Climate Change and the Future of Groundwater in California:

Conjunctive-Use and Aquifer Recharge

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Presentation to

CCWAS IGERT

Climate Change and the Future of California Groundwater

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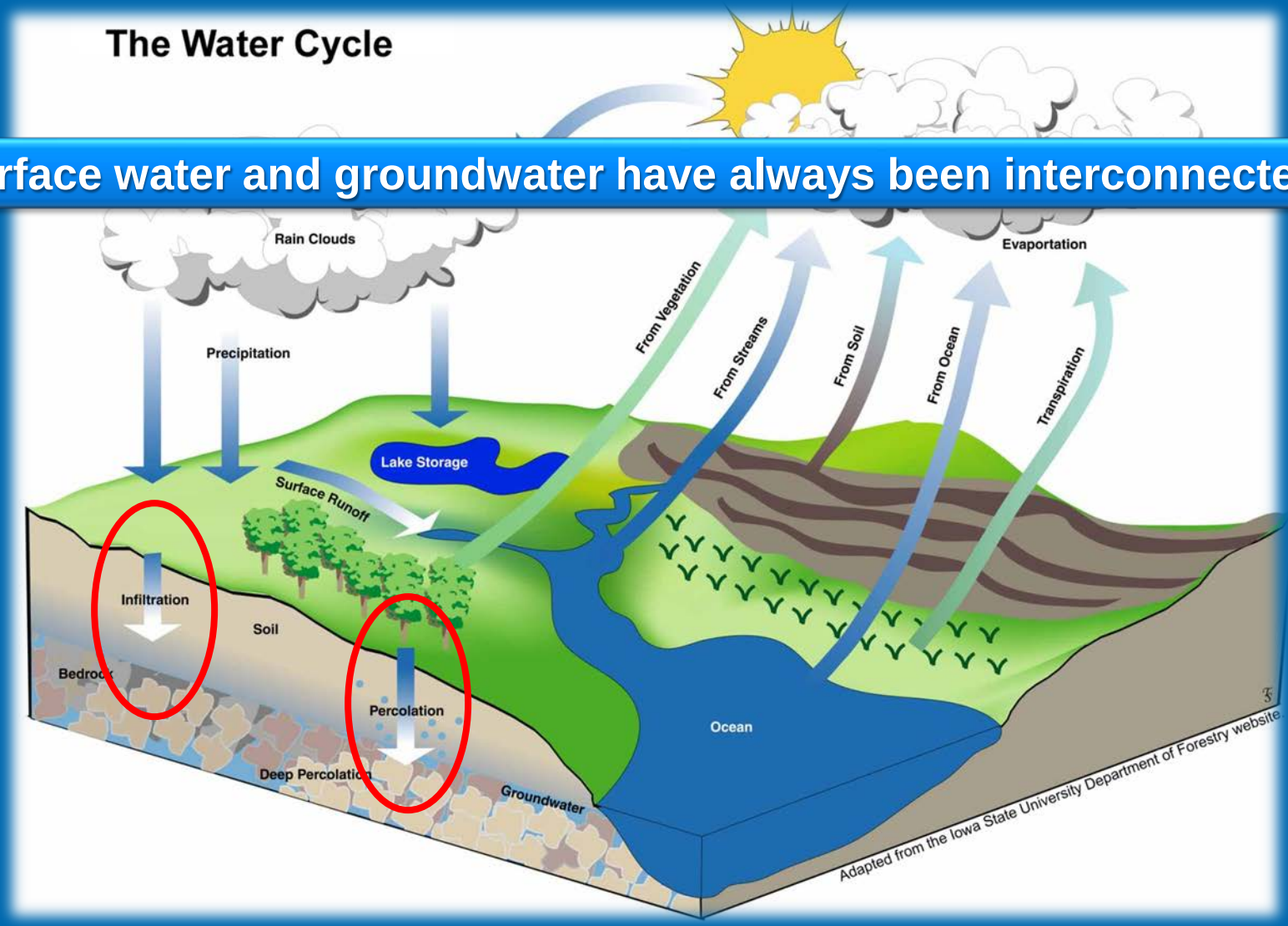
Groundwater recharge is a hydrologic process where water moves downward from surface water to groundwater.



Surface water and groundwater have always been interconnected!

Managed aquifer recharge (MAR) describes man's attempt to supplement natural recharge and use the aquifer as an underground reservoir.

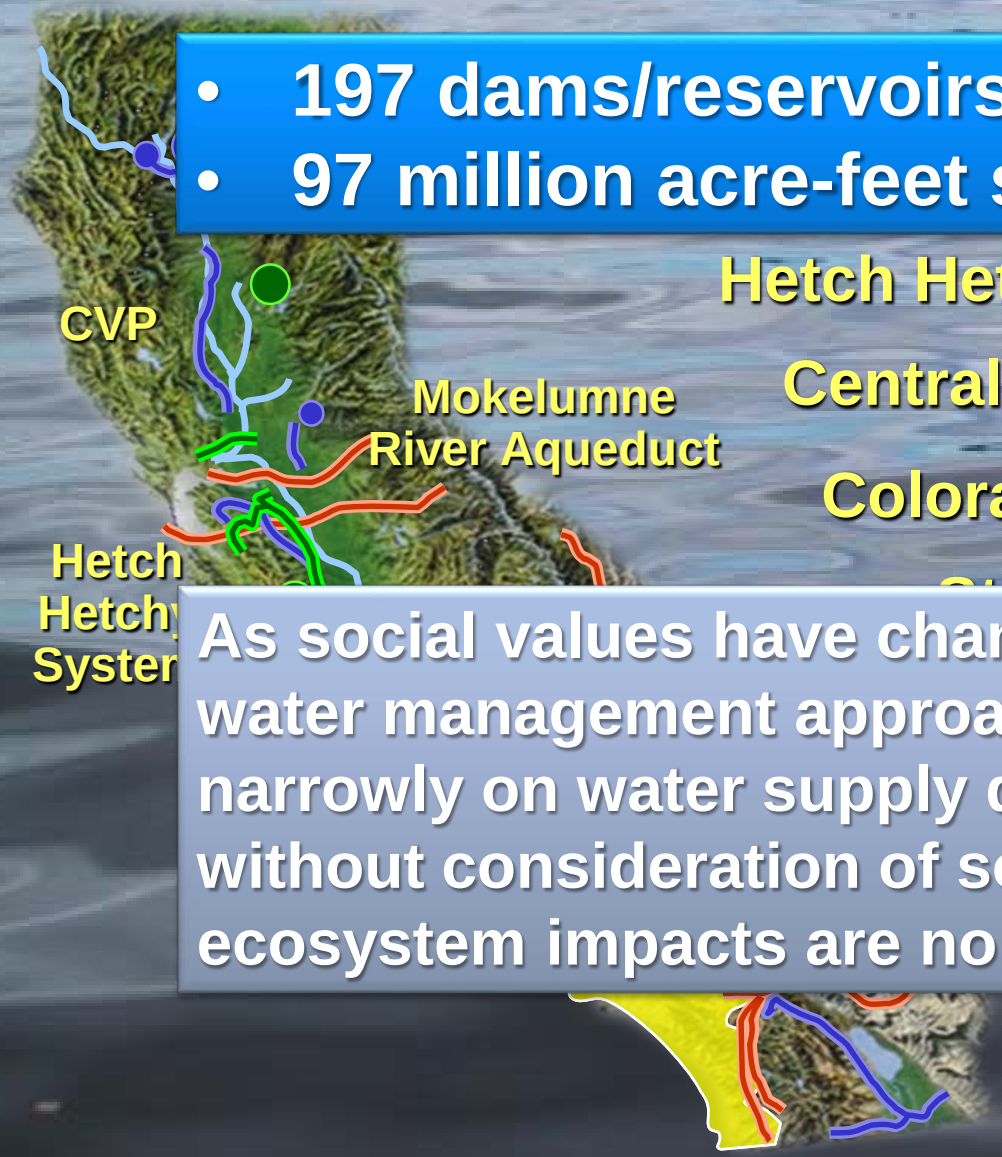
- **Enhanced river/creek recharge**
- **Spreading basins**
- **Injection wells**
- **In-lieu recharge**

There are many advantages to MAR:

- Storage in aquifer can be better than surface storage
- Makes better use of local water supplies
- Allows for increased use of groundwater basin storage
- Can improve water quality

California has an extensive surface water storage and distribution system.

- 197 dams/reservoirs
- 97 million acre-feet storage capacity



Hetch Hetchy Aqueduct: 1934

Central Valley Project: 1933

Colorado River Aqueduct: 1939

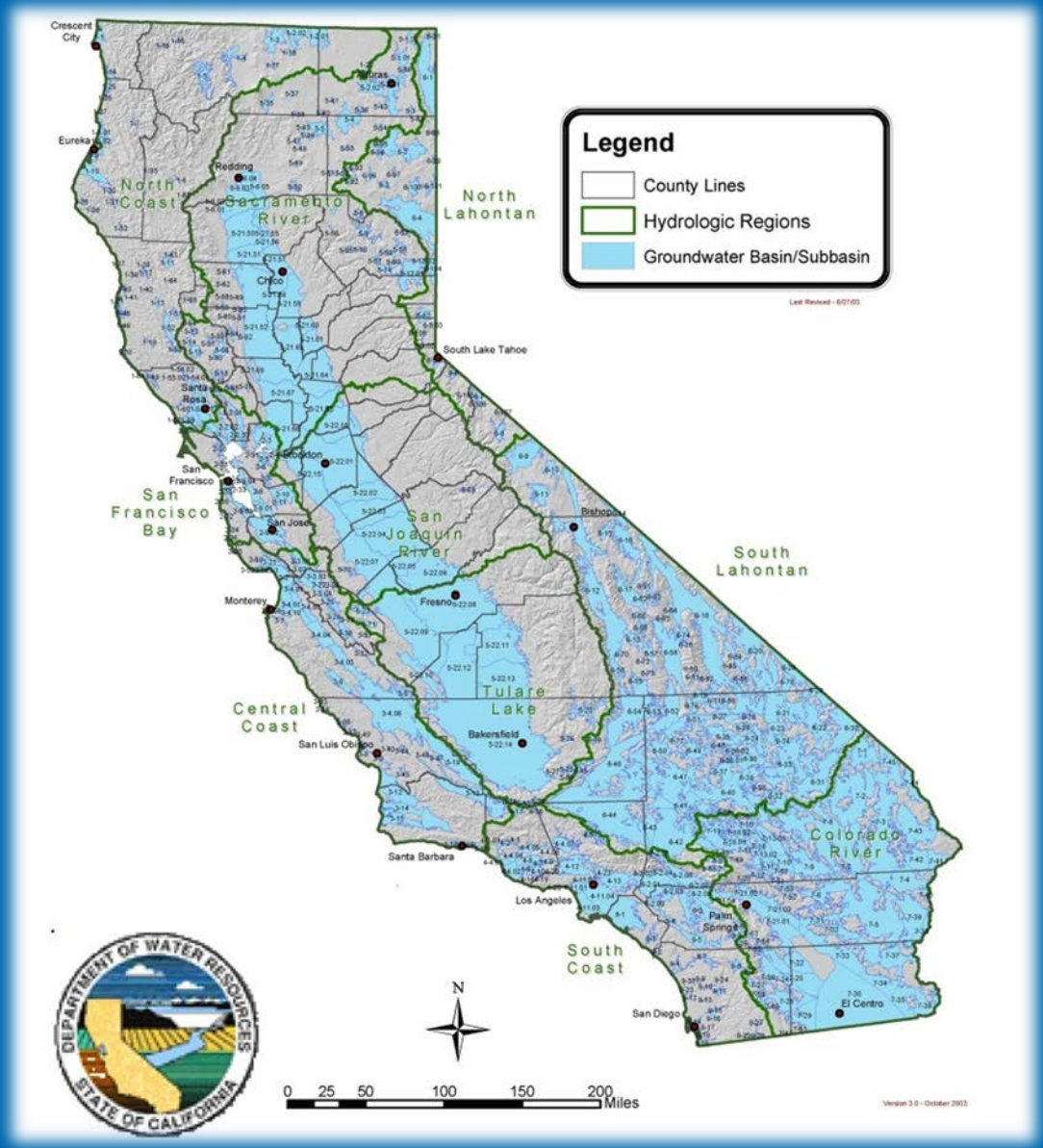
1960

As social values have changed, traditional water management approaches focused narrowly on water supply development without consideration of social or ecosystem impacts are no longer sufficient.

Groundwater provides 30 percent of the state's water supply.

- 431 groundwater basins
- Cover 40% of state
- Storage capacity: 851 million af
  - Not all is usable

Surface Storage: 97 million af

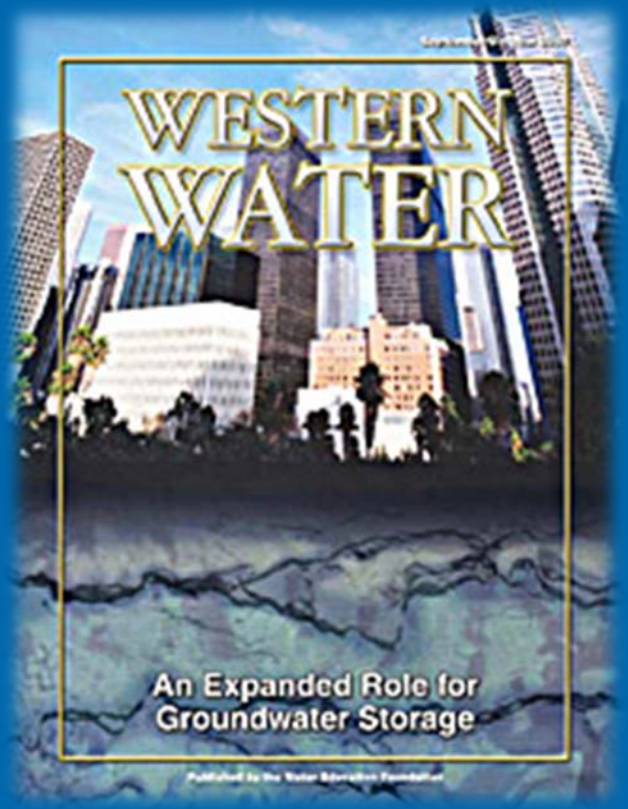


Conjunctive use and integrated water resources management are key to California's water future.

"In the future, Californians must increasingly rely upon the state's subsurface reservoirs and integrated management approaches in order to respond to the challenges of an increasing population as well as larger swings in precipitation and temperature."

The Increasing Importance of Groundwater for California Water Supply, California Groundwater Coalition, 2007.

Subsurface and surface reservoirs should be treated as an interconnected, inseparable resource.

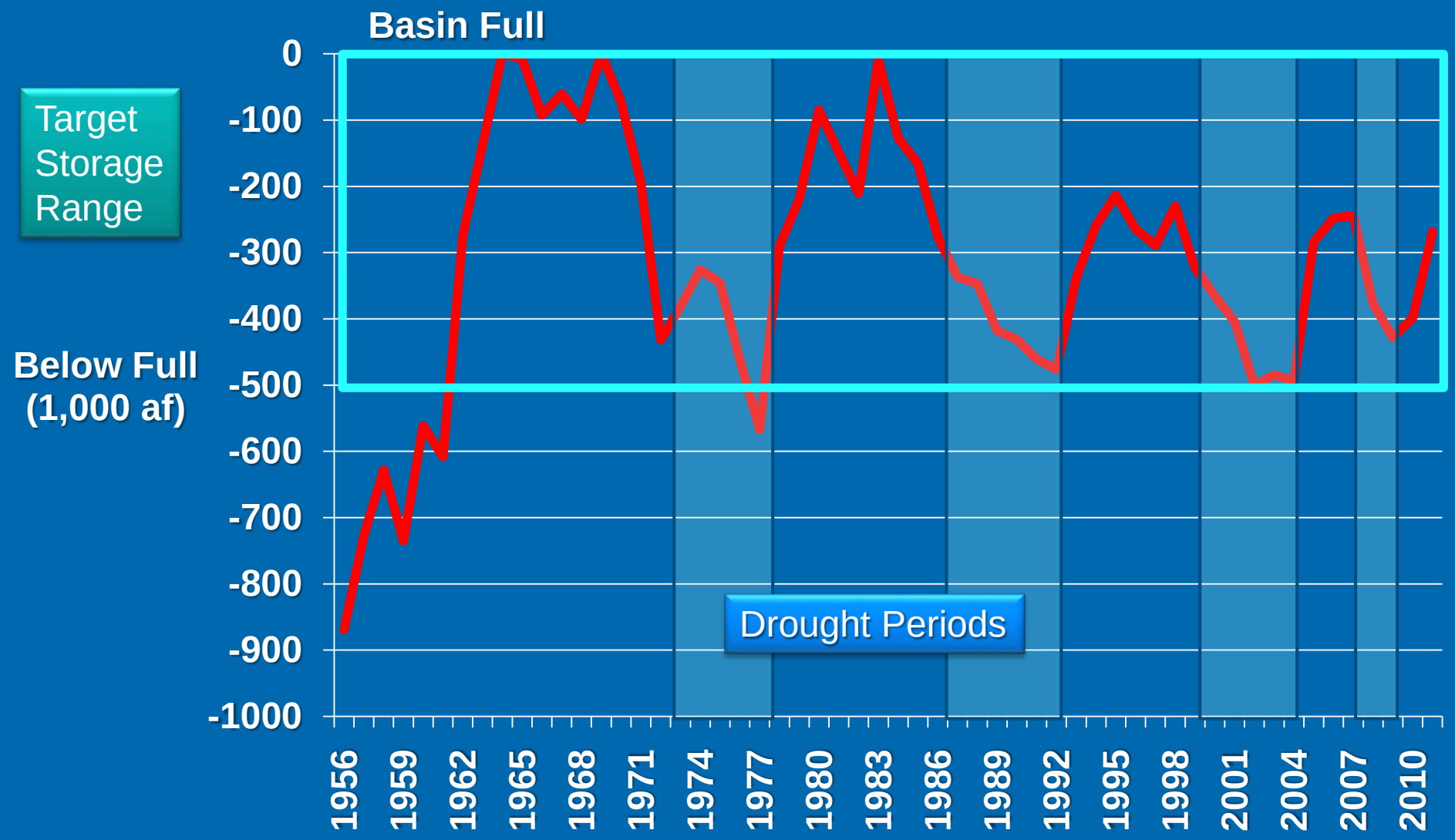


OCWD is good example of how conjunctive use and MAR can increase available water supplies.

- Surface water supplies
  - Santa Ana River base flow
  - Storm water
  - Imported water (Colorado River/State Water Project)
  - Recycled water
- Surface storage facility
  - Prado Dam

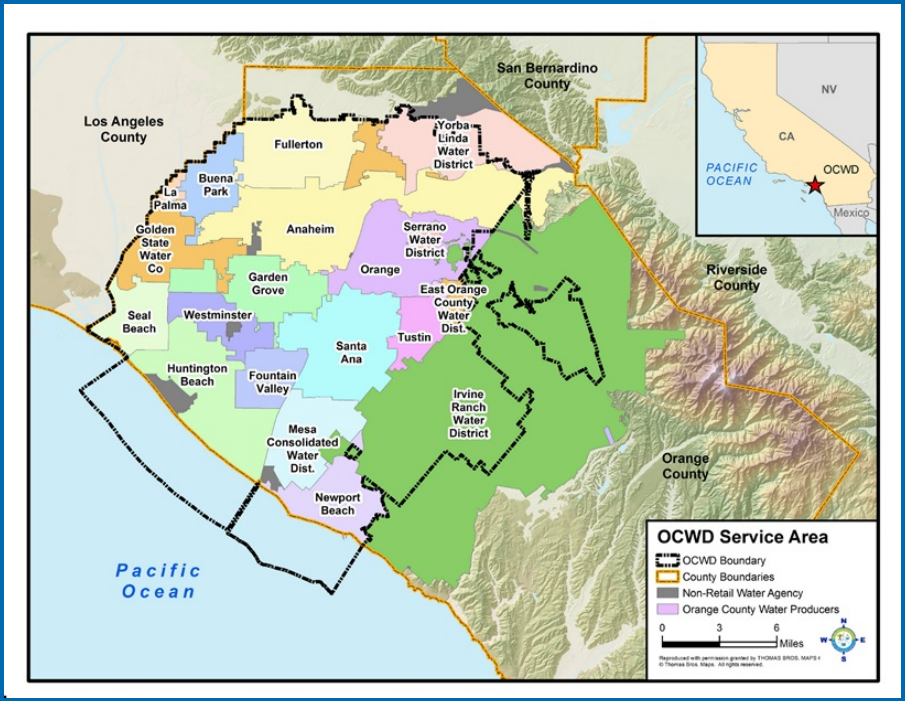
- MAR system
  - 1,500 acres
  - 248,000 afy capacity
  - Seawater intrusion barrier
  - Extensive monitoring well network
  - Pumping is metered and reported
  - Pumping controlled with economic incentives

The groundwater basin should be viewed as a reservoir that can be emptied and refilled.



An integrated approach to water resources management has allowed OCWD to more than double the yield of the groundwater basin.

- **Keys:**
  - Manager of entire groundwater basin
  - Access to surface water
  - Managed aquifer recharge
  - Managed pumping
  - Stakeholders treated equally (socialistic)
  - Political courage and foresight



Conjunctive use increases the availability of water supplies.

Challenges to Conjunctive-Use and MAR

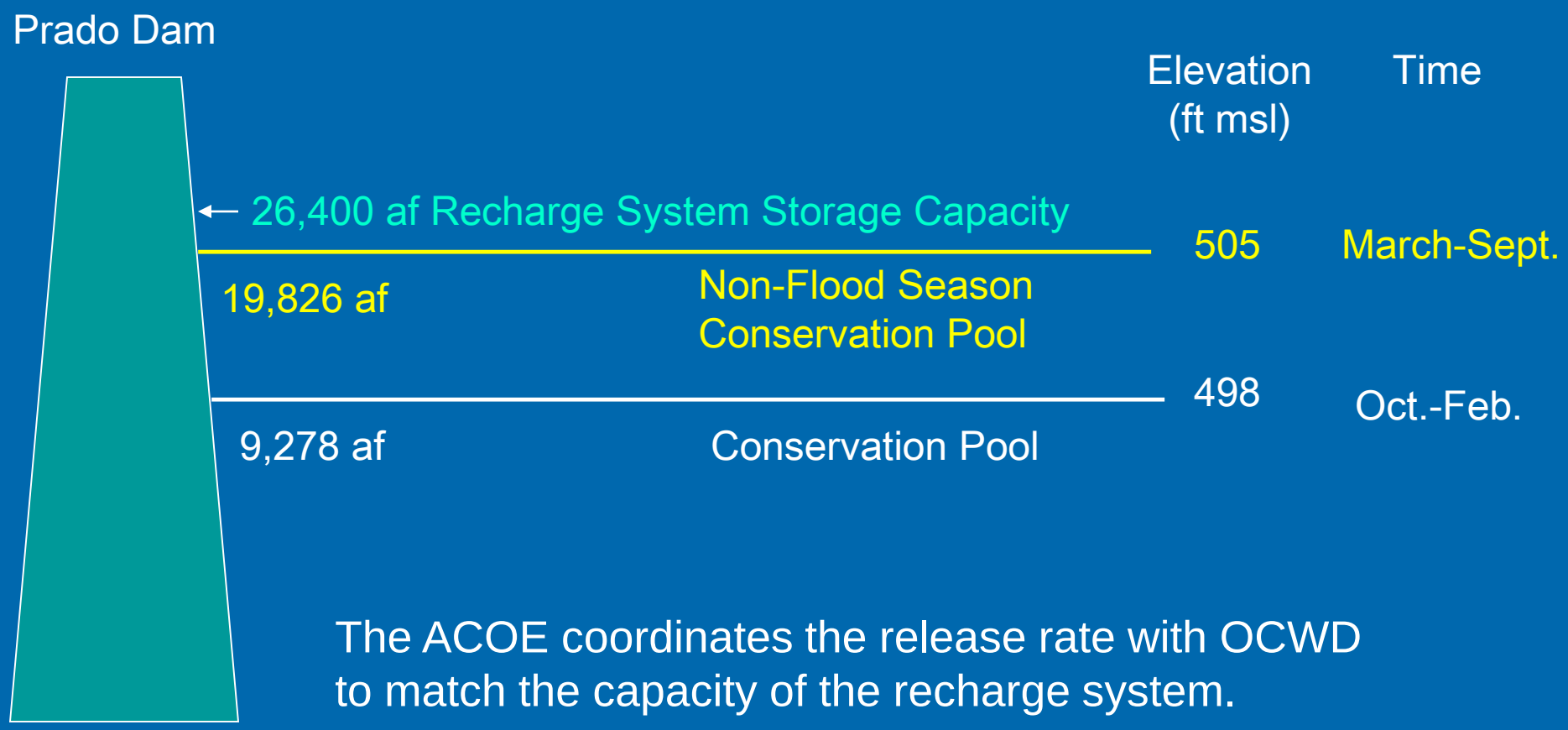
- Surface and groundwater are treated differently
- Conveyance restrictions
- Defining usable basin storage
- Defining inputs/outputs (Water budgets)
- Measuring/controlling pumping
- Protecting potential recharge areas from development.
- Who pays?
- Are there winners and losers? Is there a win-win?

Extra Slides

Challenges to Conjunctive-Use and MAR

- Surface and groundwater are treated differently
  - Surface water permitted
  - Groundwater rights not defined in most basins
  - Who has rights to store water?
- Conveyance restrictions
  - Various owners of aqueducts, canals
  - How do you transfer or wheel water across the state and who pays?
- Managed Aquifer Recharge
  - What is usable basin storage?
  - Can inputs and outputs be defined and controlled?
  - Can you measure pumping?
  - Where should MAR facilities be located?
  - Protect potential recharge areas from development.
- Institutional Issues
  - Who has control?
  - Who pays?
  - Are there winners and losers? Is there a win-win?

The storm water conservation program at Prado Dam is a good example of cooperation between two governmental agencies.



The ACOE coordinates the release rate with OCWD to match the capacity of the recharge system.

Committee of 12 formed to "Save the Basin" in 1952.

- Believed that common pool of water was more valuable than individually, adjudicated share of groundwater.
  - Said no to "philosophy of scarcity"
- Introduced innovative changes that had both socialistic and capitalistic elements
  - All pumpers treated equally
  - All pumpers have access to water
  - Prices established to control pumping, encourage conservation
- Took political courage to implement
  - Predominant model was adjudication