1500 cfs during April and May.

Water Temperature

The Districts used the CALFED Temperature Model to model the affects of the proposed transitional plan on water temperatures in the Stanislaus River. The model, the CALFED Peer Review report, the Districts proposed operation, and CALFED's analysis of the proposed operation are attached. The following focuses on the impacts analysis and rationale for proposed temperature objectives.

The proposed transitional plan consistently meets the CALFED proposed temperature objectives from approximately mid-November through mid-April and deviations are low from mid-April through mid-May and from June through August. Although the Districts' proposed transitional plan does not meet the CALFED proposed temperature objectives during late-May and again from September through mid-November, the need for these objectives during these periods is not warranted for the following reasons:

Late-May. In our proposed transitional plan, we have made a deviation from the CALFED temperature objectives during the April-May pulse flow time period. CALFED objectives recommend 57°F to the confluence from April 16 to June 3 for smoltification. However, this objective is not justified based on information presented in the CALFED Peer Review Report, by over 10 years of outmigrant trapping data, and factors influencing water temperatures in the Stanislaus and San Joaquin Rivers, as discussed below. Rather than providing a temperature objective for smoltification through June 3, the transitional plan proposes to shorten the timeframe to between April 16 and May 15.

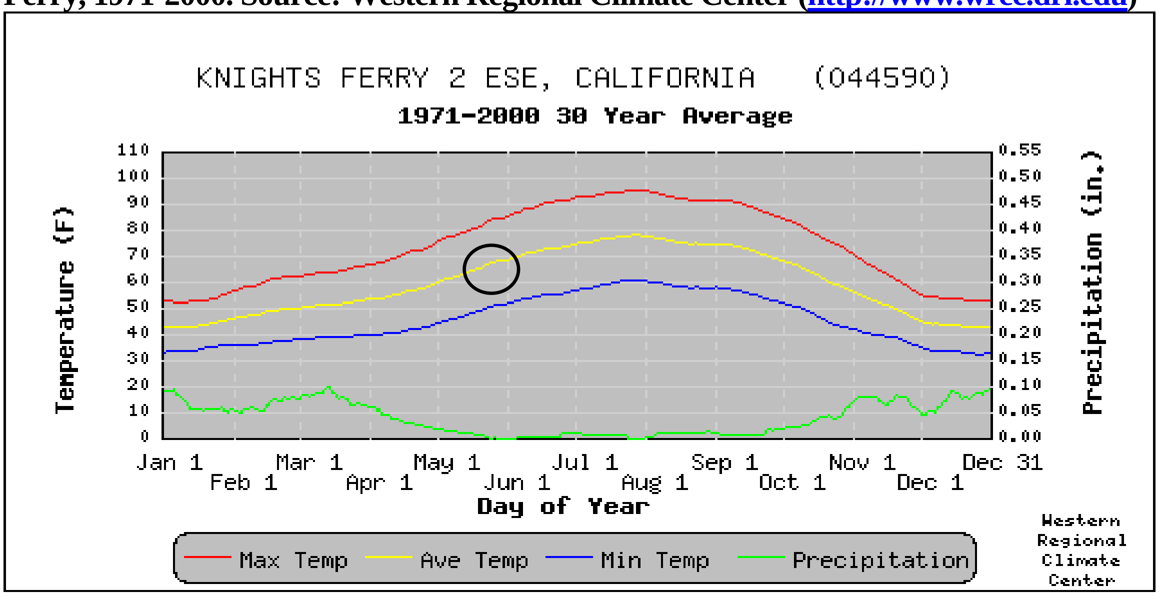
The temperature objective for over-summer juvenile rearing at Orange Blossom Bridge would then begin on May 16 instead of June 4.

Specifically, the objectives recommended by the CALFED Peer Review Report extend the composite smoltification period to June 3 in order to accommodate more protective measures for steelhead smoltification. However, the timing of steelhead smoltification is described in the same report as extending only from April to early May; therefore, the extended coverage period is not warranted for steelhead smoltification.

As for FRCS smoltification, rotary screw trap data collected annually since 1995 indicate that about 97% of salmon juveniles migrate out of the Stanislaus River by May 15; therefore, temperatures at the confluence to protect smoltification after May 15 are not necessary for such a small portion (i.e., 3%) of the population.

Third, ambient air temperature has been identified as the largest determinative factor on water temperature in the Stanislaus River (AD and RMA 2002). The average ambient air temperature for late May is 65-70°F (Figure 7). Thus, meeting a 57°F requirement at the confluence is difficult when antecedent conditions are dry and ambient air temperature is high. In fact, CALFED temperature modelers calculated that the amount of water that would be required to meet the temperature objective at the confluence during late-May would exceed the allowable maximum of 1,500 cfs, or approximately 45,000 acre-ft due to ambient temperature influences.

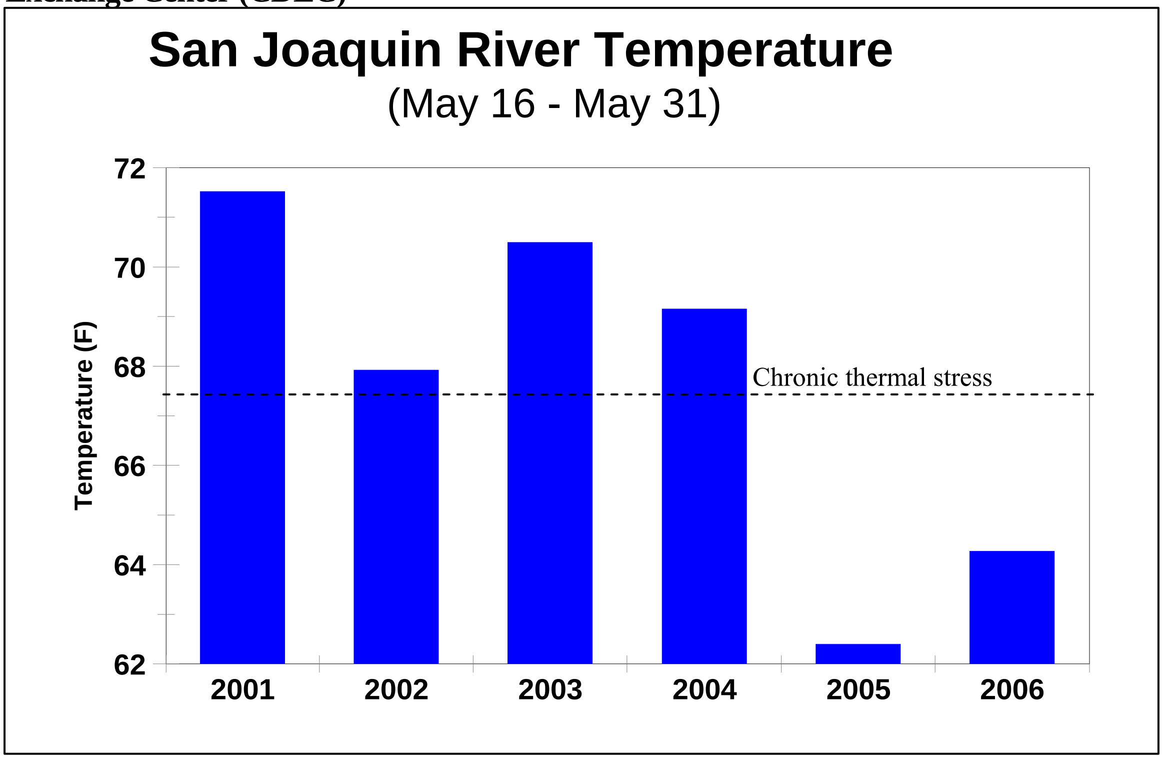
Figure 7. Minimum, maximum, and average daily ambient air temperature at Knights Ferry, 1971-2000. Source: Western Regional Climate Center (http://www.wrcc.dri.edu)



Finally, even if temperatures at the confluence of the Stanislaus River were 57°F between May 16 and June 3, any juveniles migrating out of the river during this period would experience chronic stress due to the excessive water temperatures in the San Joaquin River. Chronic stress can cause an increased susceptibility to predation and disease. The chronic thermal stress threshold identified in CDFG annual performance reports is 67.5 °F for juvenile salmon. Average water temperatures in the San Joaquin River in late May ranged from 67.9°F to 71.5°F during 2001-2004 when flows at Vernalis were managed (i.e., 2,150-2,900 cfs) and from 52.4 to 64.3 under flood control conditions (i.e., average flow 12,500-25,000 cfs) during 2005 and 2006 (Figure 8). The CALFED modeling effort revealed that operating the Stanislaus River to maintain cooler water temperatures in the San Joaquin River at Vernalis is pointless because there is only a negligible influence from incremental Stanislaus River flow changes up to the allowable 1,500 cfs maximum Goodwin releases.

Based on smoltification and migration timing of juvenile salmon and steelhead and the inability to significantly alter water temperatures regardless of flow levels because of the large influence of ambient air temperature conditions, it is reasonable to shorten the timeframe of the smoltification objective from June 3 to May 15 and to begin the temperature objective for over-summer rearing at OBB on May 16.

Figure 8. Average water temperature (°F) in the San Joaquin River at Vernalis during late-May, 2001-2006. Source: Temperature data obtained from the California Data Exchange Center (CDEC)



September. The next period in dispute for temperature objectives is September. CALFED proposes 64°F at the confluence from September 4 through October 1, and CDFG proposes 64°F at the confluence during above normal and wet years, at Ripon (RM 15) during below normal years, and at McHenry Bridge (RM 30) during dry/critical years for immigrating adult FRCS. However, these objectives are not justified based on observed adult migration patterns and on environmental conditions in the lower San Joaquin that do not support adult migration during much of September, as discussed below. The transitional plan proposes to change the adult migration temperature objective start date to October 1 with the compliance point located at the confluence.

Observations of adult immigration at the Stanislaus River weir during the past several years indicates that 97% of adult FRCS migrate into the Stanislaus River after October 1 (Table 7). This coincides with environmental factors in the San Joaquin becoming conducive to upstream migration. What little migration occurs earlier in the Stanislaus River generally takes place in the latter part of September as a combination of environmental factors becomes adequate for migrations (i.e., DO levels increase in the Stockton Deep Water Ship Channel and ambient air temperatures decrease resulting in concomitant water temperature decreases).

Table 7. Generalized upstream migration timing pattern observed at the Stanislaus River Weir near Riverbank (River Mile 31.2) during 2003-2005.

Date	% Adult Chinook Passing Weir
Sep 1-15	<0.05
Sep 16-30	2.7
Oct 1-15	184
Oct 16-31	26.6
Nov 1-15	32.7
Nov 16-30	12.7
Dec 1-15	5.6
Dec 16-31	1.2
Jan 1-15	0.2
Jan 16-31	<0.05

In many years, there is a dissolved oxygen problem in the Stockton Deep Water Ship Channel in September. A study of FRCS adult migration conducted by Hallock and others (1970) revealed that salmon did not generally migrate past Stockton until the DO had risen to about 4.5 mg/L, and the run did not become steady until concentrations were above 5 mg/L. To protect the homing ability FRCS, the 1995 SWRCB Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary established a minimum DO standard of 6 mg/L at Rough and Ready Island from September 1 through November 30. Actual recordings from 2001-2005 show that daily average concentrations during September seldom met the 6 mg/L standard (i.e., 7.3% of the time), and there is only a 36% probability that concentrations will exceed 5 mg/L during September (Table 8). Consequently, FRCS will not typically be able to move through the DWSC in September during the transitional plan period because the DO problem in the DWSC will not have been resolved by 2010. The aeration project is not set to commence until 2007 and will likely take several years for full implementation.

Table 8. **Exceedance probability of average daily dissolved oxygen concentration at Rough and Ready Island during September (calculated from 2001-2005 data downloaded from CDEC).**

Dissolved oxygen concentration (mg/L)	Exceedance Probability (%)
1	99.3
2	96.0
3	84.0
4	60.0
5	36.0
6	7.3

Third, water temperatures in the San Joaquin River in September are generally too high for FRCS to migrate. The CALFED Peer Review report identifies 69.8°F as the chronic lethal temperature for adult salmon. Further, Hallock and others (1970) found that adult migration did not become steady until water temperatures were 66°F or less. Average water temperatures at Vernalis over the past seven years have ranged from 69°F to 74°F with higher temperatures typically occurring early in the month and declining to approximately 69°F by the end of the month (Table 9). Temperatures in the San Joaquin River during September have only been below the chronic lethal temperature for adult salmon 27.9% of the past seven years, and were 66°F or less on only 3 days out of the 204 daily records.

Table 9. **Average daily water temperature (°F) of the San Joaquin River at Vernalis, 1999-2005. Source: Data obtained from CDEC**

Date	1999	2000	2001	2002	2003	2004	2005	AVG
01-Sep	69.5	68.3	75.7	76.2	76.3	76.2	74.0	73.8
02-Sep	69.7	67.8	76.0	76.9	77.2	75.6	74.3	73.9
03-Sep	70.3	68.8	76.1	77.2	78.1	72.0	74.1	73.8
04-Sep	70.6	68.4	75.9	75.9	77.7	70.9	73.5	73.3
05-Sep	71.6	68.3	74.7	71.4	76.3	73.0	73.1	72.6
06-Sep	72.6	68.3	72.7	70.0	74.6	74.8	73.2	72.3
07-Sep	73.5	--	72.2	69.0	73.1	75.5	72.7	72.7
08-Sep	73.4	--	72.3	69.2	72.3	76.0	72.3	72.6
09-Sep	73.3	--	71.9	70.4	71.4	76.0	72.1	72.5
10-Sep	72.6	--	71.7	71.9	71.5	75.0	71.2	72.3
11-Sep	72.1	--	71.8	73.0	72.9	74.5	69.9	72.4
12-Sep	72.3	--	71.8	73.3	74.2	74.2	69.2	72.5
13-Sep	72.3	70.7	71.8	73.0	73.7	72.5	68.8	71.8
14-Sep	71.8	71.9	72.9	72.8	73.7	71.5	68.3	71.9
15-Sep	71.9	72.0	73.5	72.2	73.6	71.4	68.4	71.8
16-Sep	71.7	68.5	72.7	70.9	72.2	73.1	68.5	71.1
17-Sep	71.2	69.6	72.0	71.1	70.3	73.3	68.6	70.9
18-Sep	70.8	72.0	72.6	71.4	69.3	68.5	68.3	70.4
19-Sep	70.2	73.5	72.9	72.7	70.2	65.2	68.4	70.4
20-Sep	70.0	74.4	72.7	73.8	71.5	65.2	69.0	70.9
21-Sep	70.5	73.6	72.0	73.9	72.6	65.5	69.7	71.1
22-Sep	72.1	71.3	71.6	73.6	73.6	67.2	70.5	71.4
23-Sep	73.1	69.5	70.9	73.9	73.8	69.1	70.2	71.5
24-Sep	73.0	68.6	69.9	73.6	72.9	70.4	68.0	70.9
25-Sep	72.8	68.7	69.9	72.9	71.5	71.1	66.8	70.5
26-Sep	71.7	69.5	70.2	72.1	71.0	70.6	67.1	70.3
27-Sep	69.7	69.4	70.3	70.7	71.0	70.2	67.6	69.9
28-Sep	67.7	68.8	68.6	69.1	70.9	69.4	68.2	69.0
29-Sep	68.2	68.3	68.2	68.0	70.4	69.0	69.1	68.7
30-Sep	69.3	69.4	69.5	67.3	70.4	69.0	69.7	69.2

Fourth, the amount of water needed to try meeting CALFED temperature objective during September, as quantified by the CALFED temperature modelers, was approximately 1,500 cfs or 90,000 acre feet. Modeling was not conducted to determine if CDFG's proposed criteria with dynamic compliance points could be met.

Based on migration timing of adults and on the lack of adequate migration conditions (i.e., dissolved oxygen and water temperatures) in the lower San Jaoquin during September, it is reasonable to change the start date of the adult migration temperature objective from September 4 to October 1 and to make the compliance point at the confluence. Based on adult migration timing observations and typical San Joaquin River conditions, it is anticipated that this start date would provide the greatest protection for most emigrating adult FRCS.

October through mid-November. The final period in dispute for temperature objectives is October through mid-November. CDFG proposes 55°F at Riverbank (RM

34) during above normal and wet years, at Oakdale (RM 39) during below normal years, and near Valley Oak (RM 44) from October 2 through November 12 for FRCS egg incubation. However, this objective is not justified based on observed spawning timing and distribution. According to CDFG annual spawning surveys, only 1.6% of spawning generally occurs prior to October 15, and 98.2% of this spawning activity occurs above Oakdale (Table 10). Therefore, protective temperatures at Riverbank as early as October 2 are not necessary for such a small portion of the population that may spawn prior to October 15. Additionally, spawning activity prior to December 1 generally occurs above Oakdale so placing the objective at Riverbank prior to December 1 is not justified. Instead of the incubation temperature objective beginning on October 2, the transitional plan proposes to start the incubation temperature objective of 55°F on October 15 at Oakdale, and to move the compliance point to Riverbank on December 1.

Table 10. **Generalized timing pattern of spawning in the Stanislaus River based on redd counts from CDFG spawning surveys. Source: Electronic data and annual reports provided by CDFG**

Date	%Redds Observed[1]	Distribution of Redds[2]			
		Goodwin	Knights Ferry to Horseshoe	Horseshoe to Oakdale	Oakdale to Riverbank
Before Oct 1	0.1%	100.0%	0.0%	0.0%	0.0%
Oct 1-15	1.5%	32.1%	61.3%	4.8%	1.8%
Oct 16-31	10.5%	17.5%	55.0%	24.5%	3.0%
Nov 1-15	29.4%	15.1%	51.4%	31.1%	2.5%
Nov 16-30	29.4%	13.6%	49.5%	33.6%	3.3%
Dec 1-15	19.0%	19.7%	38.9%	33.2%	8.2%
Dec 16-31	9.0%	14.5%	44.6%	34.3%	6.6%
Jan 1-15	1.1%	0.0%	46.5%	43.9%	9.7%

[1] Based on 1998-2005 CDFG spawning survey data.
[2] Based on 2000-2005 CDFG spawning survey data. CDFG indicated that there are problems with earlier data.

Adult Upstream Migration Flows

Similar to existing conditions, the proposed transitional flows during the adult FRCS upstream migration period are expected to provide suitable instream migration conditions for adult passage (i.e., water depths >0.78 ft and velocities <7.9 ft/s) within the Stanislaus River (SRFG 2006). Proposed transitional flows do not include attraction flow targets because attraction flows are not necessary for the maintenance of suitable migration conditions in the Stanislaus River but are a Delta issue that will be addressed in a separate forum.

Since the early 1990s, adult attraction flows have been released from the Stanislaus, Tuolumne, and Merced rivers during mid- to late October to reduce adult straying resulting from low DO concentrations within the Deep Water Ship Channel (DWSC). The DO deficiency in the DWSC is a Delta issue that cannot be addressed by managing Stanislaus River flows alone; therefore, this issue has been, is, and will continue to be addressed in the SWRCB Bay-Delta Periodic Review hearings. Further, it is anticipated that the SWRCB will identify several actions to address the DO problem, not just flow. If coordinated releases between the three tributaries are prescribed through the SWRCB process, the proposed transitional flows would need to be adjusted accordingly.

Juvenile Outmigration flows

There is a great discrepancy between the parties regarding what amount of water is necessary for juvenile salmonid outmigration. In our opinion, the problem needs to be addressed in three segments: 1) what flow is necessary to move fish from the Stanislaus to the San Joaquin River; 2) what flow is necessary in the San Joaquin River to maintain and move fish; and 3) what flow, barrier operations, and export reductions are necessary to move fish past/through the South Delta to the bay.

The last two issues are not part of this process. Those issues have been, are, and will continue to be addressed in the SWRCB Bay-Delta Periodic Review hearings. One of the issues identified during this process has been the April–May pulse flow on the San Joaquin River, and it is currently unknown how the SWRCB will address this issue. A draft staff report is due to be released in September, and it is anticipated that the SWRCB will keep the current pulse flow standard in place for the duration of the SJRA/VAMP which is set to run through December 31, 2011. Therefore, the only obligations the USBR will have during the transitional operation is meeting the X2 flow standard established under the 1995 Bay-Delta Water Quality Control Plan, and a contractual obligation to fulfill the SJRA/VAMP. Under proposed transitional flows, the USBR will meet its obligations for X2 and for the SJRA/VAMP, including providing the Stanislaus River's share of the San Joaquin River's April–May pulse flow. However, if the SWRCB changes the current pulse flow standard, then the proposed transitional flows would need to be adjusted accordingly. Once the SJRA/VAMP is completed, the SWRCB will undertake another periodic review to address what flows and other actions are necessary to move FRCS through the San Joaquin River and Southern Delta.

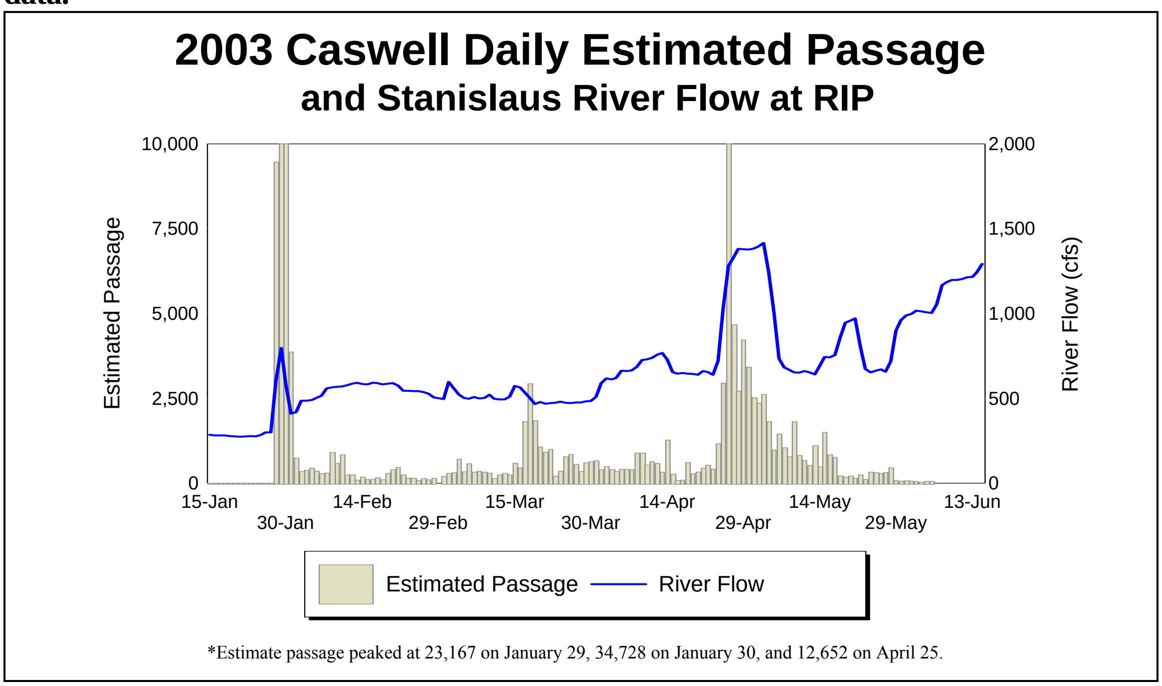
During years when San Joaquin River flows are low and the Basin index is Dry or Critical, the current flow objective in the Stanislaus River for smolt outmigration consists of relatively low (i.e., 500-1,200 cfs) "pulse" flows for extended durations (i.e, approximately 10-30 days) during a 30 day target window from mid-April to mid-May. No current flow management exists for juvenile outmigration earlier in the year. The existing flow objective is not justified in Dry or Critical years based on observed migration behavior, survival, and Delta export conditions, as discussed below. The transitional plan proposes to implement a "true" pulse flow management approach whereby multiple, short duration pulse flow events consisting of higher releases (i.e., five to six pulses up to the maximum allowable 1,500 cfs for two to three days each) are provided. The primary concept would be to pulse fish out earlier in the season, using short duration, high pulse flows to lessen instream losses while using the same total amount of pulse flow water available. In order to assist both fry and smolt outmigration during Dry and Critical years, pulse events would be provided in February (fry) and between April through early May (smolt). Base flows between individual pulse events would be provided at a level that would maintain rearing conditions for the fishery and to ensure that migration initiated by the pulse is not subsequently impeded.

Outmigrant sampling has been conducted annually with rotary screw traps at two locations in the Stanislaus River since 1995. This sampling program provides some of the best scientific data to help determine what flows are necessary to move FRCS from the Stanislaus to the San Joaquin River. The studies done to date indicate three key findings:

- A high proportion of juvenile salmon move within the first few days of a flow fluctuation, either when flows are increasing or decreasing.
- Flows as low as 750-1,000 cfs move salmon fry out of the river.
- Juvenile salmon are able to reach the Stanislaus River confluence within as little as two days and the Delta pumping stations within as little as five days of an initial flow pulse.
- Fry survival within the lower river in Dry and Critical years is low, and a better flow regime is needed to improve survival in these types of years.

Rotary screw trap data indicate that fluctuating flows stimulate both fry and smolt migration (Demko 2004, Demko and Cramer 1995). Figure 9 shows a representative outmigration pattern where peaks in migration abundance are observed within the first day or two of an increase or decrease in flow.

Figure 9. Juvenile abundance versus flow. Source: Cramer Fish Sciences unpublished data.



Rotary screw trap data from dry years (2001 and 2002), indicate that FRCS fry migrate past the upper rotary screw trap at Oakdale similar to other years, but they do not survive to the lower rotary screw traps at Caswell under dry year conditions (Demko

2004, SRFG 2004). Low flows and clear water conditions between the two locations likely resulted in high levels of predation.

A 2-day pulsed flow experiment conducted in January 2003 indicates that fry migration can be stimulated with flows as low as 750-1,000 cfs and that migration past Caswell begins within one to two days of initial flow increases during a pulse event (note: Caswell located at RM 8.6, so fish anticipated to reach confluence within two days). In addition, fish arrival at CVP and SWP Delta export facilities appears to occur within as early as five days following an initial Stanislaus River pulse flow. Although the pulse experiment provided the first targeted account of migration speed between various locations, fish arrival time at Caswell and Delta pumping stations is consistent with multiple years of rotary screw trapping data. Based on the results of the pulsed experiment, it is anticipated that higher flows of shorter pulsed duration during February would stimulate fry migration and may provide higher turbidity levels that would help fry move safely through the lower river. In addition, short duration pulse flows are expected to stimulate smolt migration during April and May similar to that observed during the pulse experiment for fry, as corroborated by multiple years of observed smolt migration responses to flow fluctuations (Demko and Cramer 1995, Cramer Fish Sciences unpublished data).

The fate of outmigrating fry after they exit the Stanislaus River is largely unknown, and identifying actions to improve survival in the San Joaquin River and Delta is not part of this process. These issues are being addressed through the SWRCB Bay-Delta Periodic Review hearings. Results from the 2003 Stanislaus River experiment suggest that fry were able to successfully migrate from the Stanislaus River, through the lower San Joaquin River, and into the Delta (Demko 2004). However, the large numbers of fry observed at the Delta Export facilities within a few days of the Stanislaus River pulse still leave open the possibility that fry may not survive in the Delta until they reach the smolt stage. Since survival through the Delta is influenced by export rates, a real-time export management approach should be explored within the SWRCB Bay-Delta Periodic Review hearings that would take into consideration the anticipated arrival time of fish (i.e., based on rotary screw traps and trawling) following a pulse flow.

Non-flow factors

River flow is only one factor among several which influence the health and abundance of Stanislaus River FRCS. Other critical factors include the quantity and quality of existing spawning, incubation, and juvenile rearing habitat. Each of these non-flow factors has been compromised by instream gravel mining, changes in streamside land use, and reduced gravel recruitment. Analyses of juvenile and adult FRCS abundance estimates suggest that the carrying capacity of the Stanislaus River under existing habitat conditions is between 1,000 and 3,000 Age 3 equivalent spawners, or 1.5 to 2.0 million juveniles (SRFG 2004). Therefore, habitat restoration actions are necessary before full benefits of improved flow management can be realized. In the absence of habitat restoration efforts sufficient enough to increase carrying capacity, the Central Valley Project Improvement Act (CVPIA) production goal of approximately 20,000 fall-run Chinook for the Stanislaus River (equivalent to approximately 10,000 plus spawners escaping to the river) cannot be achieved.

In order to improve the quantity and quality of the habitat for FRCS with the goal of increasing production, several habitat restoration projects have been completed in the Stanislaus River since 1994, and several others are in various stages of planning or implementation (Table 11). Due to the severity of past habitat degradation, numerous restoration efforts will be required to re-establish properly functioning conditions within the river. It is anticipated that it will be at least several years before restoration priorities are established and implemented, and it will likely take even longer for noticeable population responses to be observed.

Table 11. Habitat restoration projects completed or planned for the Stanislaus River.

Project Name/ Location	Type of Restoration Completed/ Proposed	Project Status
Goodwin Canyon	Gravel augmentation	Ongoing since 1997; conducted annually
Knights Ferry Gravel Replenishment	Gravel augmentation; riffle restoration	Completed in 1999
Horseshoe Recreation Area	Gravel augmentation; riffle restoration	Completed in 1994
Mohler Tract	Floodplain acquisition and riparian planting[1]	Completed in 2003[1]
Lovers Leap	Gravel augmentation; riffle restoration	Completion anticipated in 2006 or 2007, permits pending
Honolulu Bar	Channel modification; gravel augmentation; riffle restoration	Completion anticipated in 2007
Oakdale Rec. Area	Elimination of instream mine pits; floodplain and riffle restoration; gravel augmentation	Draft designs and initial environmental surveys completed
Two Mile Bar	Floodplain and riffle restoration; gravel augmentation	Feasibility analysis completed

[1] Project plan included breaching a segment of an un-maintained berm adjacent to the river which would have allowed this area to periodically inundate, promoting natural floodplain re-generation and succession. However, this aspect was opposed by the City of Ripon and was not implemented.

<u>Fish Species Management</u>

The proposed transitional plan has as its goal the maintenance and enhancement of FRCS. There exists within the Stanislaus River Basin a robust fishery of at least 39 species, and one additional fish species (e.g., Green sturgeon) may also be present, but their potential existence in the basin is currently under review by NMFS. Of these, there are two fish species that have been specially designated and one species under consideration for special designation under the federal ESA: Central Valley Fall Run Chinook Salmon (Species of Concern), Central Valley Steelhead (Threatened), and Green Sturgeon (Proposed Threatened). There is on-going litigation as to whether or not steelhead should remain listed. The transitional plan meets the OCAP Section 7 Biological Opinion and CALFED Peer Review proposed temperature regime for steelhead. Green sturgeon are currently going through a listing decision and critical habitat designation process. It is unclear whether green sturgeon exist on the Stanislaus River so the Stanislaus River may be excluded from any critical habitat designation. Although the transitional plan is targeted for FRCS, it is anticipated that proposed transitional flow management strategies will also benefit listed steelhead and will be adequate for other species.

Pursuant to CVPIA, D-1641, and the CDFG Central Valley Plan for Anadromous fish, the goal is to increase the population of FRCS. (USFWS 2001; SWRCB 2000; Reynolds et al. 1993). The USBR, DWR, USFWS, CDFG and the Districts have spent millions of dollars trying to improve fish habitat, water resource management, and other factors for FRCS in the Stanislaus River Basin, San Joaquin River Basin, and Bay-Delta. It is the belief of the Districts' policy makers that the goals and policy directives should, to the degree reasonable, be implemented.

Table 12. List of fish species captured in the Stanislaus River rotary screw traps at Oakdale and Caswell, 1996-2006. Source: Cramer Fish Sciences unpublished data

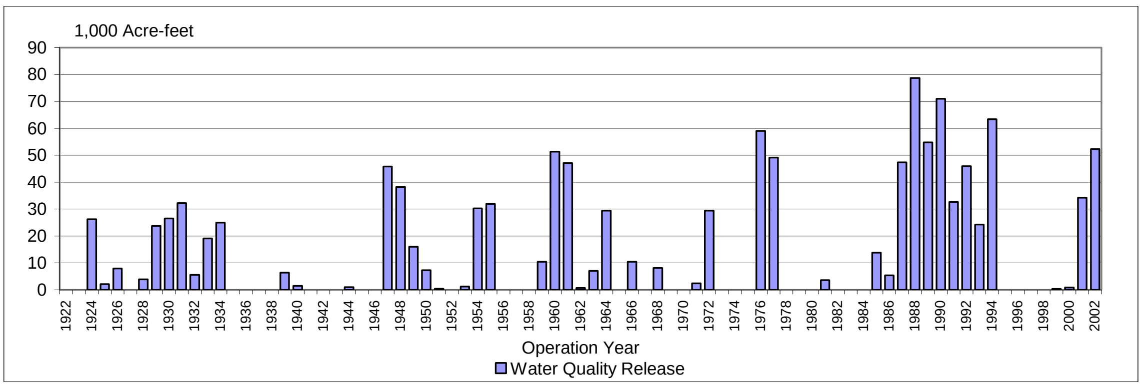
Common Name	Scientific Name
American Shad	*Alosa sapidissima*
Bigscale Logperch	*Percina macrolepida*
Black Bullhead	*Ameiurus melas*
Black Crappie	*Pomoxis nigromaculatus*
Bluegill Sunfish	*Lepomis macrochirus*
Brown Bullhead	*Ictalurus nebulosus*
Channel Catfish	*Ictalurus punctatus*
Chinook Salmon	*Onchorynchus tshawytscha*
Common Carp	*Cyprinus carpio*
Golden Shiner	*Notemigonus crysoleucas*
Goldfish	*Carassius auratus*
Green Sunfish	*Lepomis cyanellus*
Hardhead	*Mylopharodon conocephalus*
Hitch	*Lavinia exilicauda*
Inland Silverside	*Menidia beryllina*
Largemouth Bass	*Micropterus salmoides*
Pacific Lamprey	*Lampetra tridentata*
Prickly Sculpin	*Cottus asper*
Pumpkinseed	*Lepomis gibbosus*
Red Shiner	*Cyprinella lutrennsis*
Redear Sunfish	*Lepomis microlophus*
Redeye Bass	*Micropterus coosae*
Riffle Sculpin	*Cottus gulosus*
River Lamprey	*Lampetra ayresi*
Sacramento Blackfish	*Orthodon microlepidotus*
Sacramento Perch	*Archoplites interruptus*
Sacramento Pikeminnow	*Ptychochelius grandis*
Sacramento Splittail	*Pogonichthys macrolepidotus*
Sacramento Sucker	*Catostomus occidentalis*
Smallmouth Bass	*Micropterus dolomieu*
Steelhead/Rainbow Trout	*Onchorynchus mykiss*
Striped Bass	*Morone saxatilis*
Threadfin Shad	*Dorosoma petenense*
Tule Perch	*Hysterocarpus traski*
Warmouth	*Lepomis gulosus*
Western Mosquitofish	*Gambusia affinis*
White Catfish	*Ictalurus catus*
White Crappie	*Pomoxis annularis*
Yellow Bullhead	*Ictalurus natalis*

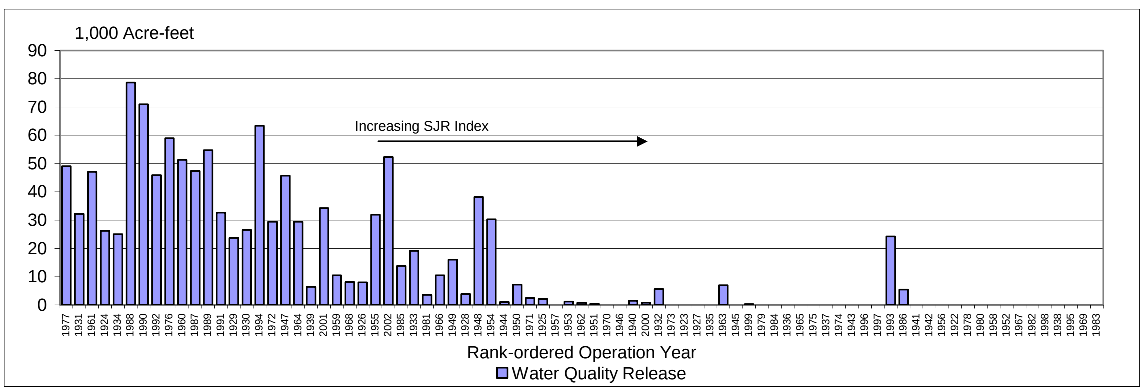
Water Quality

As described above, the fishery release component of the proposed plan serves as the foundation of releases to the Stanislaus River. Those releases are intended to be absolute. The additional release of water to the Stanislaus River for the purpose of water quality and flow objectives at Vernalis will then be provided, if needed, to supplement the incidental benefits of the fishery releases.

No constraint is placed upon the annual release for water quality or flow requirements at Vernalis; therefore the order of providing supplemental Vernalis water quality or flow releases is irrelevant. However, for (b)(2) accounting purposes, it is assumed that supplemental water quality releases occur first. Figure 10 (upper graph) illustrates the year to year supplemental provision of releases to meet water quality requirements at Vernalis. The lower graph illustrates the same data arranged by ascending San Joaquin River Index.

Figure 10. Water Quality Releases of Proposed Plan





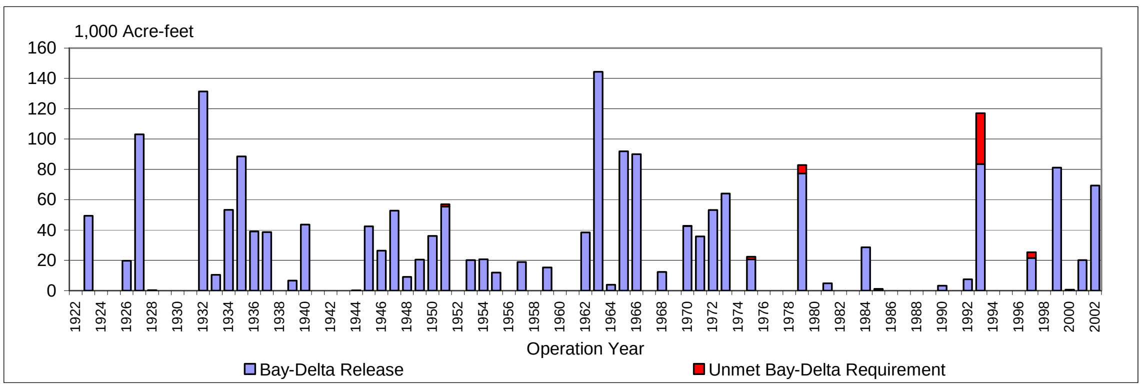
<u>Bay-Delta Releases</u>

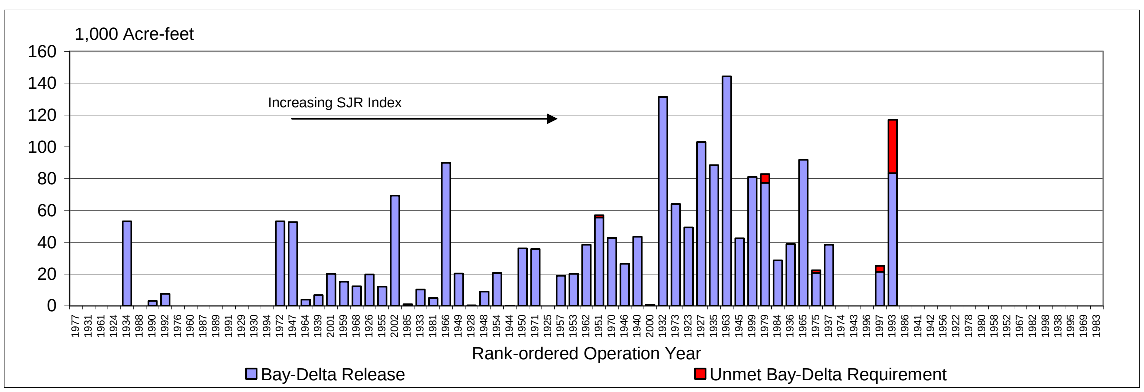
The flow requirement at Vernalis, Feb-June, excluding the April-May pulse, has been severely questioned. The SJRGA and other entities have offered extensive comments in the SWRCB Periodic Review process regarding the proposed objectives, their implementation, and the potential impacts. (See Master List of Exhibits for the Periodic Review of the 1995 Water Quality Control Plan for the San Francisco Bay/Sacramento – San Joaquin Delta Estuary, available at http://www.waterrights.ca.gov/baydelta/exhibits_list.htm#sj, accessed September 7, 2006.)

The SWRCB in D-1641 conditioned all CVP water right permits with the obligation of meeting the Vernalis salinity objective and all CVP and SWP water right permits with the obligation to meet the Delta outflow objectives, and provided the USBR and DWR with great latitude on how these requirements would be achieved.[4] The proposed plan however has as its premise the goal of ensuring current permit conditions, including the D-1641 San Joaquin River and Delta flow requirements at Vernalis are met through releases of water from New Melones. The current IPO does not meet the Bay-Delta flow requirement.

The proposed plan would meet the Vernalis flow requirement. Figure 11 illustrates the release to the Stanislaus River for Vernalis flow requirements. These supplemental releases occur over and above the fishery and water quality releases described above.

Figure 11. Bay-Delta Releases of Proposed Plan





While at times requiring substantial supplemental releases, the proposed plan will meet the Vernalis flow requirement. The only time the modeling indicates that the requirement is not met is when the Stanislaus River release is constrained by the 1,500 cfs flow limitation at Goodwin. (See Appendix A: Modeling Appendix, Jeanne Zollezi's

[4] Other available options include releases from other CVP reservoirs such as Friant; releases from San Luis Reservoir; recirculation of water from the Delta Mendota Canal, through the Newman Wasteway; construction of a drain to eliminate saline discharge into the San Joaquin River; and purchases of water from willing sellers to release to meet these objectives.

letter and attached docs to Bill Loudermilk re: 1,500 cfs flow limitation.) During these periods there is sufficient water in New Melones storage to meet the requirement but the release constraint limits the amount of water that can be contributed.

Dissolved Oxygen at Ripon

SWRCB Water Rights Decision 1422, revised by the 1995 Bay-Delta Water Quality Control Plan, established a minimum DO concentration of 7 mg/l, as measured on the Stanislaus River near Ripon.

The current IPO allocates up to 60,000 afa to meet the dissolved oxygen requirement at Ripon. The USBR assumes that a flow of approximately 250 cfs during June, July, August and September is needed to meet the standard. Currently Reclamation accounts for this release outside of any of the existing IPO allocations.

It was assumed for the purposes of this proposed transitional plan that since June-September flows would be 200 cfs for the fishery release alone, and greater if water quality releases are occurring, the DO at Ripon would be met.

The Districts propose as part of the transitional plan to modify the DO objective at Ripon. The proposed modification would be to change the DO objective compliance point during June through September from the Ripon location to Orange Blossom Bridge. The standard of 8 mg/l would remain. (See Draft Petition to Change the Dissolved Oxygen Compliance Point on the Stanislaus River from Ripon to Orange Blossom Bridge, submitted separately.)

Operations Criteria and Plan (OCAP) Section 7 Opinions

There currently exists a Section 7 opinion for OCAP. The OCAP maintain daily average water temperature in the Stanislaus River between Goodwin Dam and the Orange Blossom Road bridge at no more than 65°F during the period of June 1 through November 30 to protect rearing juvenile Central Valley steelhead. (USBR, Long-Term Central Valley Project Operations Criteria and Plan (June 30, 2004), p[3-43]; NMFS Biological Opinion on the Long-Term Central Valley Project and State Water Project Operations Criteria and Plan (October 2004), p224.)

This requirement has not been incorporated into the IPO. It is not known if the USBR coordinates its releases with the temperature gage at Orange Blossom Bridge. It is not known what policy or procedure the USBR has implemented to meet the Section 7 opinion.

Initial modeling done under the CALFED temperature model process would indicate that the temperature objectives contained in the Section 7 OCAP opinion can be met using the proposed flow schedule. Table 13 set forth below shows the Temperature degree violation days using the proposed flow schedule.

Table 13. Monthly temperature exceedance levels at Orange Blossom Bridge

	Apr				May				Jun			
Degrees F	49	52	55	57	52	55	58	60	53	55	60	64
D1485 (1991)	-	83.0%	43.0%	15.0%	99.0%	71.0%	43.0%	6.0%	98.0%	92.0%	65.0%	3.0%
D1485 (1992)	-	82.0%	43.0%	15.0%	99.0%	71.0%	43.0%	6.0%	98.0%	92.0%	65.0%	3.0%
D1485(1993)	-	83.0%	43.0%	15.0%	99.0%	71.0%	43.0%	6.0%	98.0%	92.0%	65.0%	3.0%
D1641(1994)	98.0%	57.0%	15.0%	4.0%	89.0%	45.0%	7.0%	3.0%	97.0%	92.0%	47.0%	1.0%
D1641(1997)	98.0%	57.0%	15.0%	4.0%	90.0%	45.0%	7.0%	3.0%	97.0%	92.0%	51.0%	1.0%
Today EWA	98.0%	57.0%	15.0%	4.0%	90.0%	45.0%	7.0%	3.0%	97.0%	92.0%	50.0%	1.0%
	Jul				Aug				Sep			
Degrees F	57	60	61	63	56	58	60	65	57	58	60	63
D1485 (1991)	95.0%	51.0%	34.0%	5.0%	99.0%	75.0%	38.0%	1.0%	98.0%	97.0%	53.0%	4.0%
D1485 (1992)	96.0%	54.0%	39.0%	5.0%	99.0%	77.0%	39.0%	1.0%	98.0%	97.0%	53.0%	4.0%
D1485(1993)	95.0%	54.0%	37.0%	5.0%	99.0%	75.0%	39.0%	1.0%	98.0%	97.0%	53.0%	4.0%
D1641(1994)	95.0%	47.0%	27.0%	5.0%	97.0%	84.0%	40.0%	2.0%	97.0%	91.0%	55.0%	5.0%
D1641(1997)	95.0%	47.0%	31.0%	5.0%	97.0%	86.0%	43.0%	2.0%	97.0%	91.0%	54.0%	5.0%
Today EWA	95.0%	46.0%	30.0%	5.0%	97.0%	85.0%	43.0%	1.0%	97.0%	91.0%	54.0%	5.0%

Water Supply

SSJID and OID Agreement. The proposed operating plan meets the terms and conditions of the 1987 Agreement.

CVP Contractors - SEWD and CSJWCD.

SEWD and CSJWCD contracted with the USBR in 1983 for 155,000 acre-feet annual water supply from New Melones. The extensive hydrologic studies undertaken by the USBR prior to execution of the contracts in 1983 confirmed that the yield of the New Melones project was approximately 180,000 acre feet annually and as such contracted with SEWD for 75,000 acre-feet annual "interim supply" and CSJWCD 80,000 acre-feet annually (49,000 "firm" and 31,000 "interim"). The Congressional authorization for the New Melones Project and the contracts provide a preference for water needed within the in-basin counties of origin – Tuolumne, Stanislaus and Calaveras. As such, the "interim" water supplies are available to CVP contractors until needed for use in the counties of origin. To date, no additional water service contracts have been entered into by the Bureau for the delivery of in-basin water from the New Melones Project and no additional in-basin needs have been identified. Should any in-basin user (e.g., Tuolumne Utility District, Calaveras County Water District or Stanislaus County) contract with the USBR for water from New Melones, the "interim" contract supplies of SEWD and CSJWCD would decrease in that amount.

The USBR operates New Melones reservoir pursuant to water right permits issued by the SWRCB. The SWRCB would not allow the USBR to fill New Melones Reservoir to its' full capacity until it showed proof that the water would be put to beneficial use. The USBR presented the contracts with SEWD and CSJWCD as this proof, and only then was the USBR allowed to fully exercise its New Melones water rights.

The contracts required SEWD and CSJWCD to build the Goodwin Tunnel and related facilities to take the water from New Melones to their service area. These facilities were built at an expense of over $65 million. In 1993, these facilities were completed. Water deliveries pursuant to the contracts are critical for SEWD and CSJWCD because of the condition of the groundwater basin. Both SEWD and CSJWCD are located in the Eastern San Joaquin County Groundwater Basin. In Bulletin 118-800, the DWR declared the Eastern San Joaquin County Groundwater Basin to be in a critical state of overdraft. There are only 11 such basins in the State of California.

A number of reports have been prepared on the condition of the Eastern San Joaquin County Groundwater Basin and have reported the following:

<u>1980 Report – Bulletin 118-80</u>

In 1980 the state identified the basin as one subject to critical conditions of overdraft, which means that: the continuation of present water management practices would probably result in significant adverse overdraft-related environmental, social or economic impacts.

Further, this report indicated that "this basin for many years has experienced overdraft, the adverse effects of which include declining water levels that have induced the movement of poor quality water from the Delta sediments eastward. . . Migration of these saline waters has severely impacted the utility of groundwater. . . Wells have been abandoned and replacement water supplies have been obtained by drilling additional wells generally to the east."

<u>1985 Brown and Caldwell Report</u>

In 1985, local agencies drafted a report confirming that groundwater levels were still declining. Conclusions of the report indicated that (1) Serious overdrafting is continuing; (2) The saline front advanced inland approximately one mile between 1963 and 1983; (3) Water levels declined at an average rate of 1.7 feet per year during the period from 1947 to 1984, in the areas of the greatest groundwater depression, average water levels were over 60 feet below sea level in 1980; and (4) If no additional surface water is imported into the service area and all demands are met from groundwater, the groundwater model indicates that water levels will decline to as much as 160 feet below sea level (up to 200 feet below the ground surface) and the saline front will advance approximately an additional two miles by the year 2020.

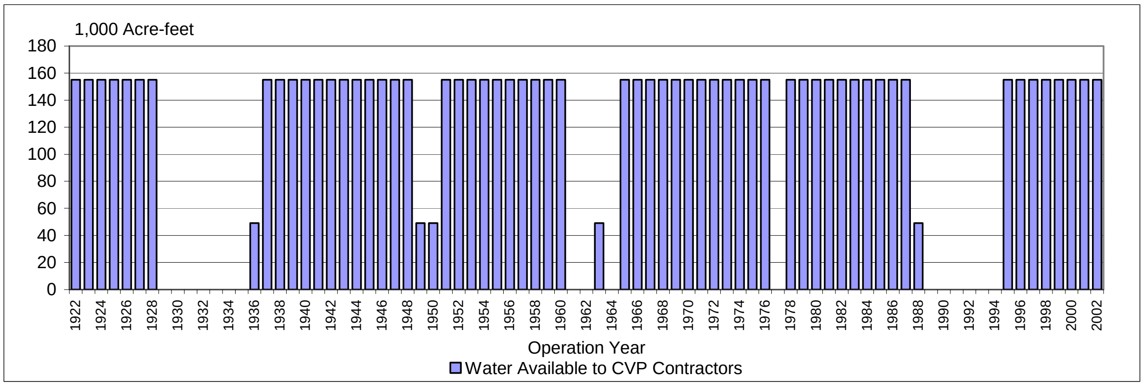
<u>2004 Eastern San Joaquin Groundwater Basin Groundwater Management Plan</u>

Based on the San Joaquin County Water Management Plan, the Basin is overdrafted by an average 150,000 af/yr. Long-term groundwater overdraft has lowered the groundwater table by two feet per year in some areas to -70 ft below sea level and has induced the intrusion of saline groundwater into the Basin from the west. Without additional surface water supplies, such intrusion will degrade portions of the Basin, rendering the groundwater unusable for municipal supply and irrigation.

These reports and studies reveal the critical condition of the future of Eastern San Joaquin County groundwater basin, and the predicted permanent destruction of an additional two miles of that basin if additional sources of supplemental surface water are not obtained.

The proposed plan of operation provides deliveries to the CVP contractors based on the New Melones Index. Two levels of annual delivery are provided, 49 TAF for an index ranging from 1,500 TAF to 1,800 TAF, and 155 TAF for an index greater than 1,800 TAF. No deliveries would be provided when the index is less than 1,500 TAF. Water available to the CVP contractors under the proposed plan is illustrated in Figure 12.

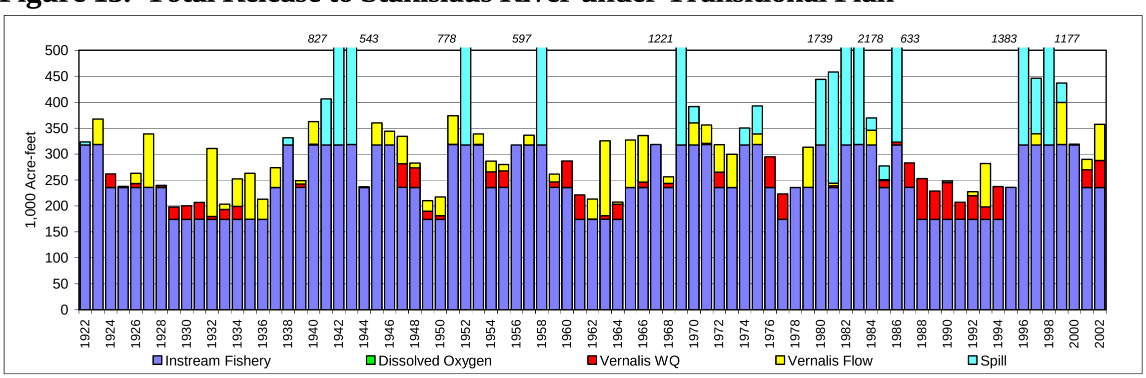
Figure 12. Water Available to CVP Contractors



Total Releases to the Stanislaus River

An important outcome of the transitional plan is a more reliable release of flow to the Stanislaus River during dry and successive dry years. In addition to this absolute release, additional releases for water quality and Bay-Delta flow objectives will occur. Figure 13 illustrates the modeled total annual release to the Stanislaus River for the 1922-2002 simulation period.

Figure 13. Total Release to Stanislaus River under Transitional Plan



Illustrated is the foundational flow provided by the fishery flow allocations, ranging annually from 174,000 acre-feet to 318,000 acre-feet. Added to this flow would be releases for water quality and Bay-Delta flow objectives. Occasionally there will still be spills from New Melones in excess of allocations.

Contingency Planning

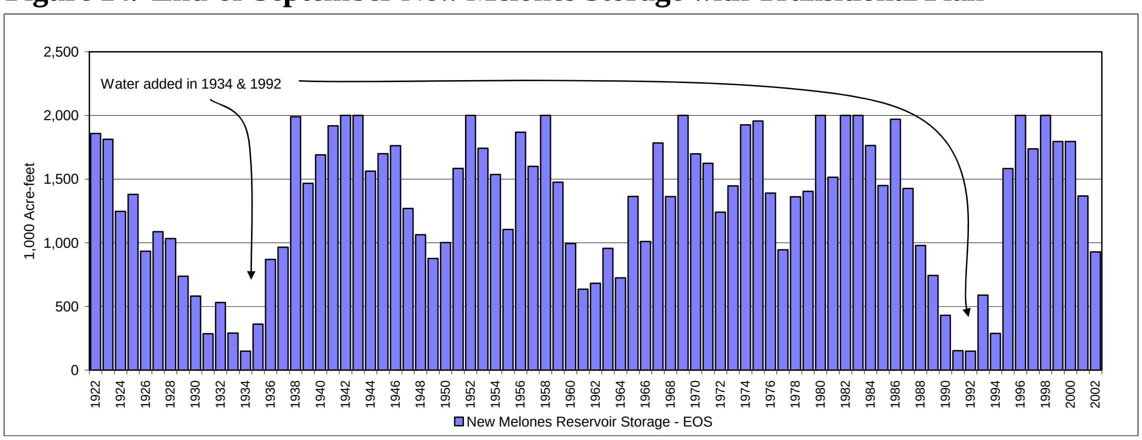
The importance of successive Critical, Dry and Below Normal years at New Melones cannot be overstated. New Melones has been subjected to several notable successive drought years 1928-1934, 1958-1962, 1975-1976 and 1987-1992. An operational plan must identify the hydrologic sequence it is planned to meet.

This proposed transitional plan is designed to meet the 1928-1934 drought. This was done because planning for the 1987-1992 drought would be too conservative and leave too much water in storage or spill too much water. This is shown in the accompanying graph comparing and contrasting reservoir levels and spills at New Melones under the IPO and the proposed plan.

As described above, the transitional plan's planning perspective is changed from providing protection against highly infrequent droughts to providing water allocations that can better exercise New Melones storage. Given that New Melones will enter the 2006-07 water year with a full reservoir and the anticipation that the proposal is intended to be transitional, water allocations have been developed to increase utilization of New Melones storage while maintaining a lessened concern for extended severe drought.

However, it is to be recognized that the transitional plan's allocation methodology is not without risk if its use continues beyond the anticipated transitional period. Figure 14 illustrates the end-of-September storage associated with the implementation of the transitional plan over the historical 82-year simulation period.

Figure 14. End-of-September New Melones Storage with Transitional Plan



As can be seen in Figure 14, New Melones storage is exercised more often and to a greater extent that under the IPO, indicating greater allocations to New Melones water uses. The note in Figure 14 regarding "added" water indicates that during a recurrence of the prolonged droughts of the 1920s-30s and 1987-1992 allocations under the transitional plan would lead to a non-viable operation by the end of those drought periods. Initial interpretation of the water supply studies indicate that during implementation of the transitional plan Reclamation and the stakeholders should re-evaluate needs and allocations if the New Melones Index is anticipated to be near 1,300,000 acre-feet or less. This point in hydrology essentially provides at least three years of the proposed allocations within the 1987-1992 drought period. Re-evaluation of needs and allocations at this point would provide sufficient time to adjust operations and provide a viable operation through historically experienced drought cycles.

Spills decrease, reservoir levels decrease and more water is put to beneficial use under the proposed transitional plan.

CVPIA (b)(2) Accounting

In 1992 the Central Valley Project Improvement Act – Public Law 102-575 (CVPIA) was signed into federal law. Section 3406 (b)(2) requires the USBR to dedicate and manage annually 800,000 acre feet of CVP yield for the primary purpose of implementing fish, wildlife and habitat restoration purposes; to assist the State of California in its efforts to protect the water of the San Francisco Bay/Sacramento-San Joaquin Delta Estuary; and to help meet such obligations as may be legally imposed upon the Central Valley Project under State or Federal law following the date of enactment of the this title, including but not limited to additional obligation under the Federal Endangered Species Act.

Project yield is defined in Section 3406(b)(2) as the delivery capability of the CVP during the drought period of 1928-1934 as it would have been with all facilities and requirements on the date of enactment of the CVPIA (October 31, 1992) in place. Since enactment of the CVPIA, up to 151.3 TAF annually has been dedicated from New Melones for (b)(2) purposes. In 1999 the Department of the Interior calculated CVP Yield for the Stanislaus River Basin for (b)(2) purposes at 3 TAF.

In order for the USBR to be consistent with the Decision on Implementation of Section 3406(b)(2) decision dated May 9, 2003, the USBR will need to continue to run a pre-CVPIA run utilizing the new model in order to account for the (b)(2) water utilized from New Melones. Pre-CVPIA assumptions remain the same, including the 1987 Fish and Game Agreement, D-1422 and Corps of Engineers Flood Control requirements.

Study Results

A summary of the annual operation of New Melones under the IPO and the proposed transitional plan are included in Appendix B. The results are from the output provided by NEWMOM simulations.

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Appendix A

Modeling Appendix

New Melones Operations Model
Users Guide

The New Melones Operations Model[5] (NEWMOM) was developed to perform simulations of the operation of the New Melones Project under varying assumptions for Stanislaus River water allocations and alternative boundary conditions within the San Joaquin River Basin. The model is an Excel workbook with a single model worksheet and several ancillary worksheets that provide input and reporting functions. The model provides a simulation of operations for an 82-year trace of hydrology, water years 1922 through 2003. Annual operations can be divided among two periods per month, with the two periods within a month capable of being divided into any two groups of days.

The boundary condition affecting Stanislaus River operations is imported from a CALSIM II simulation. Specifically required information required from CALSIM II include flow and water quality conditions for the San Joaquin River above the confluence of the Stanislaus River (Maze Boulevard), accretion and loss information (flow and water quality) upstream of Vernalis to Goodwin Dam (Stanislaus River) and Maze Boulevard (San Joaquin River), diversions and commitments by Oakdale Irrigation District and South San Joaquin Irrigation District, and the Vernalis flow objective based on the required location of X2 (if the simulation includes compliance with D1641).

Water allocations from New Melones can be fashioned various ways, along with the capability to vary the order of priority of these allocations. The structure of the water allocations has a resemblance to the methodology used for the 1997 New Melones Interim Plan of Operations, with allocations triggered by a water supply index comprised of the current year's storage plus anticipated inflow. The categories of water allocation include a) in-stream fishery releases, b) water quality at Vernalis, c) in-stream dissolved oxygen (flow surrogate), d) flow requirement at Vernalis, e) CVP(1) diversions at Goodwin, and f) CVP(2) diversions at Goodwin.

Diversions to Oakdale Irrigation District and South San Joaquin Irrigation District are derived from a land-use calculation, and incorporate district operations. Other commitments of the districts (e.g., transfers and SJRA) can be incorporated into the diversions. The districts' annual entitlement is limited by their settlement agreement with Reclamation.

[5] The New Melones Operations Model was developed by Walter Bourez, MBK Engineers and Daniel B. Steiner, Consulting Engineer through funding by the Oakdale Irrigation District, South San Joaquin Irrigation District and Tri Dam Project.

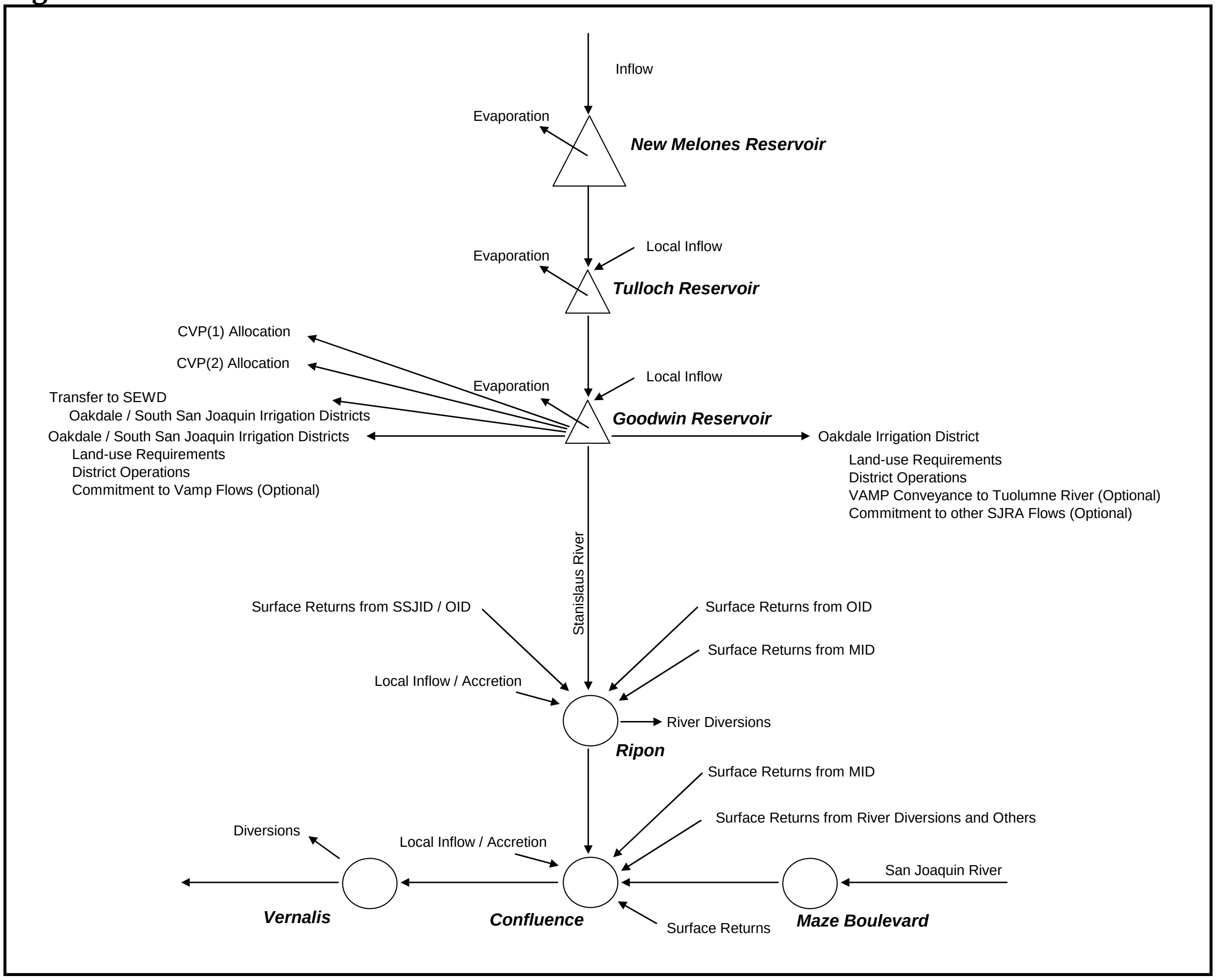
Facility Representation

The model is structured to allow relatively easy modification to its structure, content, logic and data. Figure 1 is a schematic representation for the hydrologic content of the model. In relation to geography and facilities, the model is separated into four sections: 1) New Melones Reservoir, 2) Tulloch Reservoir, 3) Goodwin Reservoir, and 4) the Lower Stanislaus River and San Joaquin River.

New Melones Reservoir

The New Melones Reservoir section provides a mass balance of inflows, outflows and constraints for the reservoir. Inflow is a time series data-set that has been incorporated into previous models and CALSIM II. The data-set is a combination of study results (Reclamation origin unavailable) and historical computed inflow (1980-2003). The evaporation at New Melones Reservoir is computed using a monthly evaporation rate (CALSIM II) and storage-area equations. An initial flood control release is determined by computing the amount of release required after considering the previous month's storage, evaporation, the current month's allowable storage (USCOE data-set) and inflow. The model will release from New Melones this initial amount if downstream demands do not incidentally call for this water. The downstream demands at New Melones Reservoir include all facets of the net requirements at Tulloch Reservoir and Goodwin Reservoir.

Figure 1 – Model Schematic



Tulloch Reservoir

The operation at Tulloch Reservoir modifies the otherwise direct interaction between net downstream demands at Goodwin Reservoir and New Melones Reservoir. Local inflow, reservoir evaporation and flood control operations at Tulloch Reservoir intercedes the direct interaction between the two reservoirs. Local inflow (CALSIM II) represents the accretion from runoff that occurs between New Melones Reservoir and Tulloch Reservoir. The evaporation at Tulloch Reservoir is computed using a monthly evaporation rate (CALSIM II) and storage-area equations. The flood control storage reservation requirements (CALSIM II) at Tulloch Reservoir are based on Reclamation information.

Goodwin Reservoir

The Goodwin Reservoir section of the model identifies the out-of-stream demands at Goodwin Reservoir and restates the releases to the Stanislaus River. Various components of out-of-stream demands are incorporated or computed in this section. The demands of the Oakdale Irrigation District and South San Joaquin Irrigation District are time series data-sets from CALSIM II. These data-sets can be created by additional spreadsheet logic in the future if necessary. Currently the water demands of the two districts include:

- Land-use based consumptive requirements
- District operation requirements (operational spills, canal seepage/losses, Woodward Reservoir)
- Commitments to the Stockton East Water District transfer
- Commitments to San Joaquin River Agreement flows (VAMP and other releases)

In addition to the water demands of the two districts, two components of CVP out-of-stream diversions can be modeled. Akin to the modeling of the 1997 IPO, these components can represent the allocation of water to the Stockton East Water District and the Central San Joaquin Water Conservation District. Two separate components have been incorporated to allow separate allocation procedures and diversion patterns.

Although their values are established elsewhere in the model, the minimum release to the Stanislaus River and computed release to the Stanislaus River are provided in this section. The minimum release to the Stanislaus River represents the required release necessary to satisfy the operator-identified required downstream objectives, e.g., salinity at Vernalis and instream fishery flows. The computed release to the Stanislaus River represents that required release plus any additional release that may have been required for flood control at New Melones Reservoir.

Local inflow between Tulloch Reservoir and Goodwin Reservoir are incorporated in the net demand at Goodwin Reservoir.

San Joaquin River

The San Joaquin River section of the model represents the hydrologic components that occur between Vernalis and upstream to Goodwin Reservoir on the Stanislaus River and Maze Boulevard on the San Joaquin River. The components of inflow and diversions are needed to calculate the flow and quality of water arriving at Vernalis. These hydrologic components are directly extracted from a selected CALSIM II study.

For this prototype model the selected CALSIM II study represents the current condition of the San Joaquin River inclusive of operating the basin to D1641 and the San Joaquin River Agreement. New Melones Reservoir is operated to the 1997 IPO.

The model utilizes the same data and performs the same calculation as CALSIM II for the calculation of flow and quality of water. Four CALSIM II nodes provide information for the model: Stanislaus River at Ripon (Node 528), San Joaquin River at Maze Boulevard (Node 636), San Joaquin River at Stanislaus River Confluence (Node 637) and San Joaquin River at Vernalis (Node 639). The hydrologic components identified at these nodes include:

- Surface returns from Oakdale Irrigation District and South San Joaquin Irrigation District
- Surface returns from Modesto Irrigation District
- Surface returns from adjacent lands and river diverters
- Surface returns from Westside lands
- River diversions
- Local inflow and accretions/depletions
- Flow and water quality at Maze Boulevard (boundary condition)

Each component of the surface flows (boundary flow or accretions) is represented by a flow (TAF) and quality (EC – uS/cm). Releases from Goodwin Reservoir are assumed to have a quality of 85 EC. Diversions are assigned a water quality value (to be removed from the mass balance) associated with the general location of the diversion. All of the components associated with the San Joaquin River section will remain relatively stable (without variation) for a given boundary condition, regardless of the Stanislaus River operation.

The water quality objective at Vernalis is incorporated into this section of the model, and any non-compliance with the objective, if any, is determined.

Initial River Requirements and Allocations

This section of the model calculates the minimum release requirements at Goodwin Dam. The model initially computes the required release from Goodwin Dam that satisfies each independent component of downstream requirement as though there is no coincidental use of releases. Subsequently, the model will prioritize the releases and one release requirement may be incidentally satisfied by a higher priority release.

The initial required release from Goodwin Dam to satisfy water quality objectives at Vernalis is computed by performing a mass balance for the hydrologic components between Vernalis, Maze and Goodwin Dam as though there is no release from Goodwin Dam. Assuming Goodwin Dam will release water at a quality of 85 EC, the amount of dilution water (if any) required to achieve the water quality objective at Vernalis is determined.

The initial required fishery release from Goodwin Dam is determined by the model's allocation procedures. An annual (March through February) allocation is determined from an input table included in the Control worksheet. The annual allocation is dependent upon the New Melones Water Supply Index, which is a sum of the end-of-February New Melones Reservoir storage and the reservoir's March through September inflow. The monthly distribution of this annual allocation is then established from additional input data included in the Control worksheet. A time-series for the split-month flow requirement can be imported to this section.

Similarly, the annual allocation for water quality releases is determined in this section. The annual (March through February) allocation is determined from an input table included in the Control worksheet. The annual allocation is dependent upon the New Melones Water Supply Index. Also included in this section is the running balance of available water quality allocation subsequent to prior usage.

The dissolved oxygen release requirement is established from look-up values included in the Control worksheet. The release requirement is described as a flow surrogate at Goodwin Dam. This input parameter can represent any minimum flow component desired at Goodwin Dam.

Like the water quality allocation, an allocation for flow requirements at Vernalis can be provided. The annual (March through February) allocation is determined from an input table included in the Control worksheet. The annual allocation is dependent upon the New Melones Water Supply Index. Also included in this section is the running balance of available water for release subsequent to prior usage.

Order of Controlling Minimum Goodwin Release

The order of controlling Goodwin Dam releases is identified in this section. The model allows the ordering of instream fishery releases, water quality releases and dissolved oxygen releases. The first flow requirement "switched on" becomes the initial release from Goodwin Dam. This flow is allowed to coincidentally meet the next identified flow requirement. If the next "layer" of flow requirement requires additional release, that release will be shown in this section. This logic continues for the third layer of flow requirement if one is identified. This layering of required releases recognizes the annual allocation constraint for water quality releases.

Vernalis Flow Requirement

Releases to meet a Vernalis flow objective are always layered last in the model. Releases for the Vernalis flow objective are constrained to the available annual allocation and the release capacity available at Goodwin Dam up to 1,500 cfs (user specified in Control worksheet). Any unmet flow objective at Vernalis is identified.

Control Worksheet

The constraints and objectives for the operation of New Melones Reservoir are identified through the Control worksheet. The following is a general overview of the parameters entered.

New Melones Forecast and Allocations

Annual Volume in 1,000 acre-feet

	New Melones Forecast Index	Instream Fish	SEWD	CSJWCD	Vernalis Water Quality	Vernalis Flow Objective
	0	1	2	3	4	5
New Melones Forecast Index	0	0	0	0	0	0
equals end-of-February	1400	98	0	0	70	0
storage plus March through	2000	125	0	0	80	0
September inflow	2499.99	345	10	49	175	0
	2500	345	10	80	175	1000
	3000	467	10	80	250	1000
	6000	467	10	80	250	1000
	7000	467	10	80	250	1000
	8000	467	10	80	250	1000
	9000	467	10	80	250	1000
Form of lookup between indices:		Interpolate	Interpolate	Interpolate	Interpolate	Lookup
Threshold cutoff for interpolation:		NA	0	0	0	NA

Instream fish allocation procedure works identical to other allocations.
To force schedules at certain indices, assign explicit volume (eg., 9999) with a paired distributed schedule below.

Release for Vernalis Flow is On
Release for Vernalis Quality is On

This table relates the New Melones Forecast Index to an annual allocation. For each of the instream fish, SEWD, CSJWCD and water quality parameters, a built-in macro will interpolate between table values. Also, for the SEWD, CSJWCD and water quality parameters a threshold cutoff index can be identified that overrides the interpolation procedure and produces a zero allocation below such index value. For the Vernalis flow objective, a simple lookup table procedure is used rather than interpolation. The stating of a large value for this parameter allows any amount of flow to be used to meet the flow objective.

Stanislaus Instream Fish Flow Requirement Monthly Distribution

Flow in CFS

	Lookup Period	Month	Lookup Reference	Breakpoints of Flow Distribution Schedules - 1,000 Acre-feet and Period Schedules - CFS							Special Forced Schedules		
Days			0	0.0	98.4	243.3	253.8	310.3	410.2	466.8	9999	99999	999999
15	10_1	Oct	1	0	110	200	250	250	350	350	200	252	
16	10_2	Oct	2	0	110	200	250	250	350	350	200	252	
15	11_1	Nov	3	0	200	250	275	300	350	400	200	300	
15	11_2	Nov	4	0	200	250	275	300	350	400	200	300	
15	12_1	Dec	5	0	200	250	275	300	350	400	200	300	
16	12_2	Dec	6	0	200	250	275	300	350	400	200	300	
15	1_1	Jan	7	0	125	250	275	300	350	400	150	150	
16	1_2	Jan	8	0	125	250	275	300	350	400	150	150	
15	2_1	Feb	9	0	125	250	275	300	350	400	173	173	
13	2_2	Feb	10	0	125	250	275	300	350	400	173	173	
15	3_1	Mar	11	0	125	250	275	300	350	400	200	200	
16	3_2	Mar	12	0	125	250	275	300	350	400	200	200	
14	4_1	Apr	13	0	250	300	300	900	1500	1500	200	200	
16	4_2	Apr	14	0	500	1500	1500	1500	1500	1500	750	1500	
15	5_1	May	15	0	500	1500	1500	1500	1500	1500	750	1500	
16	5_2	May	16	0	250	300	300	900	1500	1500	200	200	
15	6_1	Jun	17	0	0	200	200	250	800	1500	200	200	
15	6_2	Jun	18	0	0	200	200	250	800	1500	200	200	
15	7_1	Jul	19	0	0	200	200	250	300	300	200	200	
16	7_2	Jul	20	0	0	200	200	250	300	300	200	200	
15	8_1	Aug	21	0	0	200	200	250	300	300	200	200	
16	8_2	Aug	22	0	0	200	200	250	300	300	200	200	
15	9_1	Sep	23	0	0	200	200	250	300	300	200	200	
15	9_2	Sep	24	0	0	200	200	250	300	300	200	200	
	Equivalent Volume 1,000 Acre-feet:			0.0	98.9	245.7	256.2	311.5	410.2	466.8	174.0	235.4	0.0

This table provides the split-month distribution of annual allocations for instream fishery releases. The year is divided by month, and then divided into two periods within a month. The section of flow schedules centered in the above illustration is representative of the 1997 IPO flow schedules. Discrete distributions of flow schedules by six incremental annual volumes are shown. Annual allocations that fall between two discrete schedules are interpolated. Special forced schedules can be achieved by pairing a unique flow distribution with a specific allocation within the New Melones Forecast and Allocations data set.

Stanislaus Dissolved Oxygen - Surrogate Required Flow below Goodwin Dam

Flow in 1,000 acre-feet

Lookup Period	Month	Split-month Required Flow for DO
10_1	Oct	0.0
10_2	Oct	0.0
11_1	Nov	0.0
11_2	Nov	0.0
12_1	Dec	0.0
12_2	Dec	0.0
1_1	Jan	0.0
1_2	Jan	0.0
2_1	Feb	0.0
2_2	Feb	0.0
3_1	Mar	0.0
3_2	Mar	0.0
4_1	Apr	0.0
4_2	Apr	0.0
5_1	May	0.0
5_2	May	0.0
6_1	Jun	6.6
6_2	Jun	6.6
7_1	Jul	7.8
7_2	Jul	8.4
8_1	Aug	7.9
8_2	Aug	8.5
9_1	Sep	7.2
9_2	Sep	7.2
	Sum	60.1

Month	Monthly Required Flow for DO TAF	Monthly Required Flow for DO CFS
Oct	0	0
Nov	0	0
Dec	0	0
Jan	0	0
Feb	0	0
Mar	0	0
Apr	0	0
May	0	0
Jun	13.2	222
Jul	16.2	263
Aug	16.4	267
Sep	14.3	240
Sum	60.1	

Release for DO Requirement is On in Model

These tables identify an absolute minimum flow required below Goodwin Dam, in this case a surrogate flow representing the release required to meet dissolved oxygen objectives at Ripon. The split-month flow requirement is automatically updated with modifications to the monthly flow requirement table.

Maximum Goodwin Release

Flow in CFS	1500

The maximum non-flood control release from Goodwin Dam is identified by this input. Typically, only the Vernalis flow objective would call for releases in excess of 1,500 cfs. In these instances the model will limit releases to 1,500 cfs and the Vernalis flow objective will be violated. This constraint does not override the need to release greater than 1,500 cfs to maintain flood control reservation storage in New Melones Reservoir.

Reservoir Data

Storage in 1,000 acre-feet

Values currently assume split-month approximates one-half of the month

Lookup Period	Month	New Melones Flood Control (with drawdown)	New Melones Flood Control (no drawdown)	Tulloch Flood Control Storage rule	
10_1	Oct	1970.0	1970.0	57.0	
10_2	Oct	1970.0	1970.0	57.0	
11_1	Nov	1970.0	1970.0	57.0	
11_2	Nov	1970.0	1970.0	57.0	
12_1	Dec	1970.0	1970.0	57.0	
12_2	Dec	1970.0	1970.0	57.0	
1_1	Jan	1970.0	1970.0	57.0	
1_2	Jan	1970.0	1970.0	57.0	
2_1	Feb	1970.0	1970.0	57.0	
2_2	Feb	1970.0	1970.0	57.0	
3_1	Mar	2000.0	2000.0	57.8	
3_2	Mar	2030.0	2030.0	58.5	
4_1	Apr	2125.0	2125.0	60.5	
4_2	Apr	2220.0	2220.0	62.5	
5_1	May	2320.0	2320.0	64.8	
5_2	May	2420.0	2420.0	67.0	
6_1	Jun	2420.0	2420.0	67.0	
6_2	Jun	2420.0	2420.0	67.0	
7_1	Jul	2360.0	2420.0	67.0	
7_2	Jul	2300.0	2420.0	67.0	
8_1	Aug	2215.0	2420.0	67.0	
8_2	Aug	2130.0	2420.0	67.0	
9_1	Sep	2065.0	2420.0	65.3	
9_2	Sep	2000.0	2420.0	63.5	

Area-Capacity Curves

Storage Area Coefficients

A*Stor+B*Stor^.5+C*Stor^.333+D		
	New Melones	Tulloch
A	1.121	24.122
B	244.644	-142.512
C	-166.985	227.93
D	2.407	-7.024

These data represent end-of-period flood control storage reservation requirements (October through June) and user-defined drawdown storage objectives (July through September). The equations define the storage to surface area relationship for New Melones Reservoir and Tulloch Reservoir for use in the computation of reservoir evaporation.

Water Quality Data

Water Quality in EC uS/cm

Lookup Period	Month	Vernalis Water Quality Standard	Goodwin EC	Stanislaus Return EC	Stanislaus Accretion EC
10_1	Oct	1000.0	85.0	380.0	380.0
10_2	Oct	1000.0	85.0	380.0	380.0
11_1	Nov	1000.0	85.0	380.0	380.0
11_2	Nov	1000.0	85.0	380.0	380.0
12_1	Dec	1000.0	85.0	380.0	380.0
12_2	Dec	1000.0	85.0	380.0	380.0
1_1	Jan	1000.0	85.0	380.0	380.0
1_2	Jan	1000.0	85.0	380.0	380.0
2_1	Feb	1000.0	85.0	380.0	380.0
2_2	Feb	1000.0	85.0	380.0	380.0
3_1	Mar	1000.0	85.0	190.0	190.0
3_2	Mar	1000.0	85.0	190.0	190.0
4_1	Apr	700.0	85.0	190.0	190.0
4_2	Apr	700.0	85.0	190.0	190.0
5_1	May	700.0	85.0	190.0	190.0
5_2	May	700.0	85.0	190.0	190.0
6_1	Jun	700.0	85.0	190.0	190.0
6_2	Jun	700.0	85.0	190.0	190.0
7_1	Jul	700.0	85.0	190.0	190.0
7_2	Jul	700.0	85.0	190.0	190.0
8_1	Aug	700.0	85.0	190.0	190.0
8_2	Aug	700.0	85.0	190.0	190.0
9_1	Sep	1000.0	85.0	190.0	190.0
9_2	Sep	1000.0	85.0	190.0	190.0

This look-up table allows the user to define several water quality parameters used in the model. The Vernalis water quality objective is defined in this data set. Also defined are the assumed values of quality associated with Goodwin Dam releases, and surface returns and accretions to the Stanislaus River. The water quality of Westside return flows and the boundary flow at Maze are defined by time-series data within the model.

Diversion Patterns

Values currently assume split-month approximates one-half of the month

Split-month Pattern

Lookup Period	Month	SEWD	CSJWCD
10_1	Oct	0.000	0.035
10_2	Oct	0.000	0.035
11_1	Nov	0.000	0.021
11_2	Nov	0.000	0.021
12_1	Dec	0.000	0.021
12_2	Dec	0.000	0.021
1_1	Jan	0.000	0.021
1_2	Jan	0.000	0.021
2_1	Feb	0.000	0.021
2_2	Feb	0.000	0.021
3_1	Mar	0.000	0.021
3_2	Mar	0.000	0.021
4_1	Apr	0.075	0.058
4_2	Apr	0.075	0.058
5_1	May	0.075	0.058
5_2	May	0.075	0.058
6_1	Jun	0.075	0.058
6_2	Jun	0.075	0.058
7_1	Jul	0.100	0.065
7_2	Jul	0.100	0.065
8_1	Aug	0.100	0.065
8_2	Aug	0.100	0.065
9_1	Sep	0.075	0.058
9_2	Sep	0.075	0.058
		1.000	1.000

Monthly Pattern

Month	SEWD	CSJWCD
Oct	0.000	0.070
Nov	0.000	0.042
Dec	0.000	0.042
Jan	0.000	0.042
Feb	0.000	0.042
Mar	0.000	0.042
Apr	0.150	0.115
May	0.150	0.115
Jun	0.150	0.115
Jul	0.200	0.130
Aug	0.200	0.130
Sep	0.150	0.115
Sum	1.000	1.000

These tables establish the diversion patterns for the two CVP contracting entities. Currently the monthly distribution is split equally for the two periods within each month.

CALSIM II Input

Several parameters from CALSIM II are required to perform studies using the model. These parameters mostly concern the underlying hydrology of the boundary condition of the San Joaquin River and the fundamental hydrology of the Stanislaus River system, such as inflow to New Melones Reservoir and the evaporation rate at the reservoir. The following is a table of imported data from CALSIM II. These data are imported to the CALSIMInput worksheet. Subsequently, these data are disaggregated into split-month period values.

CALSIM II Parameter	Description	CALSIM II Parameter	Description
I10	Inflow to New Melones Reservoir		New Melones and Tulloch Evaporation
I78	Local Inflow to Tulloch Reservoir	R528A	Surface Returns from OID (Ripon)
I520	Local Inflow to Goodwin Reservoir	R528B	Surface Returns from OID/SSJID (Ripon)
I528	Inflow/Accretion to Ripon	R528C	Surface Returns from Modesto ID (Ripon)
I637	Inflow/Accretion to Confluence	R637A	Surface Returns from Modesto ID (Confluence)
D520B	Joint Main Canal Diversion	R637B	Surface Returns from Adjacent Lands (Confluence)
D520C	South Main Canal Diversion	R637C	Surface Returns from Adjacent Lands (Confluence)
D528	River Diversions (Above Ripon)	R637D	Surface Returns from Westside (Confluence)
D637	River Diversions (Above Confluence)	ECR637D	EC of Westside Returns
C520INSTREAM	OID SJRA Instream Water	VERNMIN_REQDV	Vernalis Flow Requirement
C520VAMP	OID/SSJID VAMP Water Stanislaus R	D520A	OID/SSJID Transfer to SEWD
D530_VAMP	OID/SSJID VAMP Water to Tuolumne	C636_NP_DV	Non-pulse Period Flow at Maze
		C636_P_DV	Pulse Period Flow at Maze
		EC_636_NP_DV	Non-pulse Period Quality at Maze
		EC_636_P_DV	Pulse Period Quality at Maze

Period Conversions

The model is structured to automatically disaggregate monthly parameters into split-month values. The Period Conversion worksheet allows the user to specify the number of days encompassed by the first period of a month. The model will then compute the appropriate conversion factors and flow volumes associated with each period within a month.

Appendix B
Study Results – Annual Summary

Table 1
Stanislaus River Operations under IPO

Table 2
Stanislaus River Operations under Transitional Plan

1997 IPO Allocations w/ Revised October 2005 CALSIM Boundary

	New Melones		Goodwin													
	New Melones Inflow	New Melones Storage	OID & SSJID Canals	Districts Other	Districts SEWD	Total OID & SSJID	SEWD / SCJWCD NM Water	Instream Fish	Dissolved Oxygen	Vernalis Water Quality	Vernalis Flow Objective	Total Goodwin Release to River	Release above Minimum	NM Forecast Index	Missed Vernalis WQ Release	Missed Vernalis Flow Release
Avg	1087		507	30	26	562	49	288	12	19	3	447	126		1	14
	WY	EOS	WY	M-F	WY		M-F	M-F	M-F	M-F	M-F	M-F	M-F		M-F	M-F
1922	1389	1852	519	26	29	574	90	407	0	0	0	407	0	2754	0	0
1923	1109	1801	528	30	27	585	90	413	0	0	31	444	0	2776	0	0
1924	385	1397	422	26	8	456	0	125	19	56	0	199	0	1986	0	0
1925	1092	1616	472	31	29	532	45	295	4	0	0	299	0	2384	0	0
1926	619	1335	539	31	29	599	7	151	21	29	0	201	0	2056	0	18
1927	1256	1626	527	33	29	589	56	334	0	0	0	335	0	2472	0	57
1928	952	1581	518	36	28	582	50	314	2	0	0	315	0	2426	0	0
1929	506	1263	475	32	29	535	0	122	22	53	0	197	0	1916	0	0
1930	671	1098	540	31	30	601	0	116	22	58	0	196	0	1782	0	0
1931	438	797	457	26	8	491	0	99	20	70	0	189	0	1410	0	0
1932	1160	1161	545	26	30	601	0	119	43	18	0	180	0	1843	0	131
1933	586	918	535	27	30	591	0	107	27	52	0	186	0	1589	0	10
1934	498	659	493	28	13	533	0	91	21	64	0	176	0	1287	0	56
1935	1082	1006	487	33	30	550	0	109	45	12	0	166	0	1623	0	91
1936	1291	1509	498	26	29	553	24	217	21	0	0	238	0	2204	0	38
1937	1080	1649	520	26	28	574	52	321	1	0	0	322	0	2442	0	33
1938	2032	2000	510	26	27	563	90	467	0	0	0	1088	621	3521	0	0
1939	562	1531	513	37	27	577	38	268	7	3	0	278	0	2319	0	1
1940	1327	1786	531	26	27	584	90	392	0	0	14	406	0	2692	0	0
1941	1290	1967	507	26	27	559	90	435	0	0	0	553	118	2868	0	0
1942	1450	2000	484	26	27	537	90	467	0	0	0	892	426	3100	0	0
1943	1538	1965	511	26	27	564	90	468	0	0	0	655	188	3090	0	0
1944	649	1567	535	36	27	598	45	295	4	0	0	299	0	2384	0	0
1945	1228	1736	497	34	27	558	90	384	0	0	16	399	0	2657	0	0
1946	1175	1806	501	35	27	563	90	406	0	0	0	406	0	2750	0	0
1947	632	1441	535	33	28	596	28	231	13	35	0	280	0	2236	0	53
1948	853	1409	499	31	29	559	17	189	30	32	0	251	0	2143	0	8
1949	732	1292	544	26	29	600	0	125	34	30	0	189	0	1981	0	20
1950	1027	1435	539	33	29	602	20	203	22	8	0	546	313	2174	0	32
1951	1654	1729	524	31	28	583	90	393	0	0	8	422	20	2695	0	1
1952	1844	2000	518	26	27	571	90	467	0	0	0	975	508	3415	0	0
1953	965	1747	537	35	27	599	90	393	0	0	16	409	0	2695	0	0
1954	882	1598	542	26	27	595	49	308	2	4	0	314	0	2413	0	14
1955	656	1345	538	26	29	593	8	158	17	48	0	223	0	2071	0	12
1956	1825	2000	540	31	28	599	90	467	0	0	0	560	93	3073	0	0
1957	878	1715	534	35	27	596	90	379	0	0	5	384	0	2637	0	0
1958	1599	2000	444	26	27	496	90	467	0	0	0	766	299	3147	0	0
1959	624	1554	542	37	27	606	44	292	4	0	0	296	0	2374	0	4
1960	574	1247	516	31	29	576	0	124	17	79	0	219	0	1950	4	0
1961	446	932	462	26	8	496	0	106	24	73	0	203	0	1560	0	0
1962	863	994	541	31	30	601	0	111	32	24	0	167	0	1668	0	38
1963	1227	1423	495	37	30	561	11	170	37	6	0	213	0	2097	0	142
1964	632	1195	540	31	29	600	0	123	20	57	0	200	0	1934	0	4
1965	1666	1819	521	31	28	580	90	415	0	0	21	436	0	2786	0	0
1966	733	1530	536	36	27	599	41	281	4	2	0	287	0	2350	0	67
1967	1831	2000	506	27	27	560	90	468	0	0	0	784	317	3203	0	0
1968	670	1577	533	36	27	596	49	308	2	0	0	420	110	2413	0	0
1969	2118	2000	524	27	27	577	90	467	0	0	0	1383	917	3474	0	0
1970	1321	1728	537	36	27	599	90	399	0	0	13	440	28	2720	0	0
1971	1064	1681	534	38	27	598	90	373	0	1	12	386	0	2611	0	0
1972	764	1449	537	31	28	596	29	237	9	22	0	268	0	2249	0	53
1973	1237	1681	517	26	27	570	90	363	0	0	11	374	0	2570	0	0
1974	1500	2000	476	31	27	534	90	467	0	0	0	620	153	3026	0	0
1975	1210	1938	502	30	27	558	90	450	0	0	0	497	47	2927	0	2
1976	467	1475	473	33	13	519	24	215	11	54	0	281	0	2201	0	0
1977	271	1057	344	30	8	382	0	107	25	73	0	205	0	1589	1	0
1978	1311	1571	477	26	29	532	30	241	13	0	0	254	0	2258	0	0
1979	1139	1606	539	31	27	597	90	360	0	0	59	592	173	2556	0	5
1980	1721	2000	511	26	27	563	90	467	0	0	0	521	54	3005	0	0
1981	634	1568	532	36	27	596	44	291	5	0	0	560	264	2373	0	0
1982	2229	2000	456	25	27	508	90	467	0	0	0	1804	1337	3419	0	0
1983	2900	2000	437	26	27	490	90	468	0	0	0	2243	1776	3965	0	0
1984	1621	1783	538	33	27	598	90	410	0	0	0	430	20	2765	0	0
1985	744	1528	526	29	27	582	42	282	4	5	0	398	107	2354	0	0
1986	1869	1916	502	26	27	555	90	467	0	0	0	770	303	3149	0	0
1987	497	1477	490	29	13	531	23	212	10	47	0	269	0	2192	0	0
1988	390	1094	425	26	8	459	0	113	32	75	0	220	0	1714	20	0
1989	648	892	546	26	30	601	0	107	23	73	0	203	0	1598	18	0
1990	491	614	489	26	13	527	0	89	44	63	0	197	0	1268	24	3
1991	502	390	478	26	30	533	0	70	36	49	0	156	0	989	2	0
1992	459	170	465	26	13	504	0	53	60	37	0	150	0	747	14	12
1993	1275	729	501	33	30	564	0	96	60	25	0	180	0	1359	0	122
1994	501	458	477	26	30	532	0	78	58	55	0	191	0	1105	7	0
1995	2160	1740	479	26	28	533	90	352	0	0	0	380	28	2525	0	0
1996	1512	1952	530	26	27	583	90	467	0	0	0	1553	1087	3024	0	0
1997	1902	1752	537	36	27	600	90	406	0	0	1	514	107	2749	0	4
1998	1876	2000	472	27	27	525	90	467	0	0	0	1239	772	3374	0	0
1999	1326	1828	523	37	27	586	90	433	0	0	22	489	33	2860	0	0
2000	1062	1802	495	33	27	554	90	391	0	0	0	401	10	2686	0	0
2001	588	1479	490	37	28	555	29	234	8	27	0	269	0	2242	0	20
2002	710	1291	540	31	29	600	3	136	18	77	0	231	0	2023	0	69
2003	896	1302	540		30									2035		

All units in 1,000 acre-feet unless otherwise noted. Instream Fish Release from Goodwin (1) Vernalis WQ Release from Goodwin (1) DO Release from Goodwin (1)

New Melones Operations Model - Annual Summary **Proposed Transitional Plan**

	New Melones		Goodwin														
	New Melones Inflow	New Melones Storage	OID & SSJID Canals	Districts Other	Districts SEWD	Total OID & SSJID	SEWD / CSJWCD NM Water	Instream Fish	Dissolved Oxygen	Vernalis Water Quality	Vernalis Flow Objective	Total Goodwin Release to River	Release above Minimum	NM Forecast Index	Missed Vernalis WQ Release	Missed Vernalis Flow Release	Added Water
Avg	1087		507	30	26	562	116	250	0	15	24	395	107		0	1	
	WY	EOS	WY	M-F	WY		M-F	M-F	M-F	M-F	M-F	M-F	M-F		M-F	M-F	
1922	1389	1858	519	26	29	574	155	318	0	0	0	323	6	2750	0	0	
1923	1109	1813	528	30	27	585	155	318	0	0	49	367	0	2791	0	0	
1924	385	1247	422	26	8	456	155	235	0	26	0	262	0	2012	0	0	
1925	1092	1381	472	31	29	532	155	235	0	2	0	238	0	2197	0	0	
1926	619	934	539	31	29	599	155	235	0	8	20	263	0	1825	0	0	
1927	1256	1087	527	33	29	589	155	236	0	0	103	339	0	2039	0	0	
1928	952	1034	518	36	28	582	155	235	0	4	0	240	0	1902	0	0	
1929	506	737	475	32	29	535	0	174	0	24	0	198	0	1375	0	0	
1930	671	582	540	31	30	601	0	174	0	27	0	201	0	1255	0	0	
1931	438	286	457	26	8	491	0	174	0	32	0	207	0	892	0	0	
1932	1160	532	545	26	30	601	0	174	0	6	131	311	0	1325	0	0	
1933	586	292	535	27	30	591	0	174	0	19	10	203	0	958	0	0	
1934	498	150	493	28	13	533	0	174	0	25	53	252	0	658	0	0	108
1935	1082	361	487	33	30	550	0	174	0	0	89	263	0	1051	0	0	
1936	1291	870	498	26	29	553	49	174	0	0	39	213	0	1557	0	0	
1937	1080	965	520	26	28	574	155	235	0	0	38	274	0	1808	0	0	
1938	2032	1991	510	26	27	563	155	318	0	0	0	332	14	2844	0	0	
1939	562	1468	513	37	27	577	155	236	0	6	7	249	0	2345	0	0	
1940	1327	1692	531	26	27	584	155	318	0	2	43	363	0	2629	0	0	
1941	1290	1918	507	26	27	559	155	318	0	0	0	406	89	2786	0	0	
1942	1450	2000	484	26	27	537	155	318	0	0	0	827	510	3100	0	0	
1943	1538	2000	511	26	27	564	155	318	0	0	0	543	224	3090	0	0	
1944	649	1563	535	36	27	598	155	235	0	1	0	237	0	2431	0	0	
1945	1228	1700	497	34	27	558	155	318	0	0	42	360	0	2656	0	0	
1946	1175	1763	501	35	27	563	155	318	0	0	26	344	0	2724	0	0	
1947	632	1270	535	33	28	596	155	236	0	46	53	334	0	2207	0	0	
1948	853	1064	499	31	29	559	155	235	0	38	9	283	0	1936	0	0	
1949	732	877	544	26	29	600	49	174	0	16	20	210	0	1612	0	0	
1950	1027	1001	539	33	29	602	49	174	0	7	36	217	0	1744	0	0	
1951	1654	1585	524	31	28	583	155	318	0	0	55	374	0	2577	0	1	
1952	1844	2000	518	26	27	571	155	318	0	0	0	778	461	3283	0	0	
1953	965	1742	537	35	27	599	155	318	0	1	20	339	0	2695	0	0	
1954	882	1536	542	26	27	595	155	235	0	30	21	286	0	2419	0	0	
1955	656	1105	538	26	29	593	155	236	0	32	12	280	0	1999	0	0	
1956	1825	1870	540	31	28	599	155	318	0	0	0	318	0	2802	0	0	
1957	878	1601	534	35	27	596	155	318	0	0	19	336	0	2548	0	0	
1958	1599	2000	444	26	27	496	155	318	0	0	0	597	279	3042	0	0	
1959	624	1475	542	37	27	606	155	236	0	10	15	261	0	2374	0	0	
1960	574	995	516	31	29	576	155	235	0	51	0	287	0	1876	0	0	
1961	446	637	462	26	8	496	0	174	0	47	0	221	0	1268	0	0	
1962	863	682	541	31	30	601	0	174	0	1	38	213	0	1367	0	0	
1963	1227	956	495	37	30	561	49	174	0	7	144	326	0	1758	0	0	
1964	632	725	540	31	29	600	0	174	0	29	4	207	0	1456	0	0	
1965	1666	1363	521	31	28	580	155	235	0	0	92	327	0	2314	0	0	
1966	733	1011	536	36	27	599	155	235	0	10	90	336	0	1932	0	0	
1967	1831	1784	506	27	27	560	155	318	0	0	0	318	0	2633	0	0	
1968	670	1363	533	36	27	596	155	235	0	8	12	256	0	2254	0	0	
1969	2118	2000	524	27	27	577	155	318	0	0	0	1221	904	3364	0	0	
1970	1321	1699	537	36	27	599	155	318	0	0	43	391	31	2720	0	0	
1971	1064	1625	534	38	27	598	155	318	0	2	36	356	0	2595	0	0	
1972	764	1241	537	31	28	596	155	235	0	29	53	318	0	2199	0	0	
1973	1237	1447	517	26	27	570	155	235	0	0	64	300	0	2349	0	0	
1974	1500	1927	476	31	27	534	155	318	0	0	0	350	33	2818	0	0	
1975	1210	1956	502	30	27	558	155	318	0	0	21	393	54	2927	0	2	
1976	467	1392	473	33	13	519	155	235	0	59	0	294	0	2240	0	0	
1977	271	945	344	30	8	382	0	174	0	49	0	223	0	1484	0	0	
1978	1311	1362	477	26	29	532	155	235	0	0	0	235	0	2139	0	0	
1979	1139	1404	539	31	27	597	155	236	0	0	77	313	0	2335	0	5	
1980	1721	2000	511	26	27	563	155	318	0	0	0	444	126	3002	0	0	
1981	634	1514	532	36	27	596	155	235	0	4	5	458	214	2381	0	0	
1982	2229	2000	456	25	27	508	155	318	0	0	0	1739	1421	3419	0	0	
1983	2900	2000	437	26	27	490	155	318	0	0	0	2178	1860	3965	0	0	
1984	1621	1764	538	33	27	598	155	318	0	0	29	370	23	2765	0	0	
1985	744	1450	526	29	27	582	155	235	0	14	1	277	27	2349	0	0	
1986	1869	1970	502	26	27	555	155	318	0	5	0	633	310	3149	0	0	
1987	497	1428	490	29	13	531	155	236	0	47	0	283	0	2267	0	0	
1988	390	979	425	26	8	459	49	174	0	79	0	253	0	1643	0	0	
1989	648	744	546	26	30	601	0	174	0	55	0	229	0	1447	0	0	
1990	491	431	489	26	13	527	0	174	0	71	3	248	0	1097	0	0	
1991	502	153	478	26	30	533	0	174	0	33	0	207	0	772	0	0	
1992	459	150	465	26	13	504	0	174	0	46	8	227	0	488	0	0	271
1993	1275	589	501	33	30	564	0	174	0	24	83	282	0	1315	0	34	
1994	501	289	477	26	30	532	0	174	0	63	0	237	0	957	0	0	
1995	2160	1583	479	26	28	533	155	236	0	0	0	236	0	2339	0	0	
1996	1512	2000	530	26	27	583	155	318	0	0	0	1383	1065	2919	0	0	
1997	1902	1737	537	36	27	600	155	318	0	0	21	446	107	2749	0	4	
1998	1876	2000	472	27	27	525	155	318	0	0	0	1177	859	3374	0	0	
1999	1326	1796	523	37	27	586	155	318	0	0	81	437	37	2860	0	0	
2000	1062	1795	495	33	27	554	155	318	0	1	1	319	0	2673	0	0	
2001	588	1368	490	37	28	555	155	235	0	34	20	290	0	2246	0	0	
2002	710	929	540	31	29	600	155	235	0	52	69	357	0	1881	0	0	
2003	896	828	540		30									1622			

All units in 1,000 acre-feet unless otherwise noted. Instream Fish Release from Goodwin (1) Vernalis WQ Release from Goodwin (1)