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Managing Water in the West

Suggested Approaches to the Use of Analytical Tools for Evaluating Water Supply, Hydrodynamic & Hydropower Effects—SWRCB Workshop #3

U.S. Department of the Interior
Bureau of Reclamation

November 13 & 14, 2012

Analytical Tools

- **WATER SUPPLY EFFECTS: CalSim II, Calite**
- **HYDRODYNAMIC EFFECTS: DSM2, RMA, Temperature Models**
- **HYDROPOWER EFFECTS: PLEXOS & other Optimal Power Flow (OPF) Production Cost Models**

Temperature Models

- Development of Central Valley Temperature Models authorized & partially funded: CVPIA, Section 3406(g)(2)
- Sacramento, Trinity, Feather, American, Stanislaus and San Joaquin Rivers
- OBJECTIVES:
  - To improve temperature prediction versus reservoir storage
  - To support reservoir operations to restore fisheries in the Central Valley and comply with biological opinion RPAs
  - To analyze the effects of operational scenarios on temperature and thereby to maximize beneficial water uses
- EFFECTIVE COLLABORATION:
  - Resource Agencies: Reclamation, DWR
  - Regulatory Agencies: SWRCB, USFWS, NMFS, CDFG
  - Local Districts: OID, SSJID, SEWD

2008 OCAP Graphic of Temperature Models

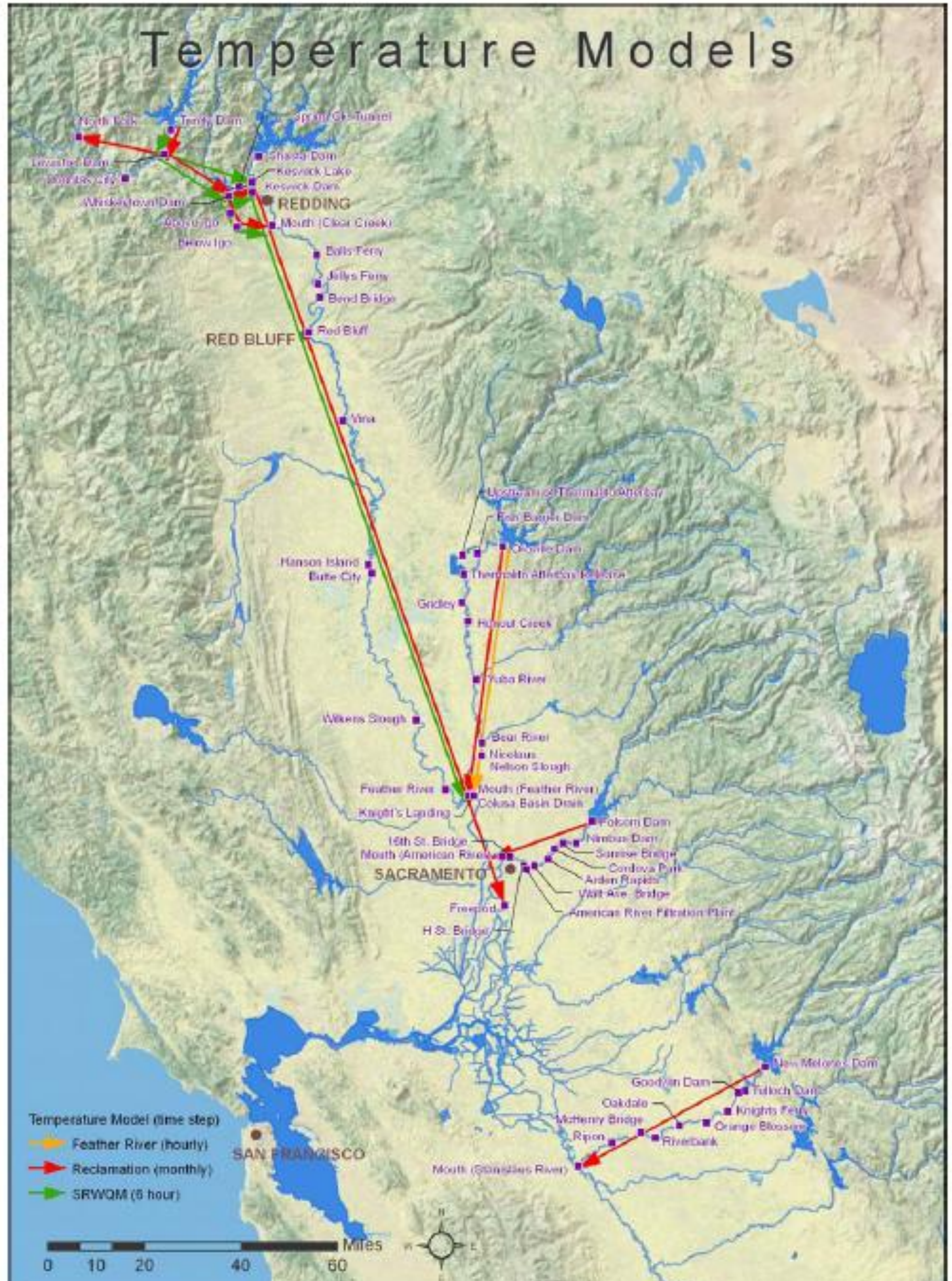

Figure 9-5 General spatial representation of the temperature model networks.

Temperature Models

- **Current Tools:**
  - Based on HEC-5Q modeling system that use hydrological, meteorological, and operational conditions by using HEC5 and HEC5Q model codes with daily time-steps for flows and 6-hourly time-steps for water temperatures
  - CE-QUAL-W2 models
  - Monthly outputs from Calsim II are processed to provide daily input data for the temperature models--processors work through Data Storage System (DSS) files;
- **Future Tools:**
  - Development of multi-dimensional hydrodynamic model with recent bathymetry-- NMFS, USACE and EPA
  - Integrate water temperature simulation algorithm within a water operation model (e.g. CalSim II) and optimize the model with water temperature as the target variable

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SJR: Water Quality Modeling

- Initiated in 1999 on Stanislaus River to analyze the relationship among the following parameters:
  - Reservoir operations
  - Water temperature regimes
  - Fish survival (Fall-run Chinook Salmon and Steelhead Rainbow Trout)
- Extended to Tuolumne and Merced tributaries
  - Funded through CALFED Bay-Delta Program
  - Extending to SJR Basin below Stevinson
- Extended to entire San Joaquin Basin (incl. Bypass)
  - To model thermal impacts of SJR restoration alternatives &
  - CVP/SWP components (canals and storage facilities between the Delta and Mendota Pool)
  - EC modeling also included

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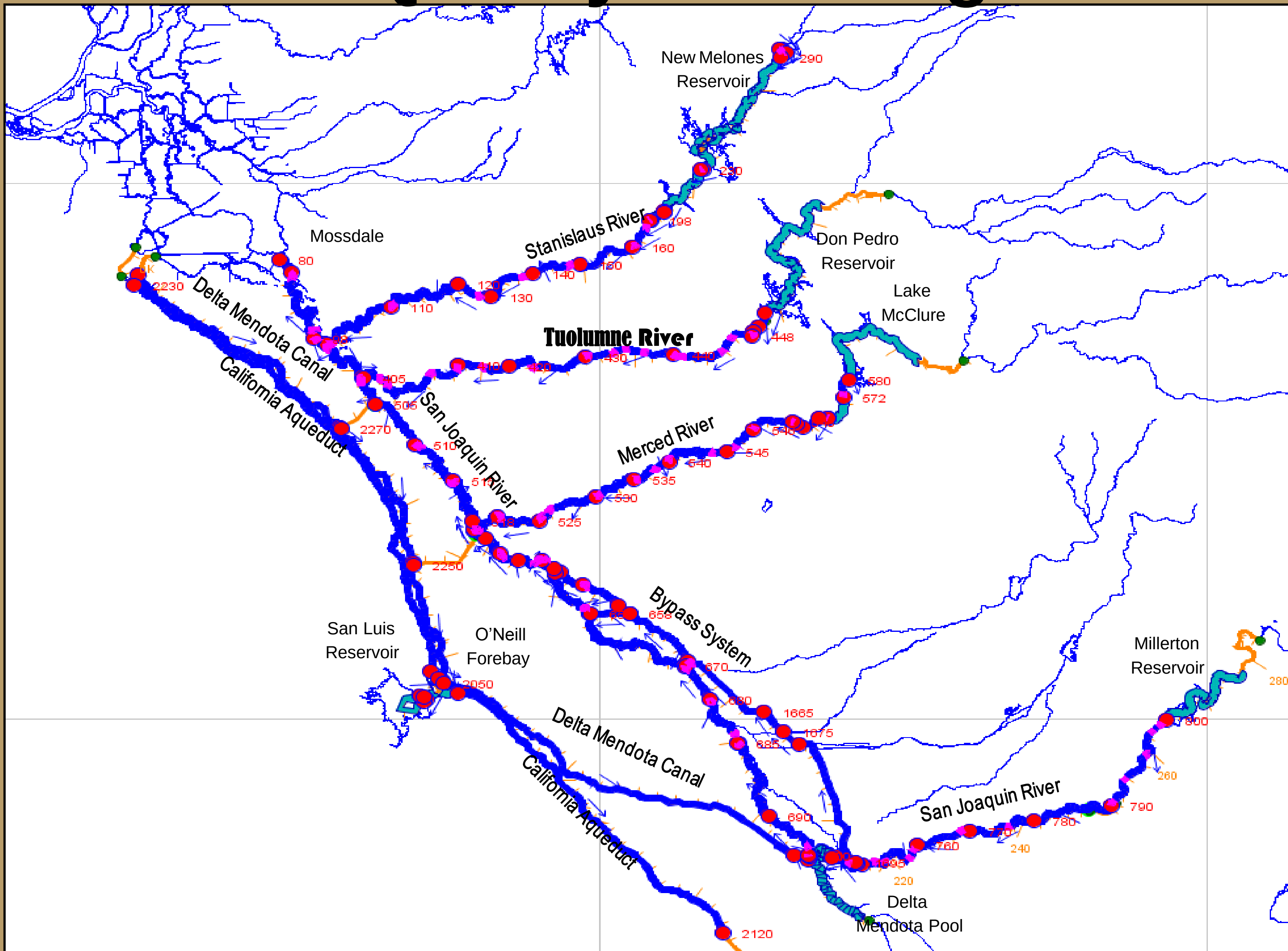
SJR: Water Quality Modeling



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Modeling Effects of SWRCB Alternative Standards

- **CalSim II is powerful Planning Tool, but does not paint complete picture**
  - **Models current operations, water rights, contracts, etc.**
  - **Monthly time step & use of perfect foresight in San Joaquin Basin → issues re: evaluation of operational implementation**
  - **Temperature analysis is currently not integrated**
  - **Hydro generation is estimated through post processing**
- **PLEXOS**
  - **Hourly dispatch of all generation in Western Interconnection respecting transmission constraints; model under contract to Reclamation is focused on CAISO market.**
  - **Used to estimate value of hydro generation**
    - **On-peak, Off-peak generation**
    - **Ancillary Services**
    - **Capacity through post processing**

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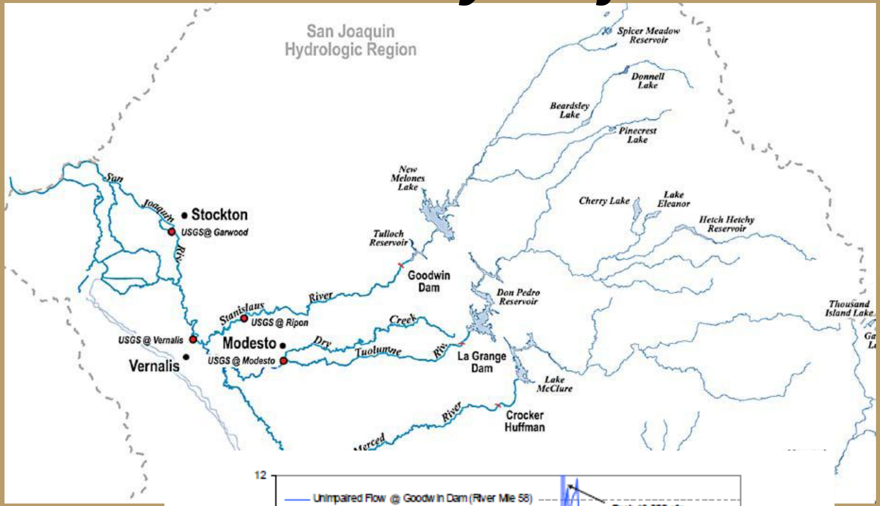
CASE STUDY: Modeling Alternative SJR Flow Objective

SWRCB's Oct 2011 *Technical Report on Scientific Basis for Alternative SJR Flow & So. Delta Salinity Objectives*

- Salmon doubling narrative goal (1967-91 population)
- Flow augmentation to mimic the shape of the unimpaired hydrograph
- Tributary compliance points
- Feb-June release X% (e.g. 20-60%) unimpaired inflow
- Vernalis base flow pro-portionately from tributaries
- Adaptive Management



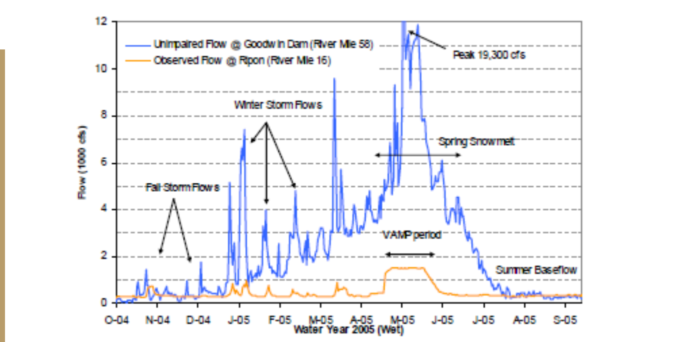


Figure 2.1. Typical Stanislaus River Annual Hydrograph of Daily Average Unimpaired and Observed Flows during a Wet Water Year (2005) Illustrating Important Hydrograph Components

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CASE STUDY

- **Comparison of New Melones Operations under D-1641/VAMP, 20%, 40%, 60% bypass of unimpaired inflow standard**
- **CALSIM II D-1641/VAMP ASSUMPTIONS:**
  - **Future Level of Development (2020)**
  - **VAMP releases according to SJR Agreement**
  - **D-1641 base flow (capped in drier years) and Vernalis salinity standards met with releases from New Melones**
  - **OID/SSJID Senior Water Rights modeled per 1988 Stipulation Agreement**
  - **CVP contract = 155 TAF maximum**
  - **DO standards on Stanislaus June-Sept**
  - **RPA releases; no 1500 cfs capacity constraint**
  - **Full San Joaquin River Restoration Program releases**

Modeling Alternative SJR Flow Objective

Modeling Assumptions/Changes from D-1641/VAMP:

Differences from D-1641/VAMP Assumptions

- SWRCB 20%, 40%, and 60% of unimpaired flow standards implemented at mouths of tributaries
- No releases for VAMP or for D-1641 base flows or fall flows

Modeling Changes

- Current Calsim II methodology cannot be used for 40% and 60% bypass standards→ changes to methodology presented in following slides

Modeling Proposed SJR Flow Objective

- **Alternate delivery allocation used**
  - **To enable meeting 40% and 60% standards**
  - **In March, model computes available water supply based on Mar-Sept inflows (perfect foresight), releases necessary to meet flow standards, and useable storage in New Melones**
  - **All project obligations impacted at higher standards**
  - **Minimum New Melones storage was 80 taf in all scenarios, except 60% run, which was 150 taf. This was necessary to maintain release capacity**
- **All results are preliminary**

Modeling Proposed SJR Flow Objective

Useable storage in New Melones:

- **Determined by taking the difference between end of Feb storage and an end of Sept storage target. If storage target is higher then Feb storage, then useable storage is 0.**
- **End of Sept storage target is set by multiplying storage in previous Sept by a proportion which is related to Mar-Sept inflow. So storage is used more aggressively in years with less inflow.**

40% run

Mar-Sept inflow (taf)	Proportion
200-700	0.3–1.1
700-1000	1.2-1.4
1000-2000	1.4

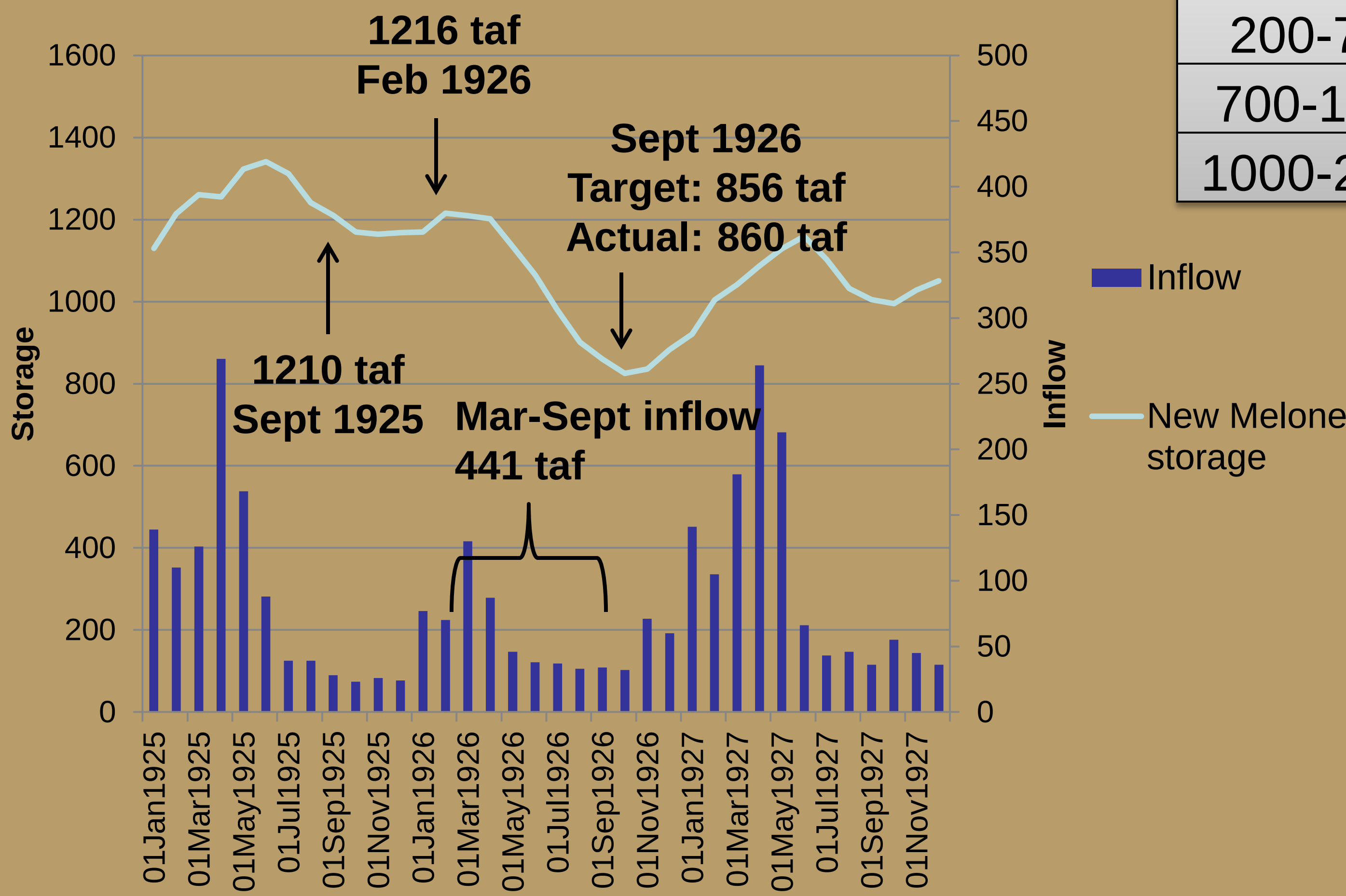
60% run

Mar-Sept inflow (taf)	Proportion
200-700	0.2-0.5
700-1000	0.8-1.4
1000-2000	1.4

Modeling Proposed SJR Flow Objective

Storage Target Example for 1926:

Mar-Sept inflow (taf)	Proportion
200-700	0.3–1.1
700-1000	1.2-1.4
1000-2000	1.4



<u>Proportion</u> 0.69

<u>Storage target calculation</u>
1210 – 80 = 1130
1130*0.69 = 776
776 + 80 = 856 taf

<u>Useable storage</u>
1216 – 856 = 360 taf

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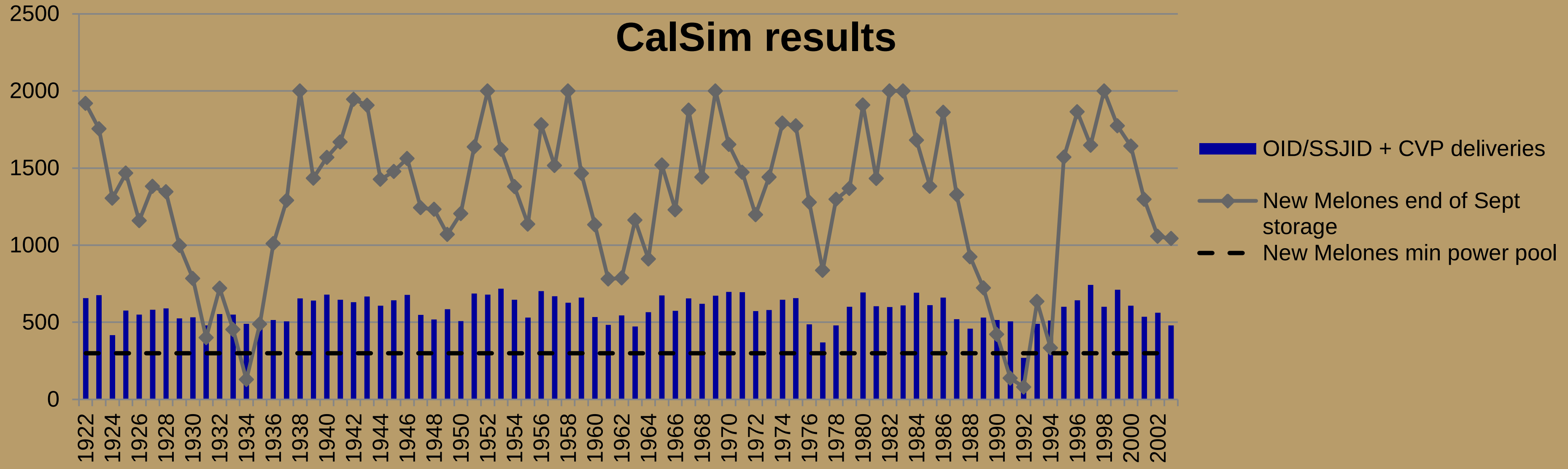
D-1641/VAMP Study



Average of all years Water Deliveries = 585 TAF

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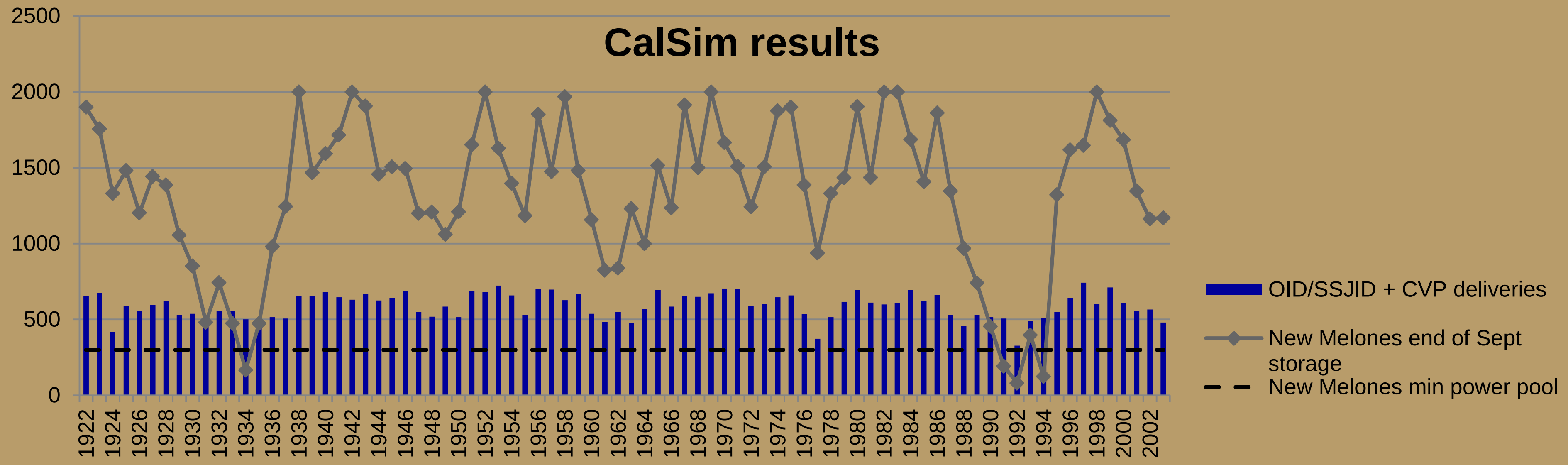
Bypass of 20% Unimpaired Inflow



Average of all years Water Deliveries = 591 TAF

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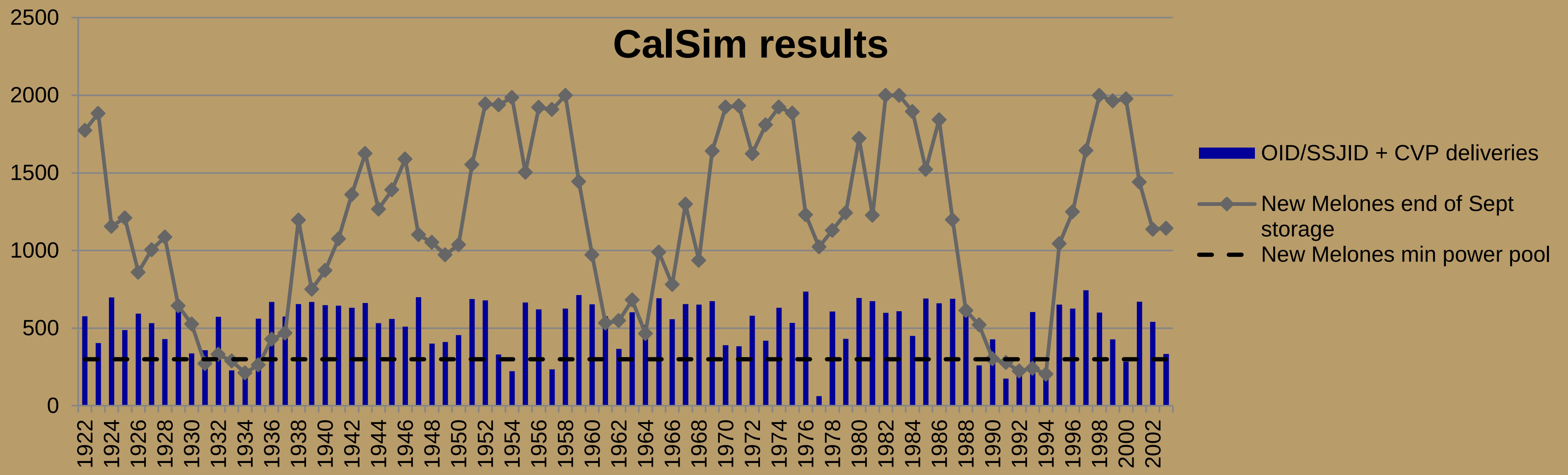
Bypass of 40% Unimpaired Inflow



Average of all years Water Deliveries = 529 TAF

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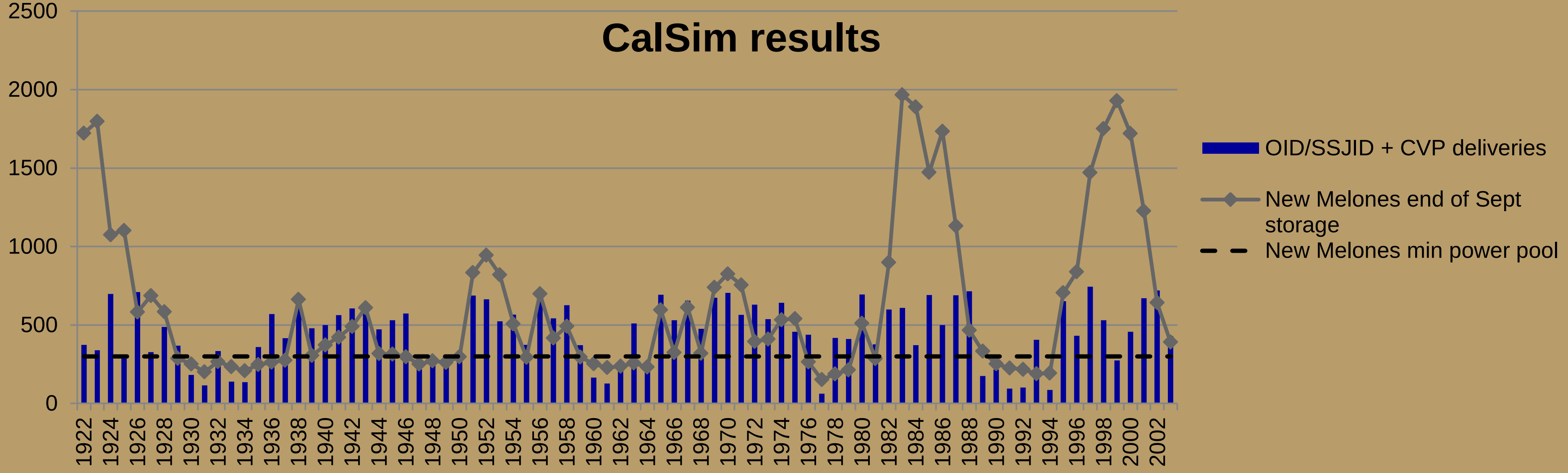
Bypass of 60% Unimpaired Inflow



Average of all years Water Deliveries = 456 TAF

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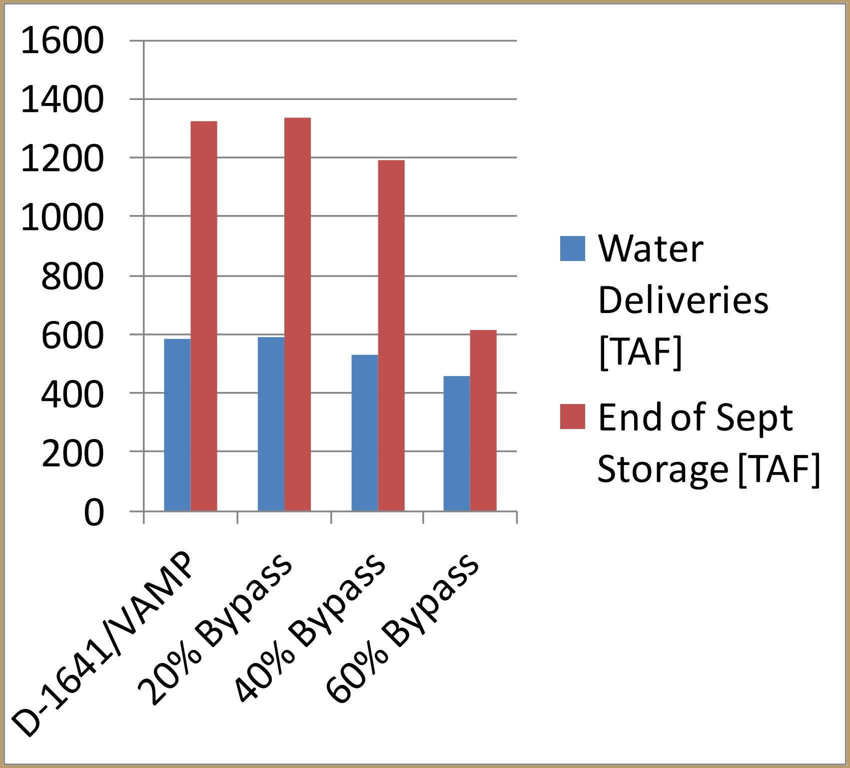
Implications of Modeling Results

Comparison of CALSIM Modeling Results:



Impact of 60% Unimpaired Inflow Standard:

- ~25% reduction in total water deliveries
- >50% reduction in Oct 1 storage likely resulting in significant power, recreation & temperature impacts
- Operational uncertainty
- Modeling to lessen storage impact→ increased water supply impact

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Encourage SWRCB to use Suite of Tools to set new Standards

- **TOOLS THAT ASSESS ALL EFFECTS WILL HOPEFULLY RESULT IN STANDARDS THAT:**
  - **Allow for sustainable operation of reservoirs like New Melones**
  - **Balance beneficial use of environmental flows with beneficial use of water supply, power, temperature needs for fishery resources, recreation, etc.**
  - **Require flows commensurate with impacts**
- **OPERATIONAL CONSIDERATIONS ARE NECESSARY TO CREATE IMPLEMENTABLE STANDARD**

OPERATIONAL CONSIDERATIONS: CENTRAL VALLEY RESERVOIR MANAGEMENT

Multiple purposes and beneficial uses

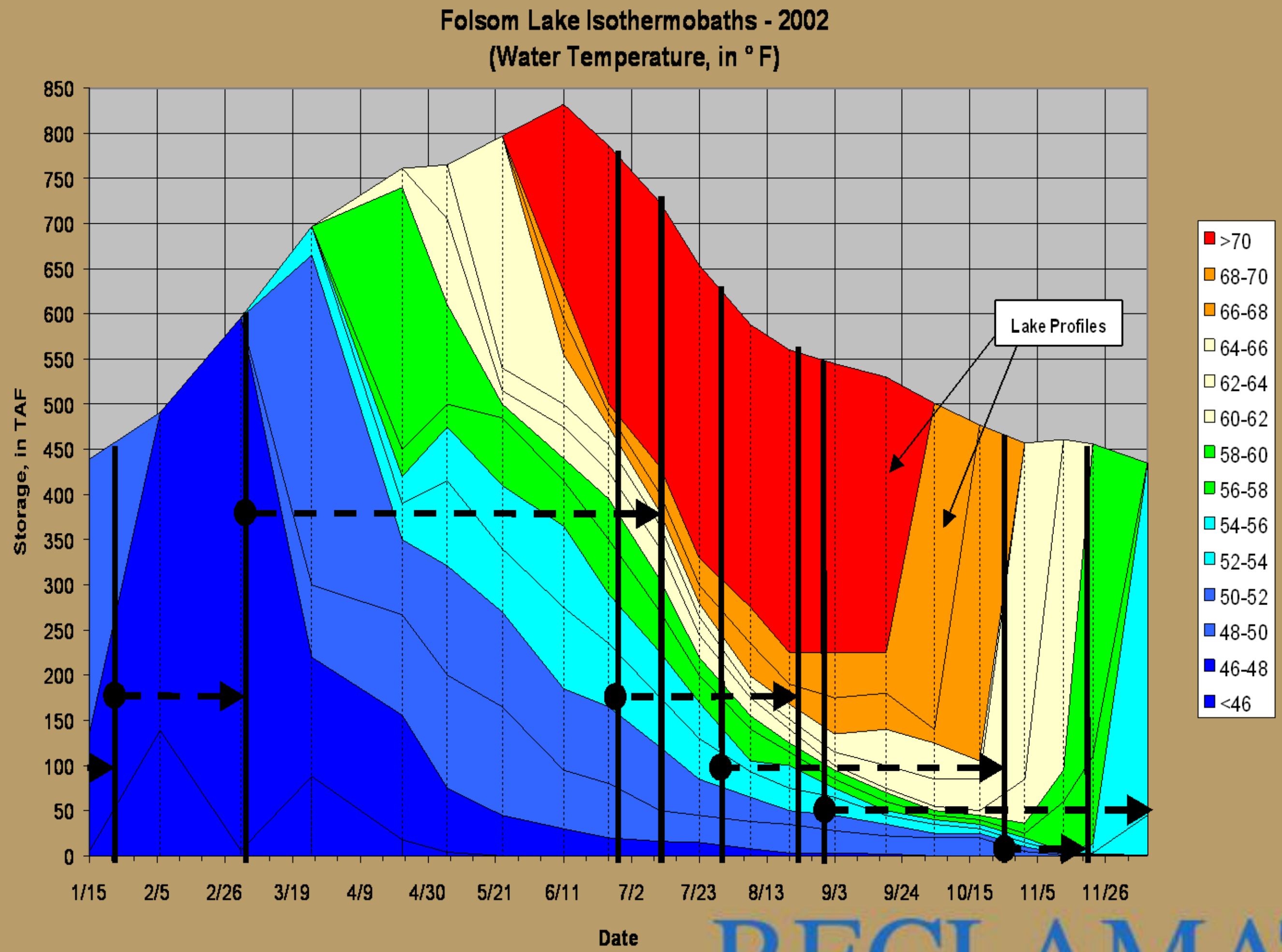
A unit of water serves multiple purposes

There will always be competing goals and objectives

Plan objectives should attempt to create situations where an acre-foot of water can meet as many purposes and goals as possible

CENTRAL VALLEY RESERVOIR MANAGEMENT

Cold Water Pool Management Example



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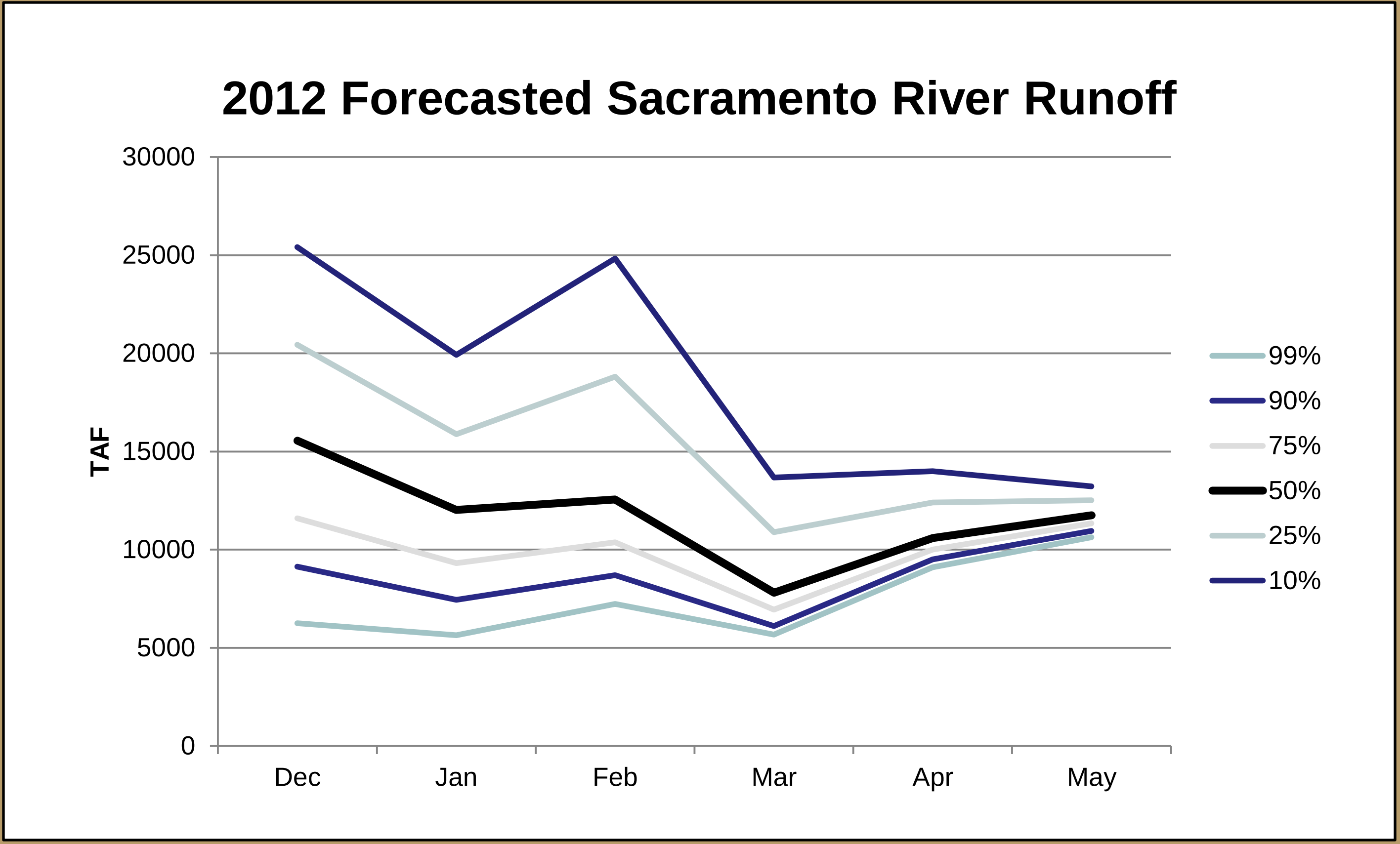
CENTRAL VALLEY RESERVOIR MANAGEMENT



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"Real Time" Reservoir Management

Seasonal planning and real time operations

Operation by reacting to current and changing conditions

Use and availability of real time data

Forecasting and use of forecasts

Scheduling considerations/Response time

When operating in a complex, unpredictable natural environment; experience is essential

Model Use in Reservoir Operations

Reservoir system model limitations

- Built in Institutional Constraints
- Forecasting Realities
- Time Step and Scale
- Use of past Hydrologic Data

Valuable to compare scenarios and to evaluate risk, but
Cannot predict outcomes or direct operations

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