



**GENERATING ECOSYSTEM RESTORATION FLOWS THROUGH  
STORAGE AUGMENTATION**

**RESERVOIR REOPERATION WITH GROUNDWATER BACKSTOPPING**



# **STORAGE RESERVOIRS IMPAIR NATURAL FLOWS IN TWO WAYS**

**1. FLOW DEPLETION**

**2. FLOW ALTERATION**

**COMBINED EFFECTS: FRESHWATER ECOSYSTEMS  
ARE THE MOST IMPAIRED ON THE PLANET**

**= EXTINCTION CRISIS**



# ENVIRONMENTAL FLOWS

**OLD PARADIGM:** “MINIMUM INSTREAM FLOWS”

**NEW PARADIGM:** MORE VARIABLE FLOWS – MIMIC  
NATURAL PATTERNS

RECONNECT RIVERS TO THEIR  
HISTORIC FLOODPLAINS

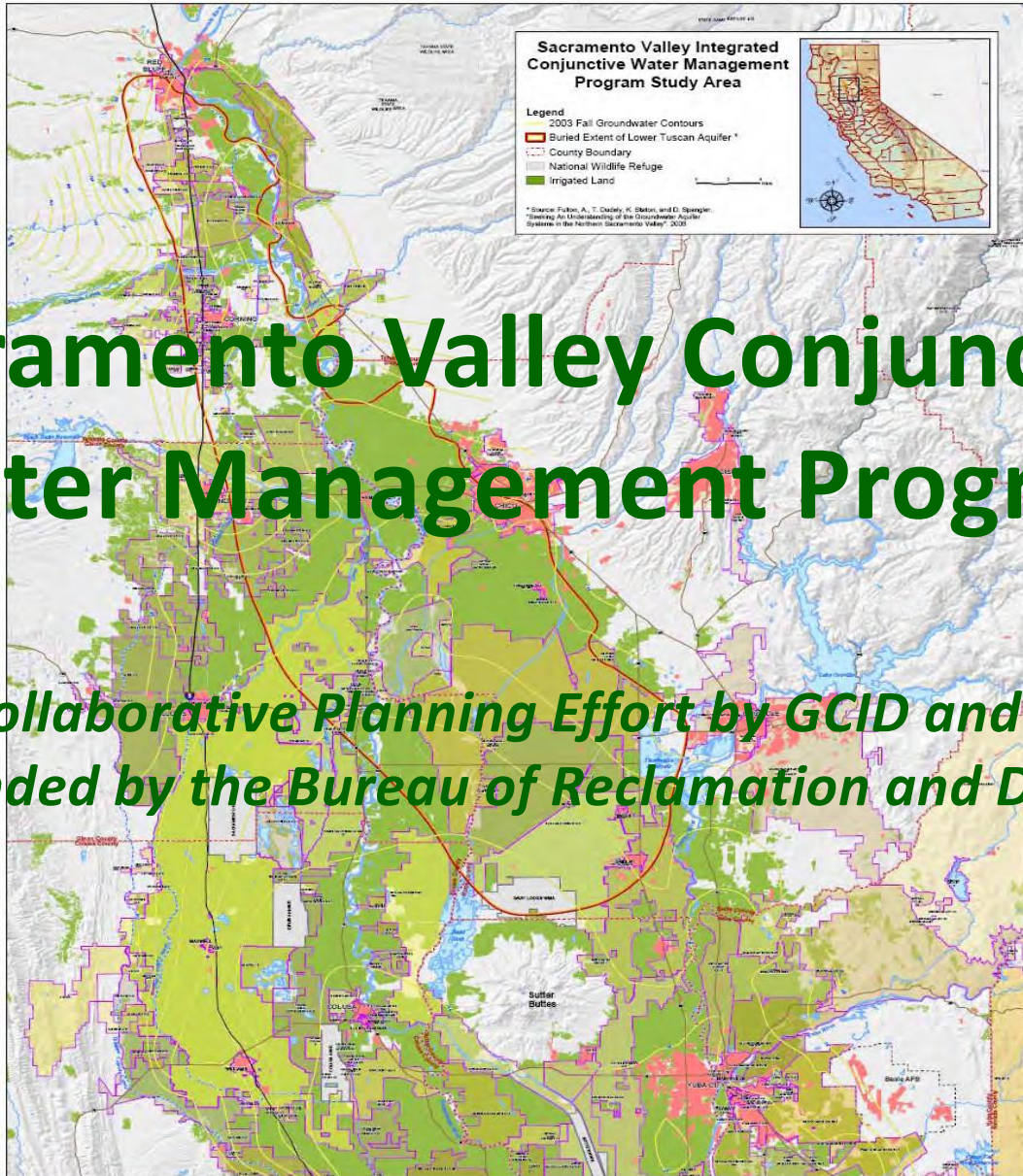


# **SPECIFYING ENVIRONMENTAL FLOW REQUIREMENTS**

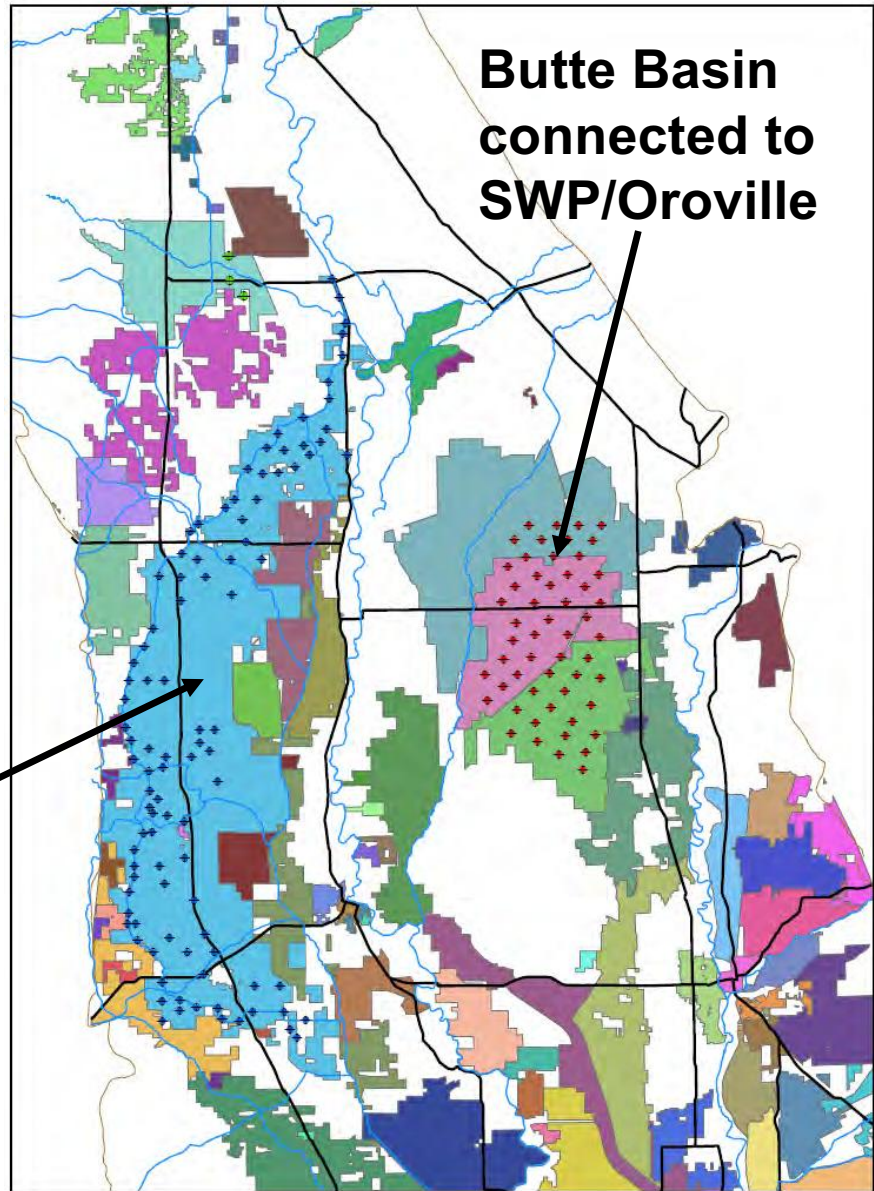
- **MAGNITUDE**
- **DURATION**
- **FREQUENCY**
- **TIMING**
- **REACH [SEQUENTIAL USE?]**

# Sacramento Valley Conjunctive Water Management Program

*A Collaborative Planning Effort by GCID and NHI  
Funded by the Bureau of Reclamation and DWR*



**Two  
Promising Sites  
Identified**



**Glenn-Colusa ID  
connected to  
CVP/Shasta**

**Butte Basin  
connected to  
SWP/Oroville**

# Environmental Flow Objectives

- **Geomorphic**
  - Single day large event
  - February or March
- **Riparian establishment**
  - Five day large flow with 60 day recession
  - April start
- **Flood plain inundation**
  - Single day large event with 45 day recession
  - Between February and April
- **Spring pulse flow**
  - Simulate more natural spring runoff period



An aerial photograph of a river valley. A large reservoir is visible in the lower-left quadrant, with a river winding through the valley. The surrounding hills are covered in sparse, dry-looking vegetation. The sky is clear and light blue.

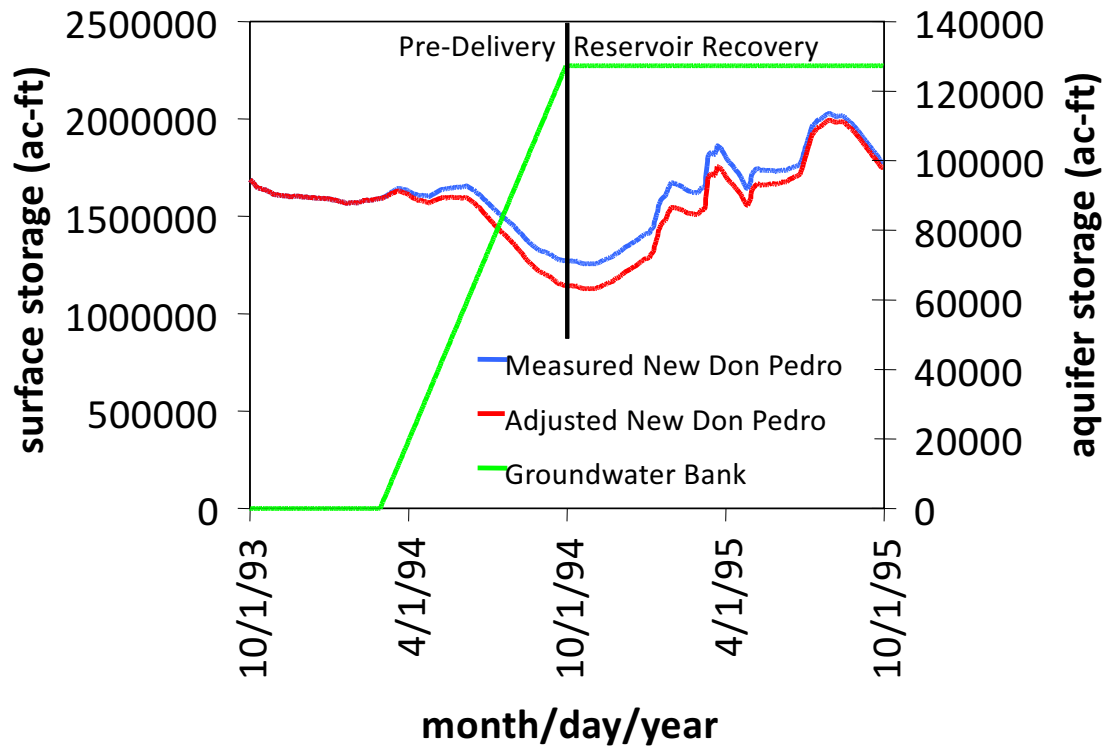
## **Reoperate Reservoirs with Backstopping by Groundwater Integration**

- **Capture the fraction of the runoff hydrograph not now controlled for beneficial use by increasing flood reservation**
- **Dedicate this “surplus” water to environmental flows and improved water supply**
- **Payback reservoir in dry years with groundwater substitution**
- **Incidental flood control benefits**
- **Incidental climate resilience benefits**

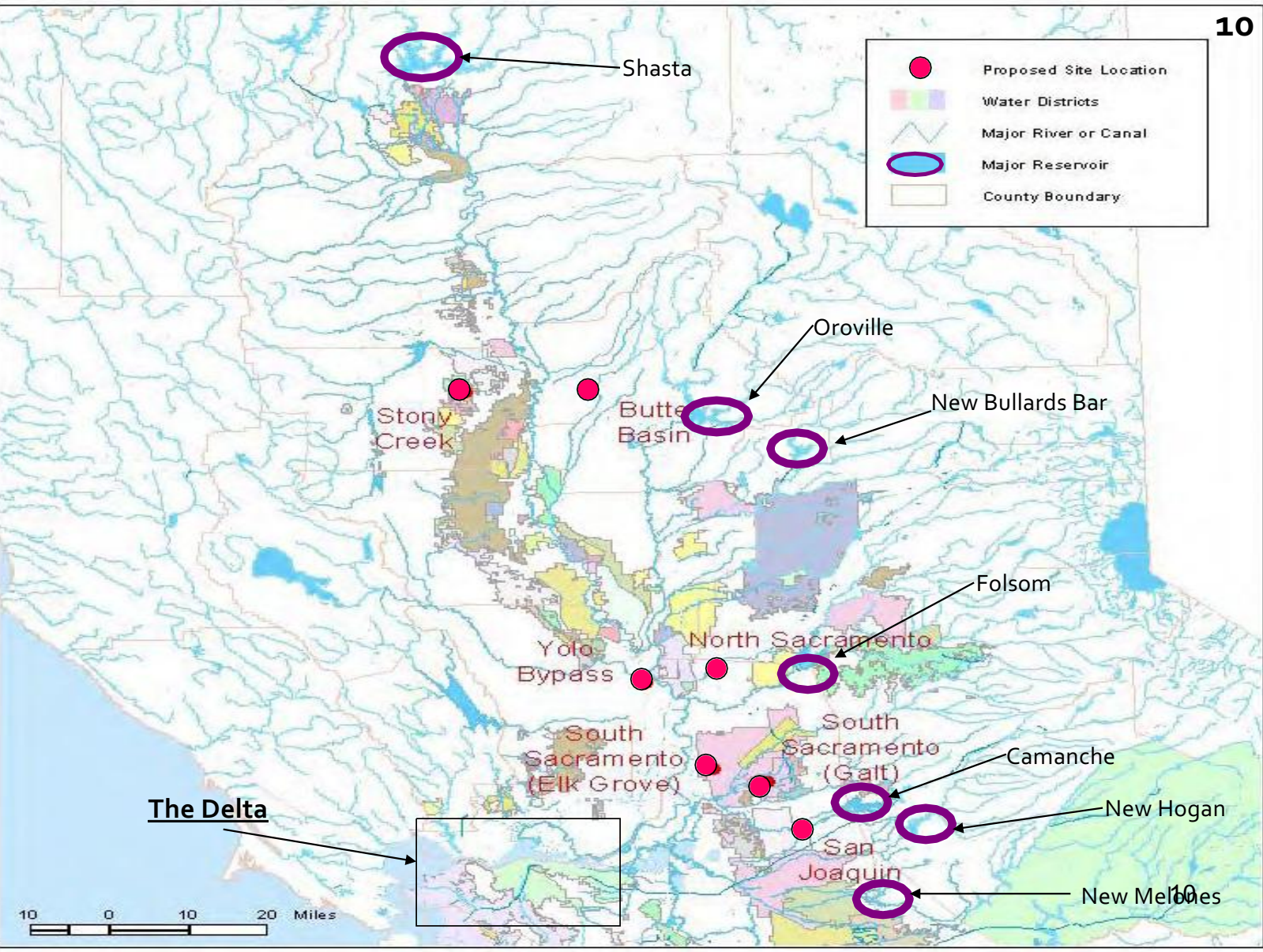


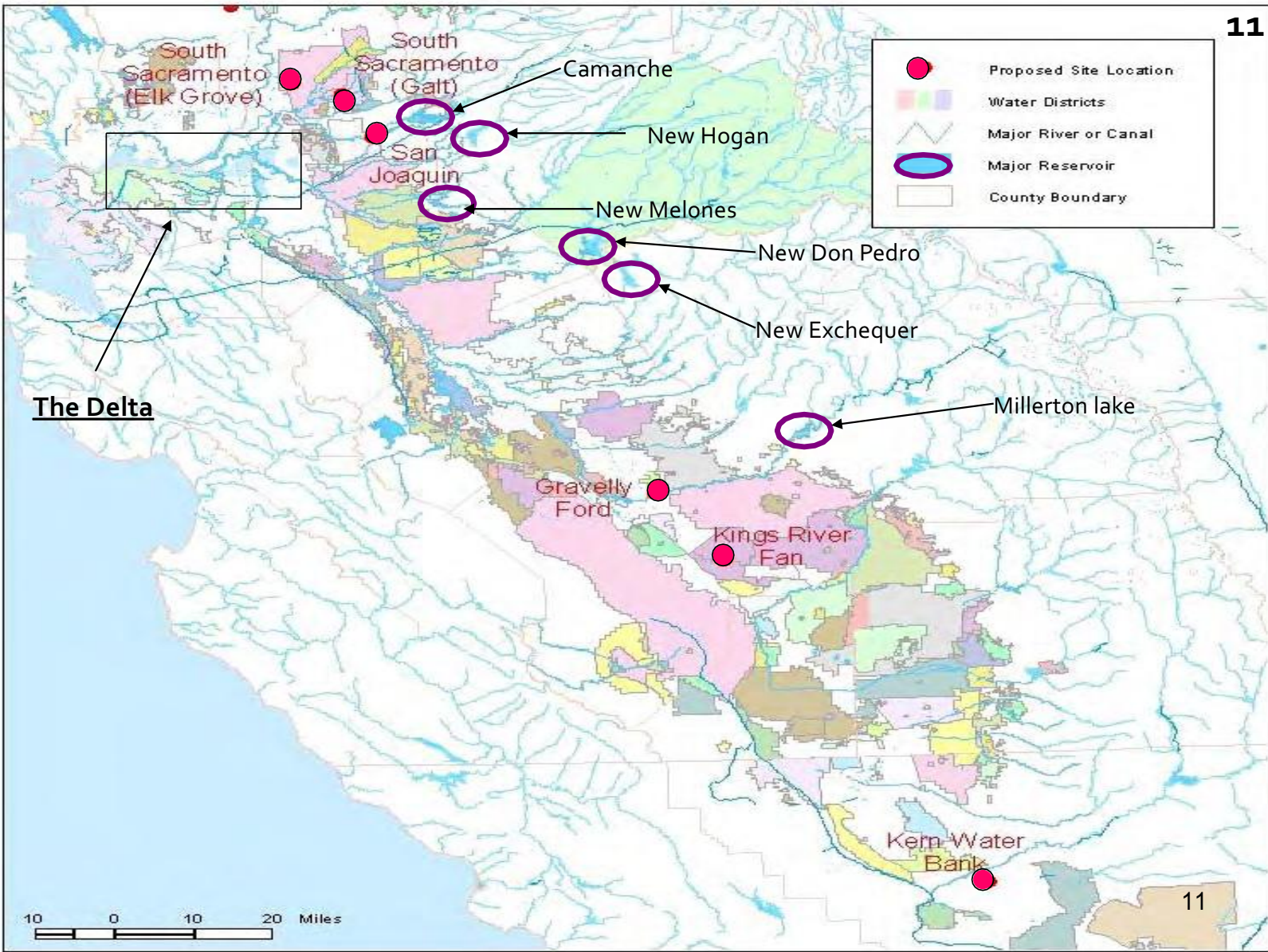
# Modes of Groundwater Banking

*NHI Approach*



	Proposed Site Location
	Water Districts
	Major River or Canal
	Major Reservoir
	County Boundary





# Reservoirs, Ownership, and Capacity

River	Reservoir/Dam	Operator	Storage (TAF)	Mean 1921-1983 Unimpaired Flow
Sacramento	Shasta	USBR/CVP	4,552	8,303
Feather	Oroville	DWR/SWP	3,538	4,441
Yuba	New Bullards Bar	YCWA	966	2,333
American	Folsom	USBR/CVP	974	2,660
Mokelumne	Camarache	EBMUD	417	730
Calaveras	New Hogan	COE	317	163
Stanislaus	New Melones	USBR/CVP	2,420	1,131
Tuolumne	New Don Pedro	MID/TID	2,030	1,841
Merced	New Exchequer	Merced ID	1,025	967
Kings River	Pine Flat	COE	1,000	1,745
Upper San Joaquin	Millerton Lake	USBR/CVP	520	1,740

## Average Annual Yield Estimates for Eleven Regulated Tributaries of the Central Valley

<b>River</b>	<b>Conjunctive Use Re-Operation (TAF)</b>
Sacramento	196.8
Feather	126.9
Yuba	144.5
American	80.4
Mokelumne	69.4
Calaveras	25.4
Stanislaus	65
Tuolumne	77.9
Merced	108.1
Upper San Joaquin	100
Pine Flat Reservoir	108
<b>TOTAL</b>	<b>1102.4</b>

The background of the slide is a photograph of several salmon swimming in clear, shallow water. The fish are silvery with a hint of pink on their sides, and they are captured in various positions, some facing left and some right, as if they are moving through the water. The water is bright and slightly rippled, suggesting a natural stream or river environment.

## Factors Taken Into Account

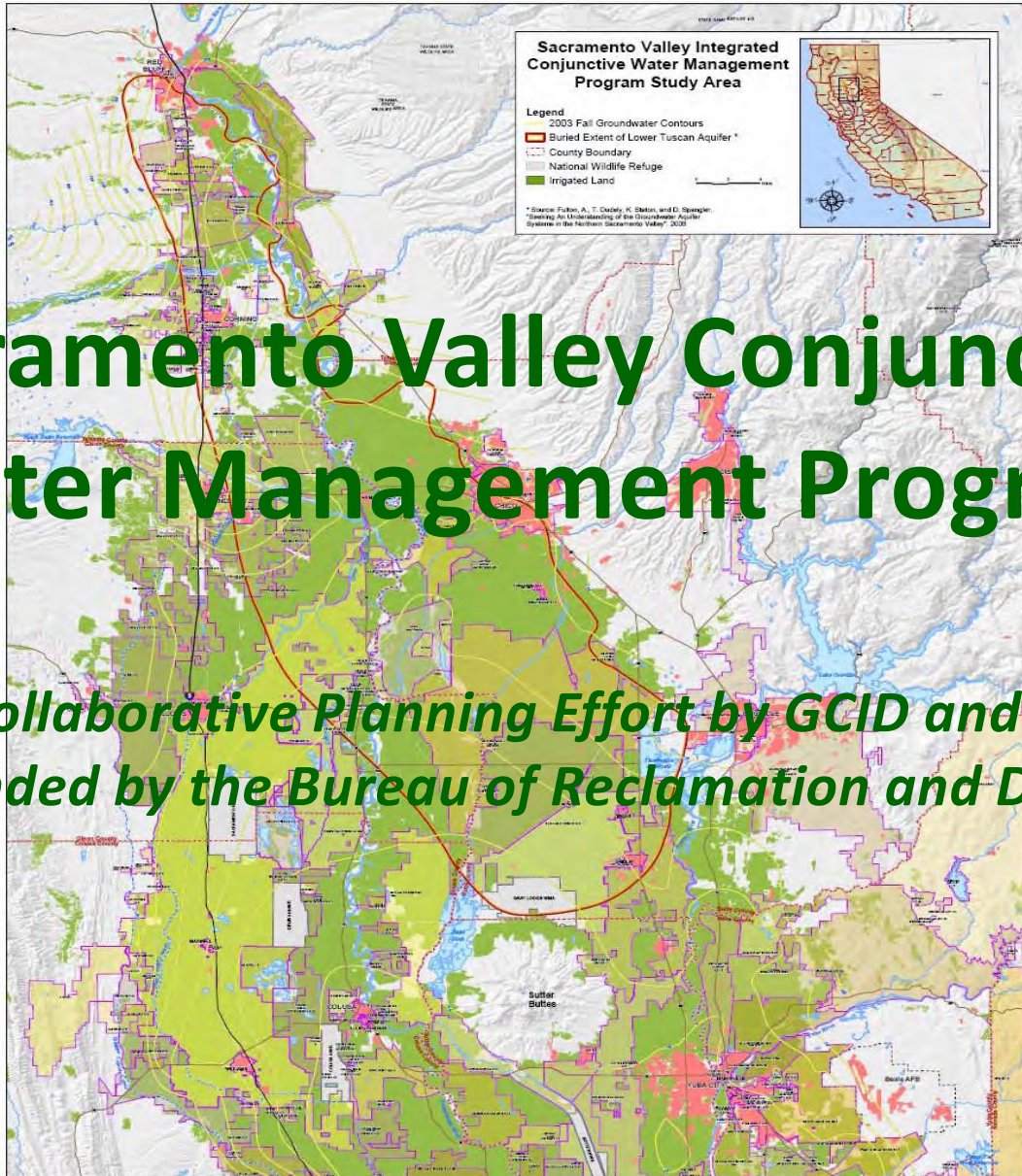
- Pre-existing rights & entitlements
- Prescribed environmental flows
- Temperature regulation

## Factors NOT Taken Into Account

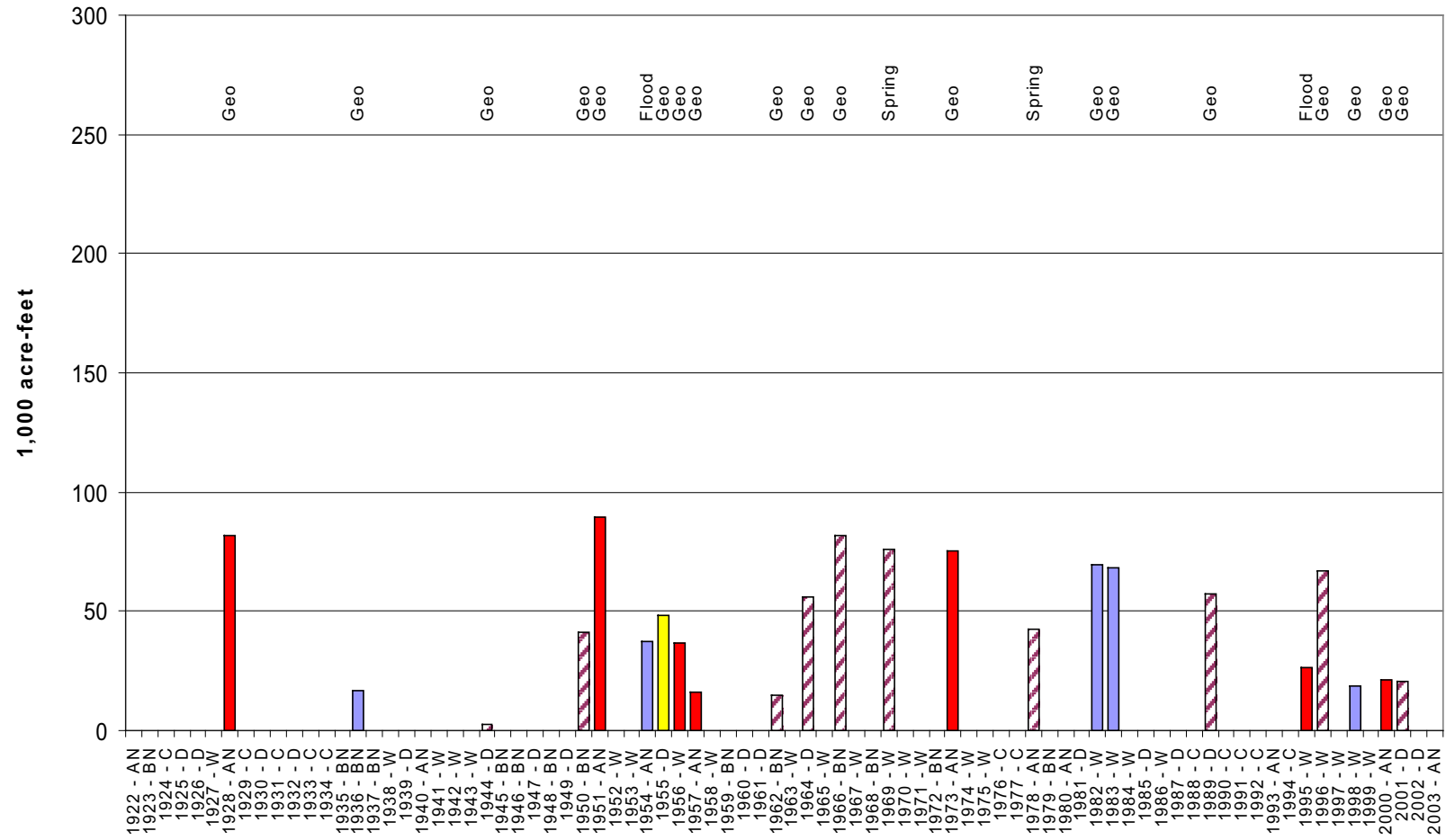
- Delta transfer constraints

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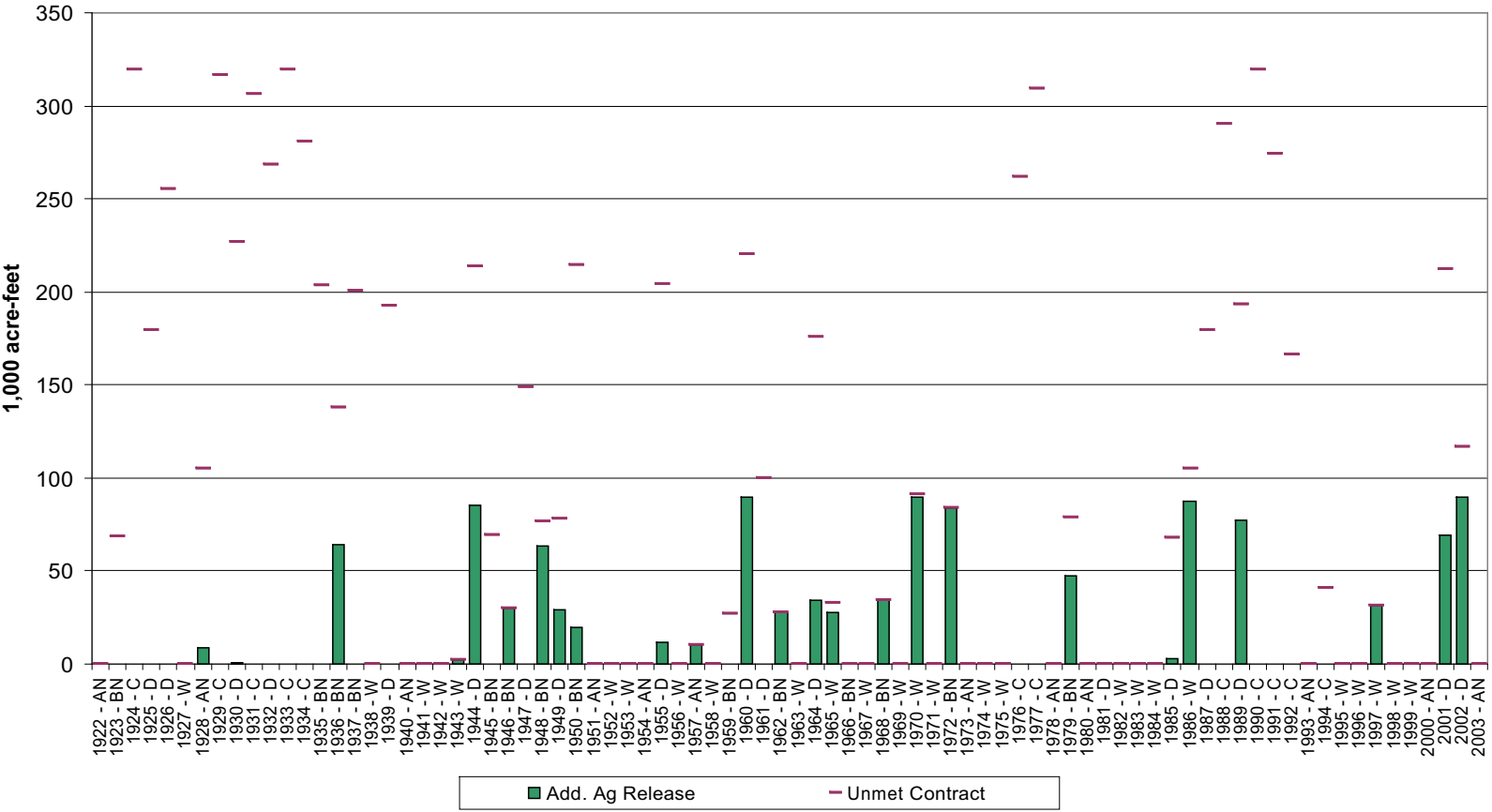


# Scenario 1—CVP/Shasta 100 TAF Pumping Capacity in GCID Environmental Flow Releases



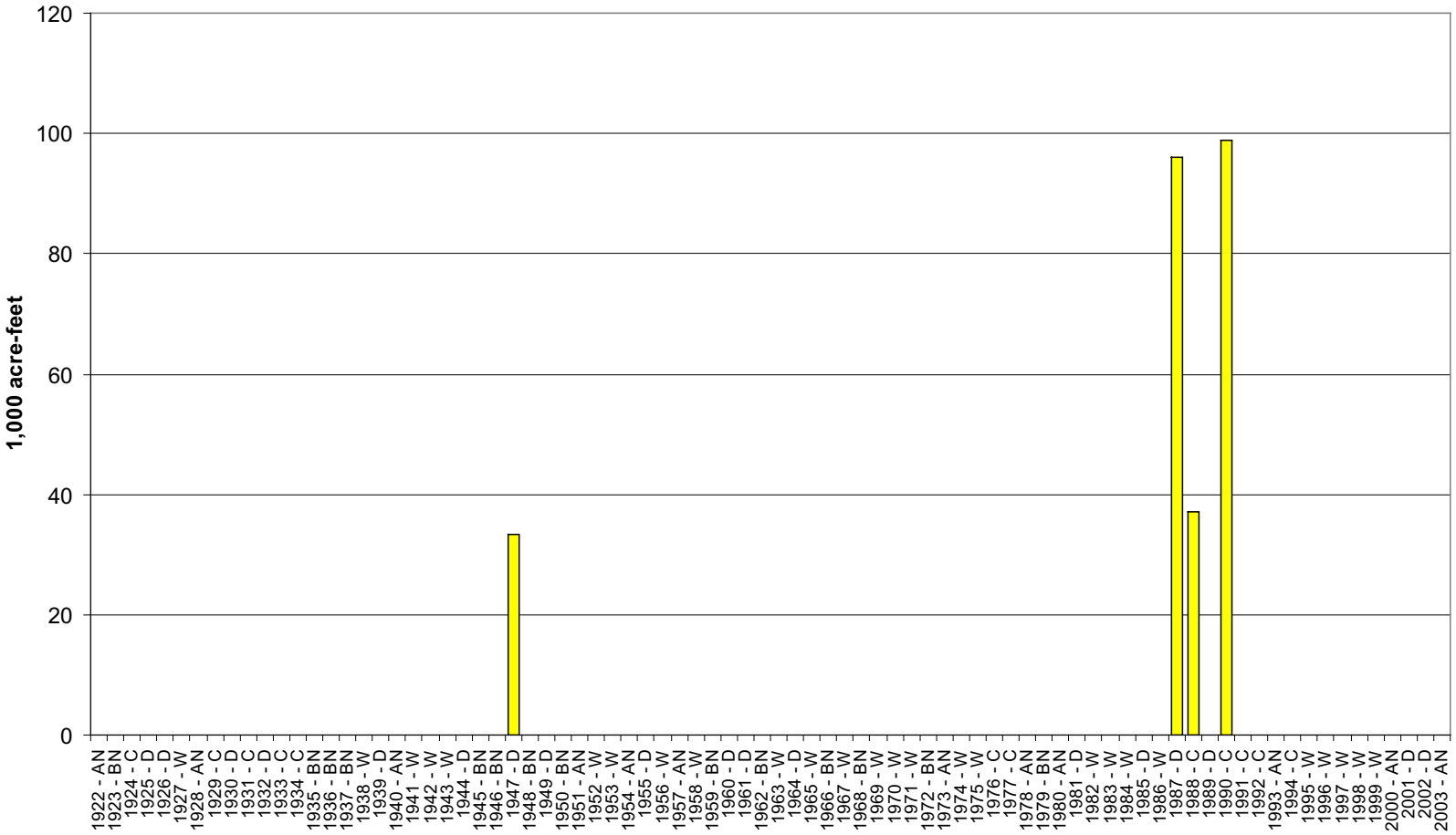


# Scenario 1—CVP/Shasta 100 TAF Pumping Capacity in GCID Sac River Agricultural Deliveries





# Scenario 1—CVP/Shasta 100 TAF Pumping Capacity in GCID Refill from Groundwater Pumping



# **Why South of Delta GW Banking is Promising**

- **Avoid impacts on Sac Valley GW Users**
- **Extract and use banked water at times of greatest need and economic value**
- **No increase in Sac Valley exports**
- **Avoid operational losses for IDC by-pass flows by “riding on the back” of PRE exports**



## **Big Question**

**This option converts Delta outflow to Delta exports:**

- Is the value of improved flows in Sacramento and Feather Tributaries larger than the value of Delta outflows during the flood season?**

**Fish don't just need water--  
they need a river!**

