# Drought –It is not just Hydrology

Impacts of Changing Delta Regulatory Requirements on CVP and SWP Delivery Capability

> Sushil Arora, Ph.D., P.E. April 22, 2013

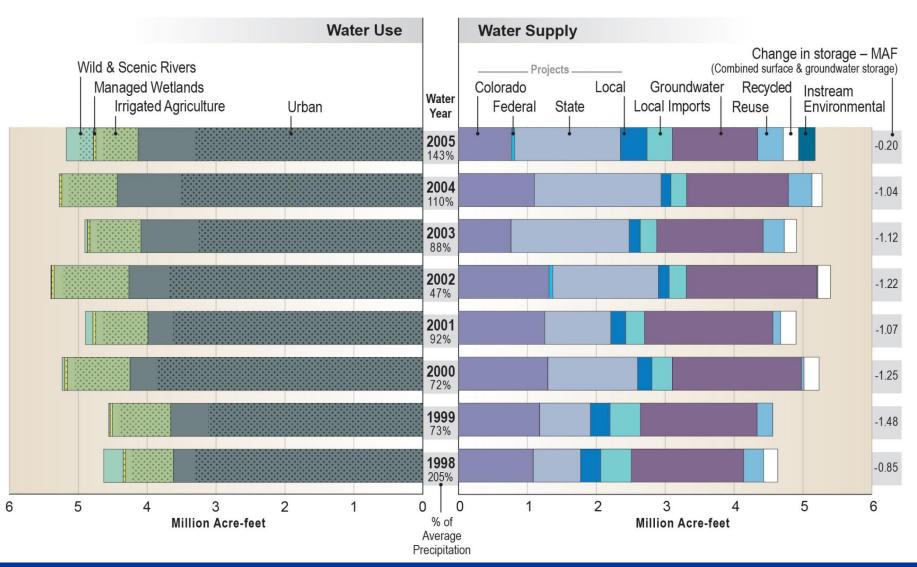


Drought? Central Valley Hydrology CVP-SWP Water Resources System Delta Regulatory Requirements Modeling Results

### **Drought?**

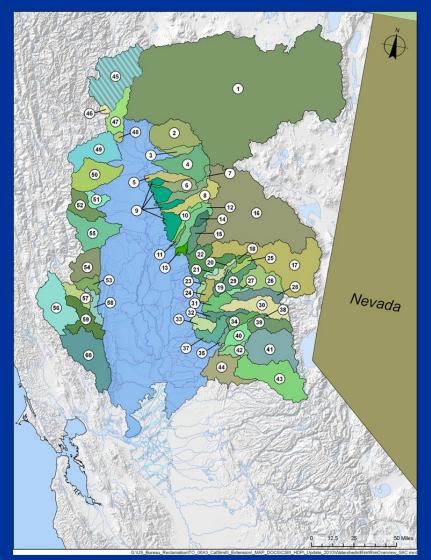
- Hydrologic Drought : Precipitation and Runoff less than Average
- Drought For Water Users : Shortage in water supply to meet demands
  - Annual Rainfall/Runoff
  - Surface and Groundwater Storage; Conveyance
  - Water Rights priorities
  - Regulatory Requirements
  - Water Supply Portfolio

### Water Use and Supply Balances for Calif. South Coastal Region

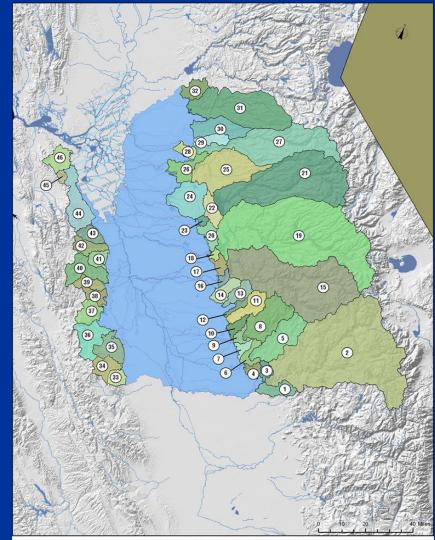


### **Rim watershed**

#### Sacramento River Rim Watershed



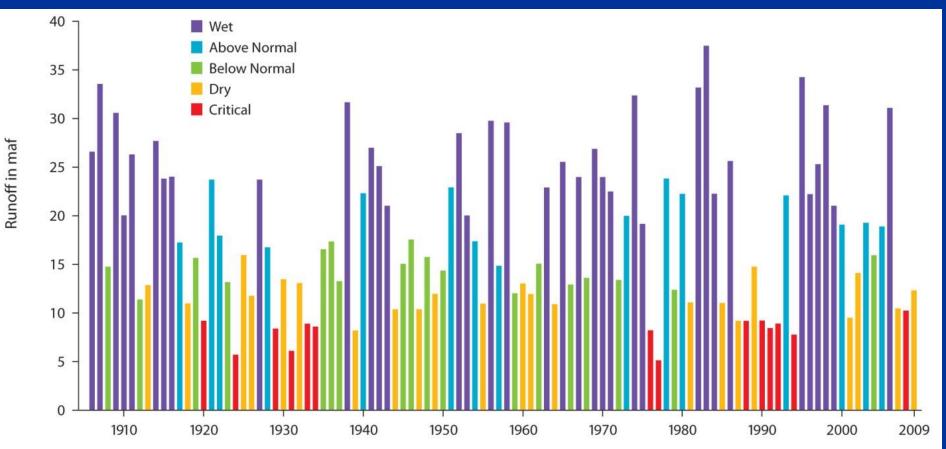
#### San Joaquin River Rim Watershed



G:IUS\_Bureau\_Rectamation\TO\_06A3\_CalSimIII\_Extension\\_MAP\_DOCS\CSIII\_HDP\Watersheds\_2008\RimOverview\_

### Natural Hydrology Variations

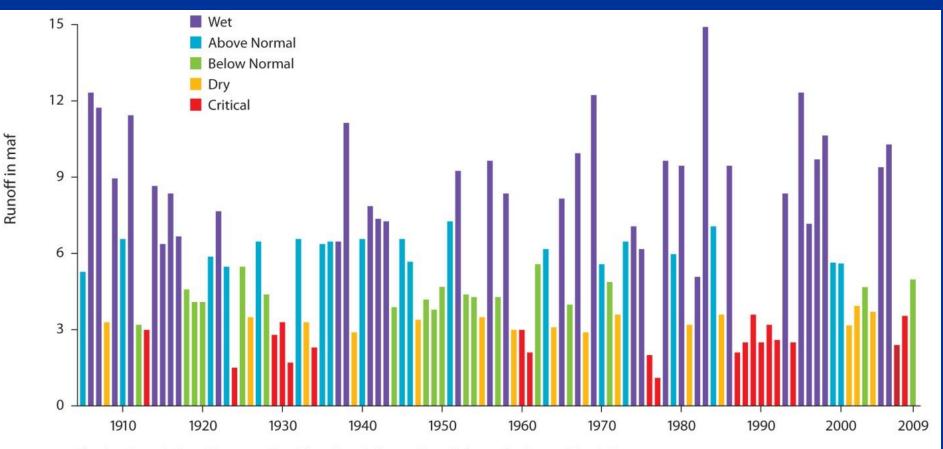
### Sacramento River



The Sacramento Four Rivers are: Sacramento River above Bend Bridge, near Red Bluff; Feather River inflow to Oroville; Yuba River at Smartville; American River inflow to Folsom

### **Natural Hydrology Variations**

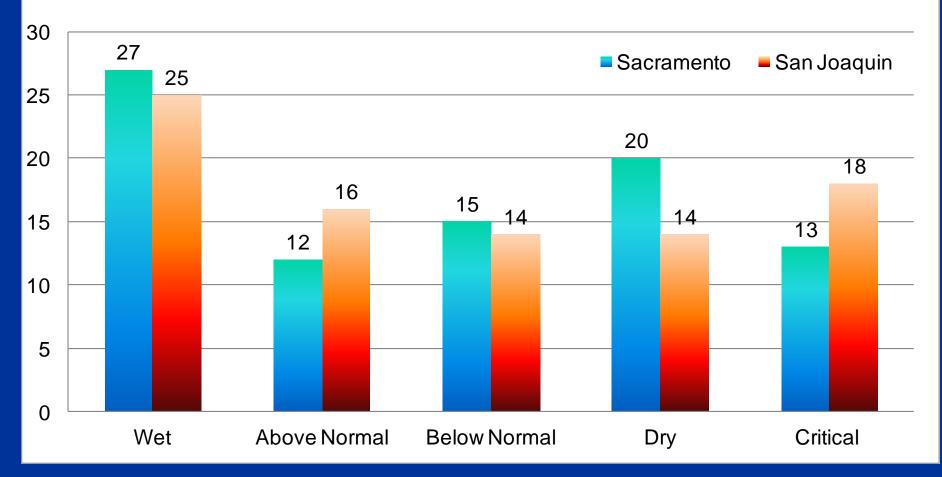
### San Joaquin River



The San Joaquin Four Rivers are: Stanislaus River inflow to New Melones, Tuolumne River inflow to New Don Pedro, Merced River inflow to New Exchequer, San Joaquin River inflow to Millerton

### Water Year Type Frequency

Histogram of Water Year Type WY 1922-2009



### Regulatory Requirements – Sacramento Basin

Sacramento River Minimum Flow below Keswick Dam (NMFS BO)

Clear Creek Minimum Flow below Whiskeytown Dam (NMFS BO) Sacramento Region Instream Flow Requirements

Feather River Minimum Flow below Thermalito Afterbay (DWR,DFG Agreement)

Feather River Minimum Flow below Thermalito Diversion Dam (2006 Settlement Agreement)

> Yuba River Minimum Flow below Daguerre Point Dam (SWRCB D-1644)

Navigation Control Point Flow Sacramento River at Wilkins Slough (NMFS BO)

Feather River Minimum Flow at Mouth (Verona)

American River Minimum Flow below Nimbus Dam (NMFS BO)

American River Minimum Flow at H Street Bridge (SWRCB D-893)

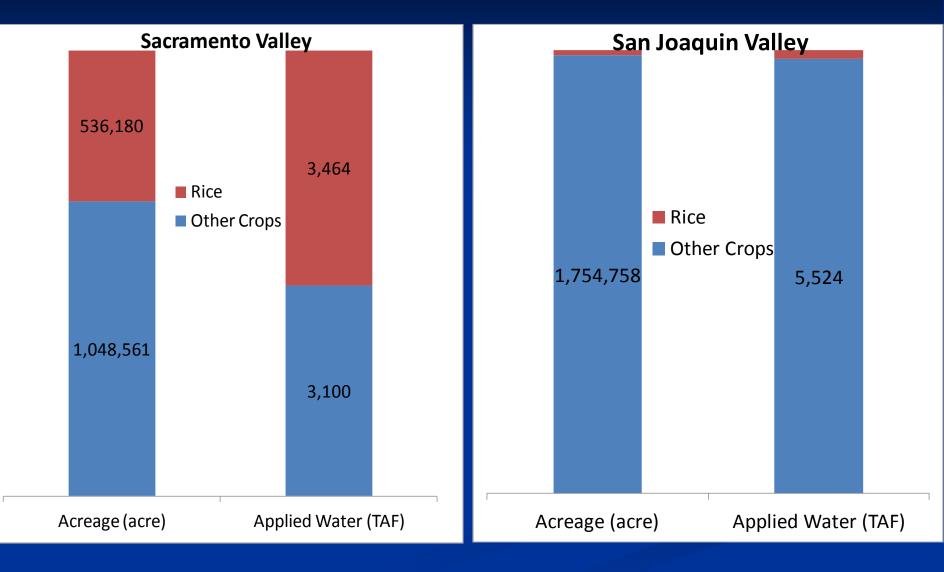
# Regulatory Requirements – San Joaquin Basin



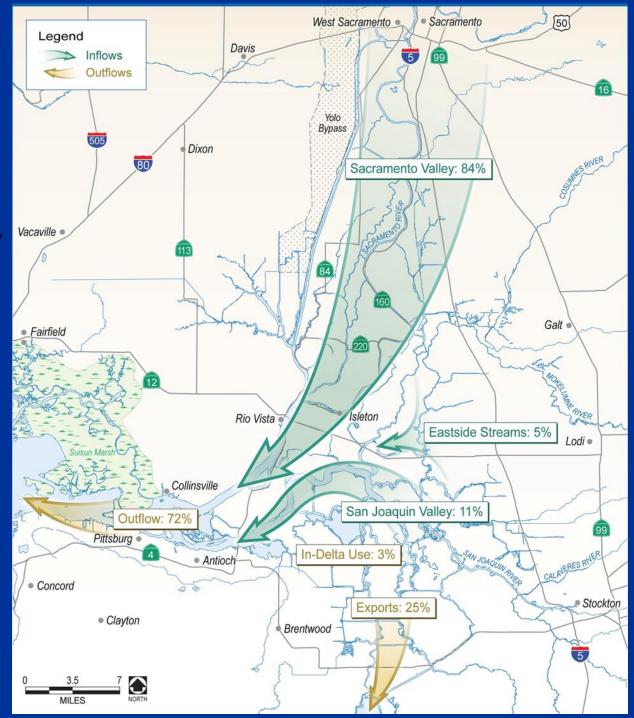
San Joaquin River below Friant Dam (NMFS BO)



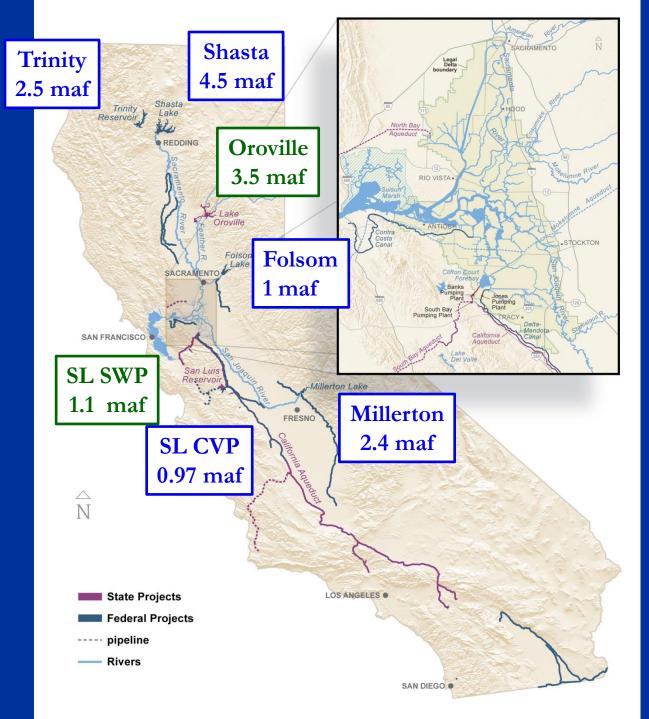
### Ag. Water Demands



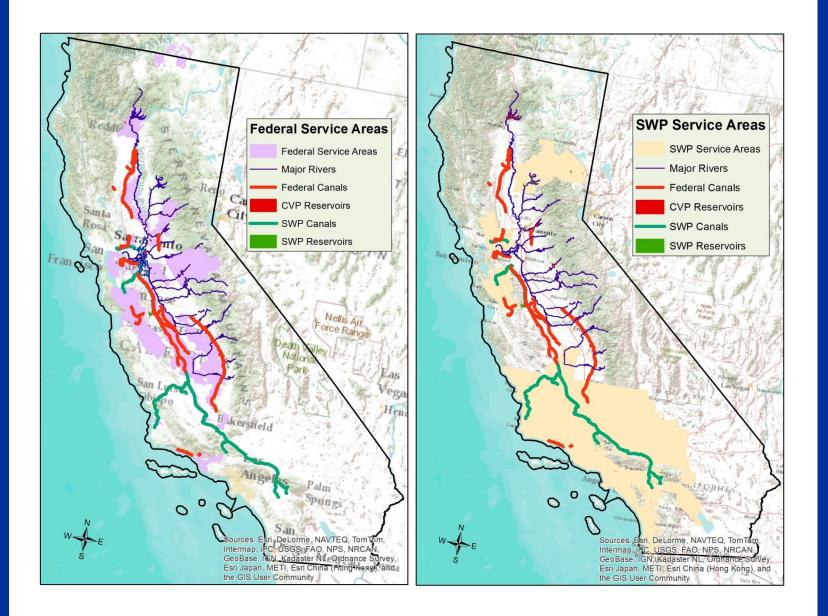
WY 2000 (AN) Delta Water Balance



CVP -SWP Water Resources System



### **CVP** and **SWP** service areas





## SWP and CVP Water Demands (Contracts)

SWP Demands (TAF/yr)	Table A - Ag	Table A - M&I	Non-SWP/WR Demand	Total
NOD Demands	-	37	1081	1118
SOD Demands	1017	3113	32	4162

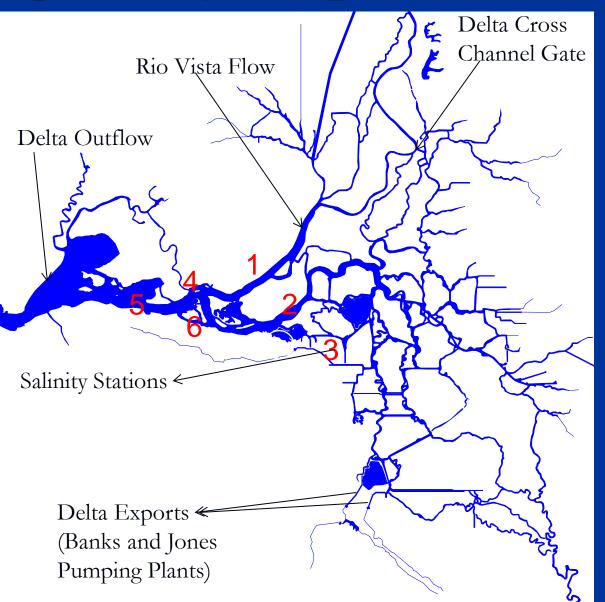
CVP Demands (TAF/yr)	Agriculture	Municipal & Industrial	Exchange or Settlement	Refuge	Total
NOD Demands	480	541	2195	207	3423
SOD Demands	1963	148	875	305	3290

### Delta Regulatory Requirements

Key Delta Regulation Points

#### Salinity Standards

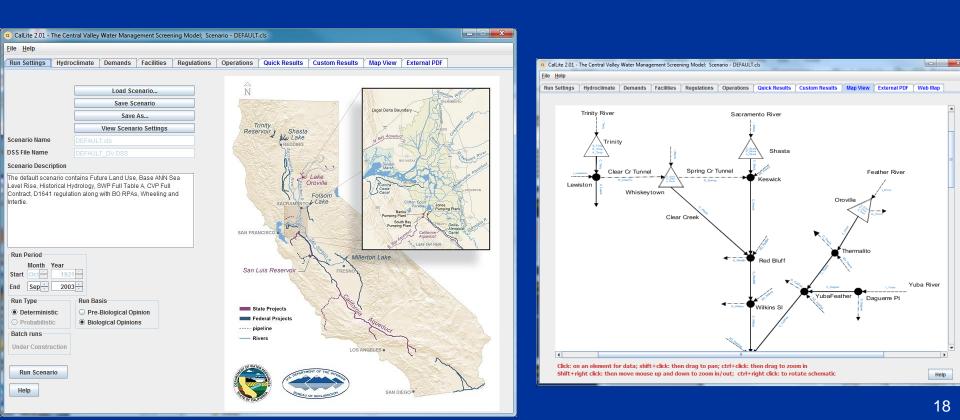
- 1. Emmaton
- 2. Jersey Point
- 3. Contra Costa PP#1
- 4. Collinsville
- 5. Chipps Island\*
- 6. Antioch\*
- \*only used in D1485 studies



### Delta Regulatory Requirements

Regulation Category	Decision 1485 (D1485)	Decision 1641 and CVPIA (b)(2) (D1641)	D 1641 with recent B0s RPAs
Chronology	August 1978	March 15, 2000	December, 2008
Rio Vista Min Flow	- Minimum flow at Rio Vista (flow varies by month)	- Minimum flow at Rio Vista (flow varies by month)	-D1641 standard
Delta Cross Channel	- # of gate days open or closed defined	- Revised Days open or closed defined	<ul><li>D1641 standard</li><li>Additional gate closure</li></ul>
Salinity Standard	- Standard for 6 Stations (M&I, Ag, and Fish)	<ul><li>Standard for 4 Stations (M&amp;I, Ag, and Fish)</li><li>San Joaquin River Salinity</li></ul>	- D1641 standard
Export Constraints	- Pumping restriction May-June	- Export Inflow Ratio (35% from Feb – Jun and 65% from Jul-Jan)	<ul> <li>D1641 standard</li> <li>Old and Middle river flow standard</li> <li>Export cap based on Vernalis flow</li> </ul>
Delta Outflow	- Minimum Delta outflow (standard varies by month)	<ul> <li>Revised Minimum Delta Outflow</li> <li>X2 requirements (Spring)</li> </ul>	<ul><li>D1641 standard</li><li>Fall X2 requirements</li></ul>

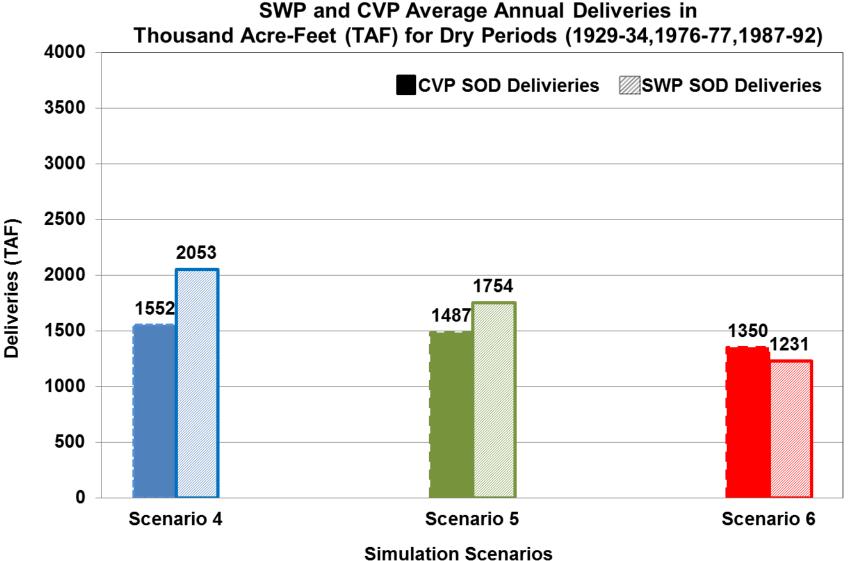
Description of CalLite Model
Central Valley Water Management Screening Model
Simulation Period is 82 years (1922-2003)
Flexible Graphical user interface



### **Model Studies Scenarios**

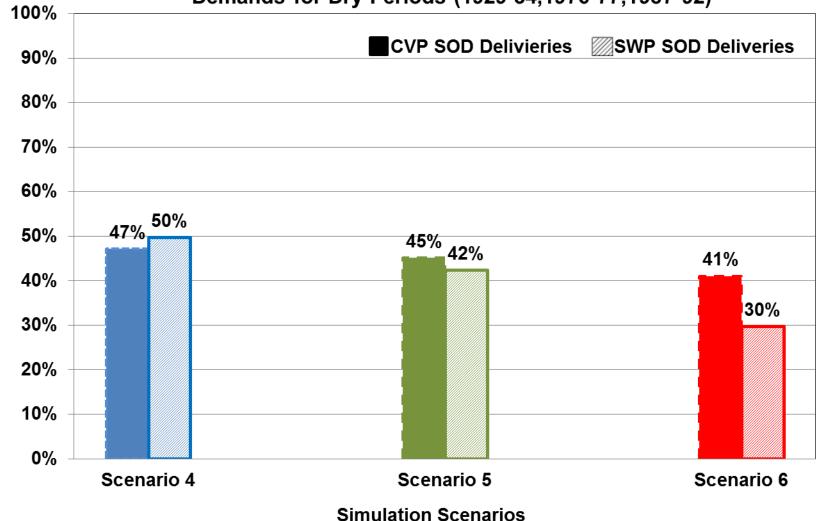
Scenario	D1485	D1641	BO RPAs	Hydrology (Level of Development)	Demand (Current or Full)
1	Х	-	-	Existing	SWP – Current CVP- Full Contract
2	-	Х	-	Existing	SWP – Current CVP- Full Contract
3	-	Х	Х	Existing	SWP – Current CVP- Full Contract
4	Х	-	-	Future	SWP – Full Table A CVP- Full Contract
5	-	Х	-	Future	SWP – Full Table A CVP- Full Contract
6	-	Х	Х	Future	SWP – Full Table A CVP- Full Contract

### **SWP and CVP Dry Period Deliveries – Future LOD** Dry Periods: (1929-34,76-77,87-92)



### SWP and CVP Dry Period Percent Deliveries– Future LOD (1929-34,76-77,87-92)

SWP and CVP Average Annual Deliveries as percentage of Maximum Demands for Dry Periods (1929-34,1976-77,1987-92)

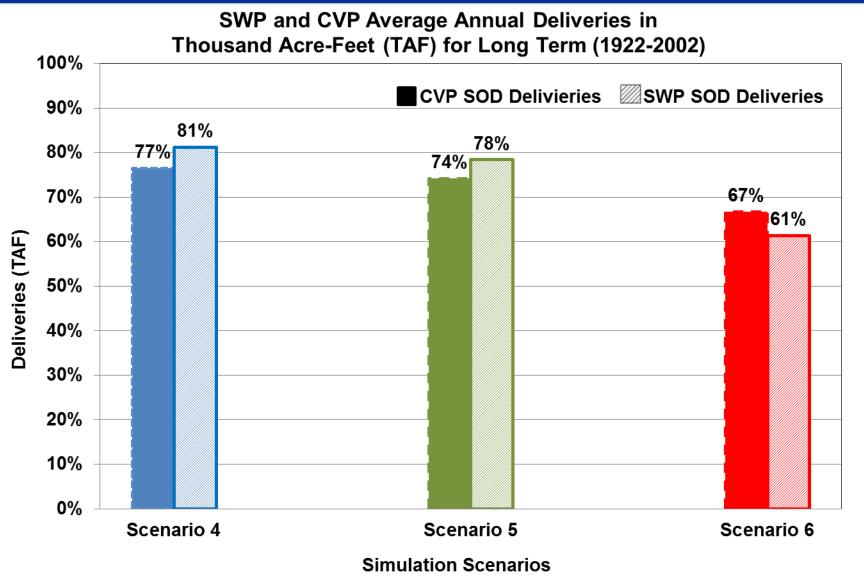


Deliveries (TAF)

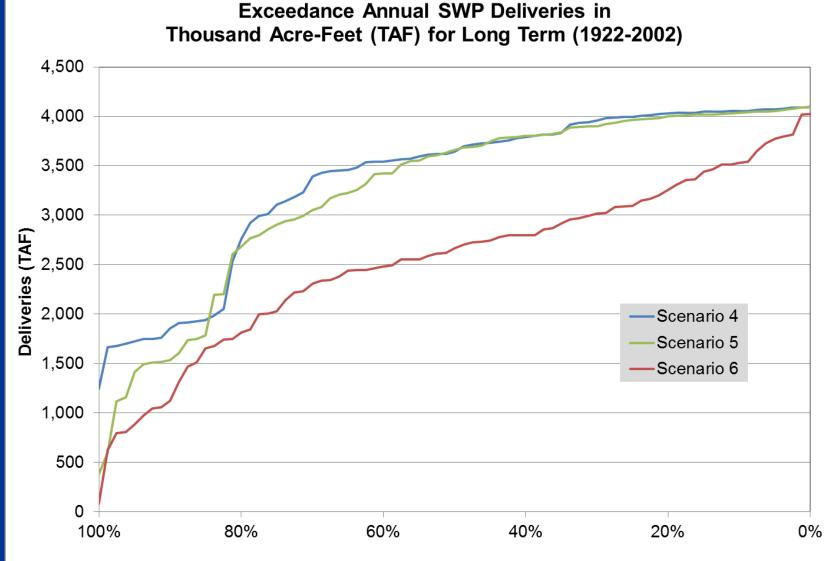
### SWP and CVP Long Term Deliveries – Future LOD

SWP and CVP Average Annual Deliveries in Thousand Acre-Feet (TAF) for Long Term (1922-2002) CVP SOD Delivieries SWP SOD Deliveries Deliveries (TAF) Scenario 4 Scenario 5 Scenario 6 Simulation Scenarios

### SWP and CVP Long Term Percent Deliveries – Future LOD

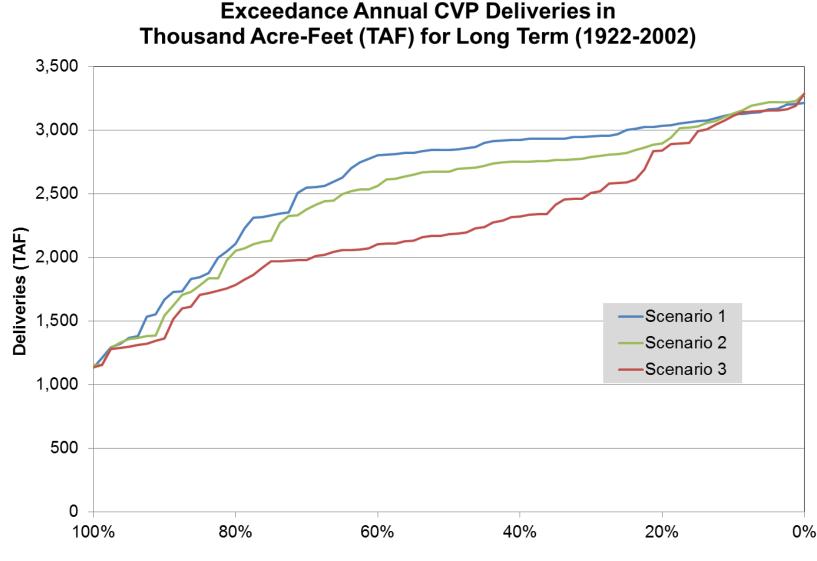


### SWP Long Term Deliveries – Future LOD



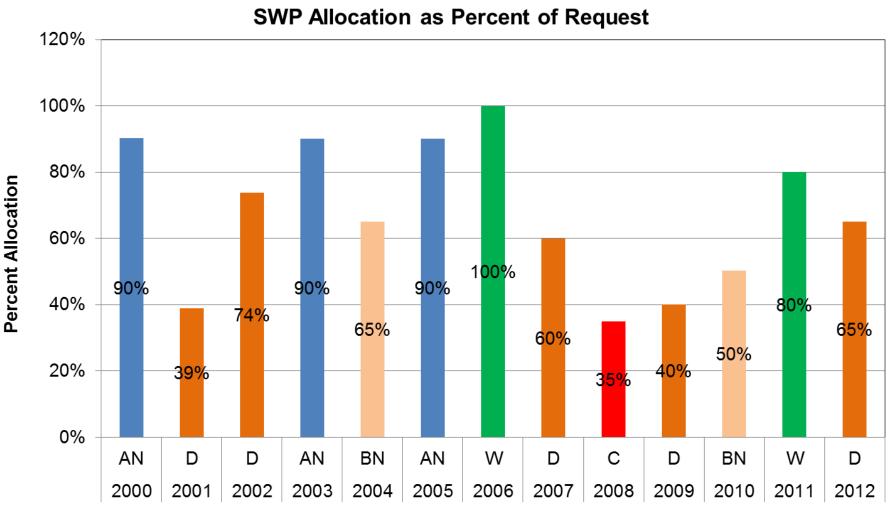
Percent at or above

### CVP Long Term Deliveries – Future LOD



Percent at or above

### Historical SWP Annual Allocations Percent of Request for 2000-2012

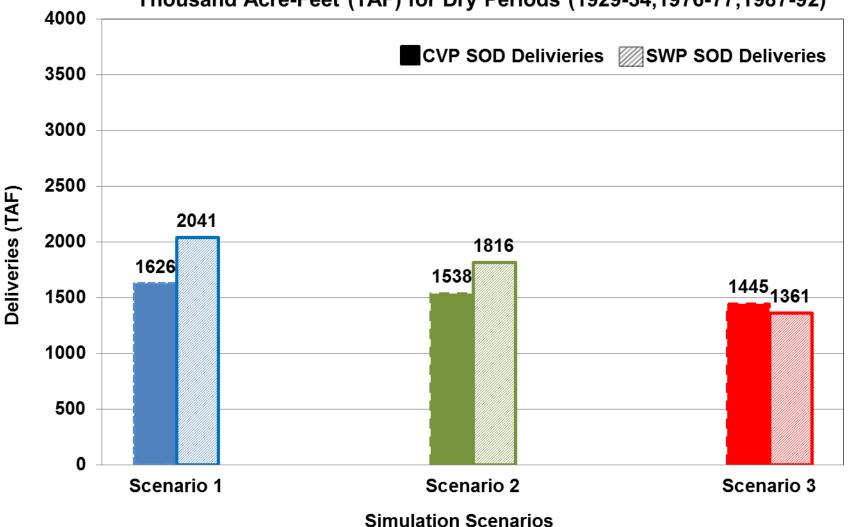


Time (year and water year type)



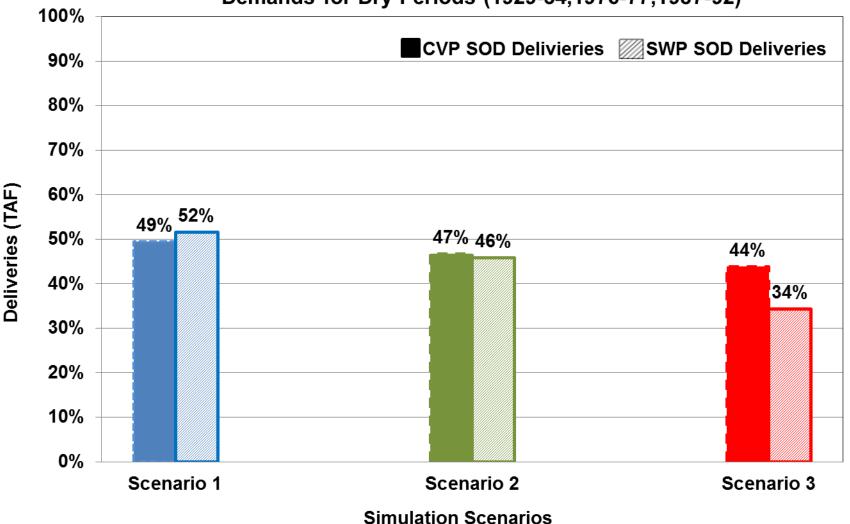
### SWP and CVP Dry Period Deliveries - Current LOD Dry Periods: (1929-34,76-77,87-92)

SWP and CVP Average Annual Deliveries in Thousand Acre-Feet (TAF) for Dry Periods (1929-34,1976-77,1987-92)



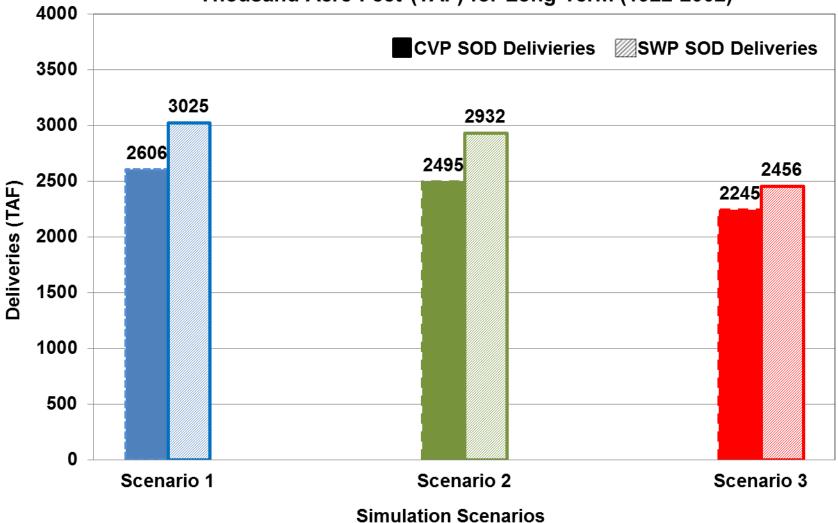
### SWP and CVP Dry Period Percent Deliveries- Current LOD (1929-34,76-77,87-92)

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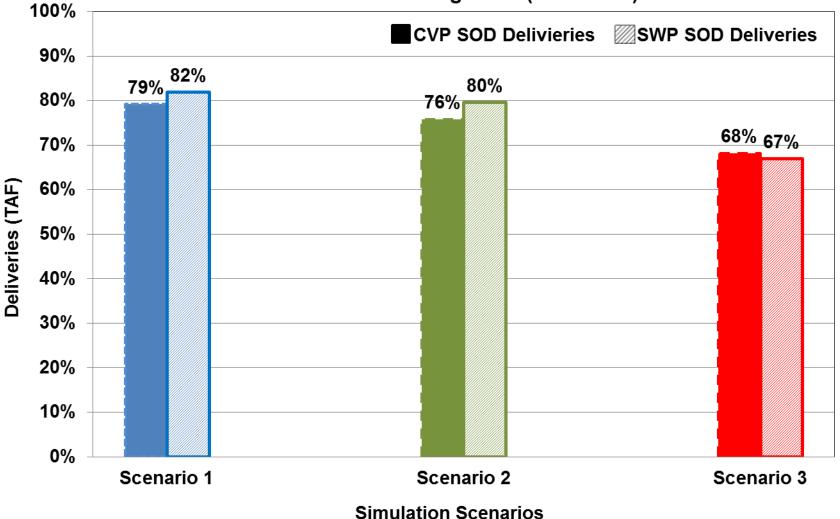
SWP and CVP Average Annual Deliveries in Thousand Acre-Feet (TAF) for Long Term (1922-2002)





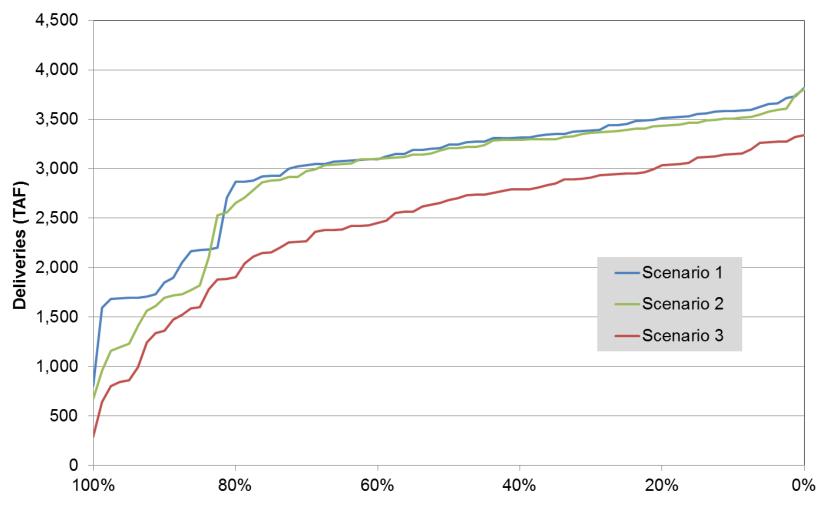
### SWP and CVP Long Term Percent Deliveries – Current LOD

SWP and CVP Average Annual Deliveries as percentage of Maximum Demands for Long Term (1922-2002)



### SWP Long Term Deliveries – Current LOD

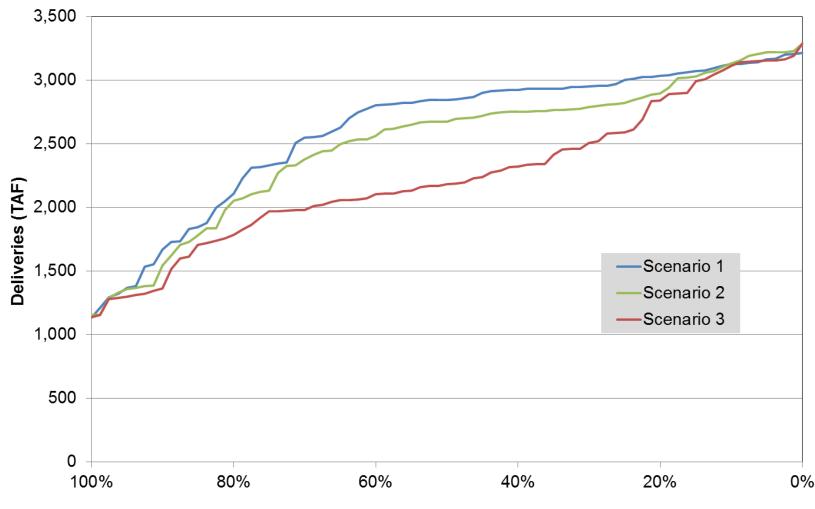
Exceedance Annual SWP Deliveries in Thousand Acre-Feet (TAF) for Long Term (1922-2002)



Percent at or above

### **CVP Long Term Deliveries –** Current LOD

Exceedance Annual CVP Deliveries in Thousand Acre-Feet (TAF) for Long Term (1922-2002)



Percent at or above