

... in Civilizations . . .

“Demography is Destiny”

French philosopher Auguste Comte

...but for California's historical development...

“Geography is Destiny”

Theme: California's unique geography has played a fundamental role in shaping the state's development, and natural resource management challenges.

Geography:

- Location of resources shaped California's development:
 - Gold
 - Arable land
 - Early irrigation systems
 - Natural harbors
 - Film industry (locations and weather)
 - WWII industrialization – economic geography

AND, WATER – distribution and demand has shaped development and its impact on natural environment

The story of
California is
the story of
water





The Gold Rush was the start of a philosophy of putting California's water to work







Hydraulic Mining

1853 - Used powerful jets of water to blast away hillsides

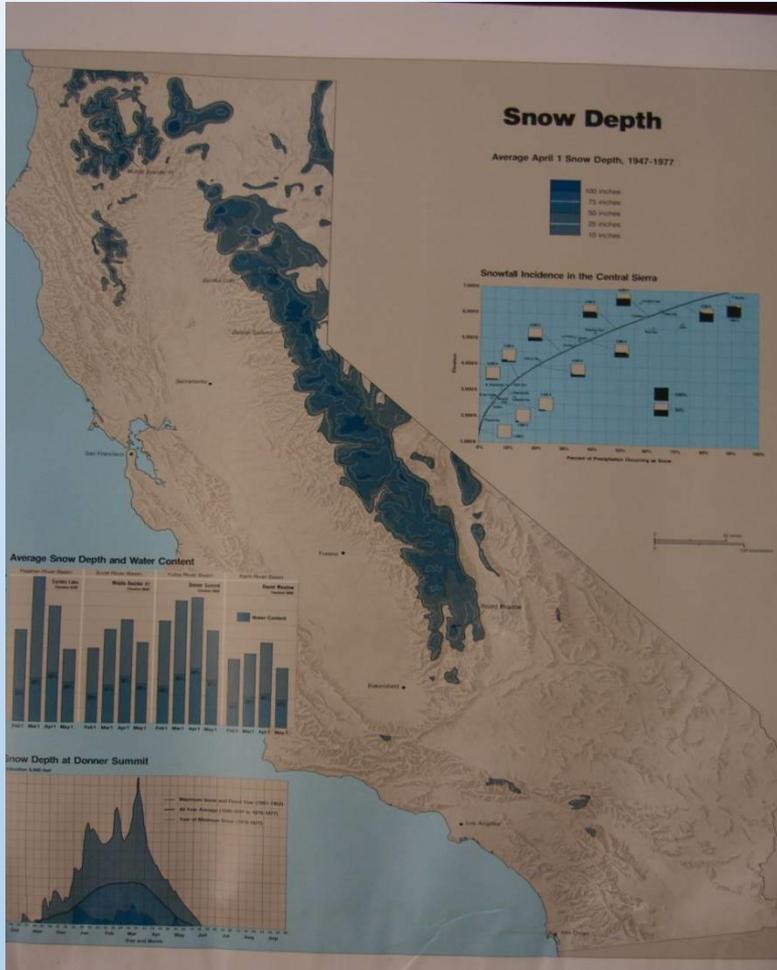
Malakoff Diggings (South Yuba River) - mined 100,000 tons of gravel per day and used **16 billion gallons** (32,000 acre-feet) of water per year.

11 million ounces of gold (**worth \$9.7 billion**) by the mid-1880s.



Arteries of Commerce

California Hydrology – geography of natural supply and use

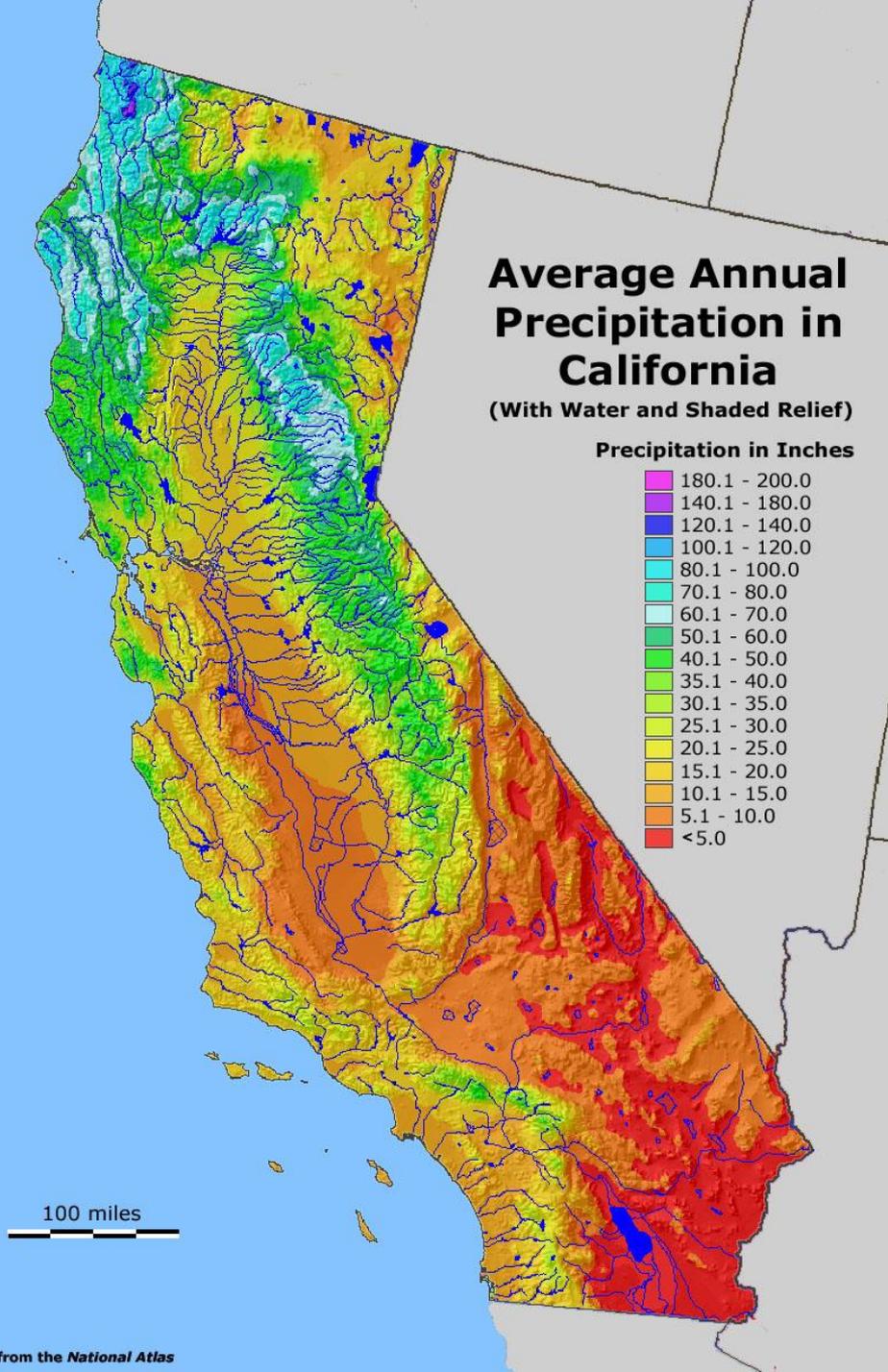


- 💧 Mediterranean climate – dry summers, mild winters
- 💧 In average year, 82 million acre-feet of water used:
 - 💧 Urban – 9 MAF
 - 💧 Agriculture – 34 MAF
 - 💧 Environment – 39 MAF

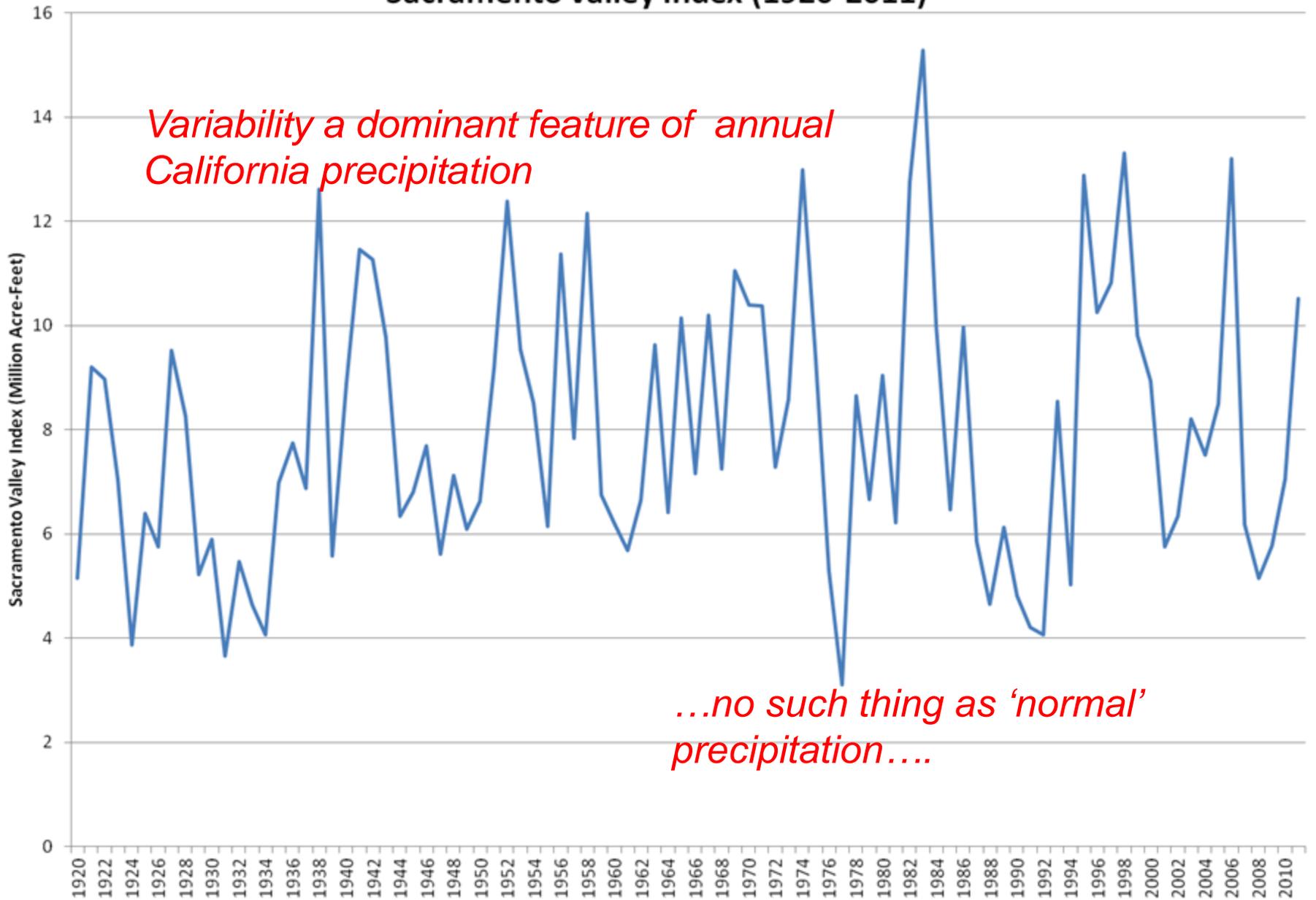
California Hydrology

Wet in north
Dry in south

Greatest population
in south



Sacramento Valley Index (1920-2011)

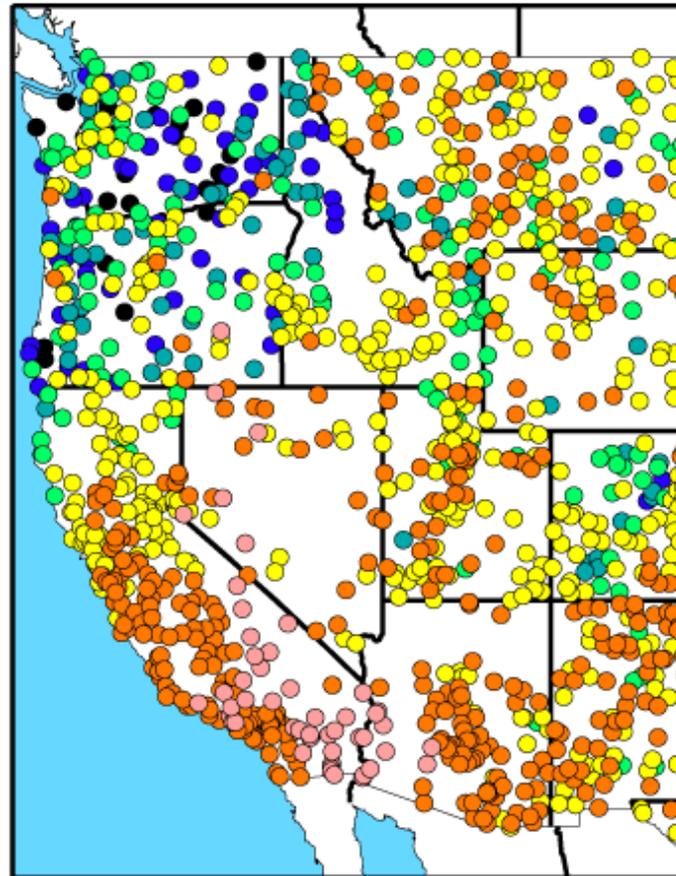


Variability a dominant feature of annual California precipitation

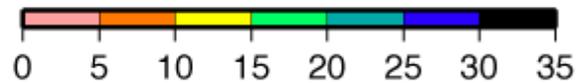
...no such thing as 'normal' precipitation....

Just a few storms each year are the core of California's water supplies

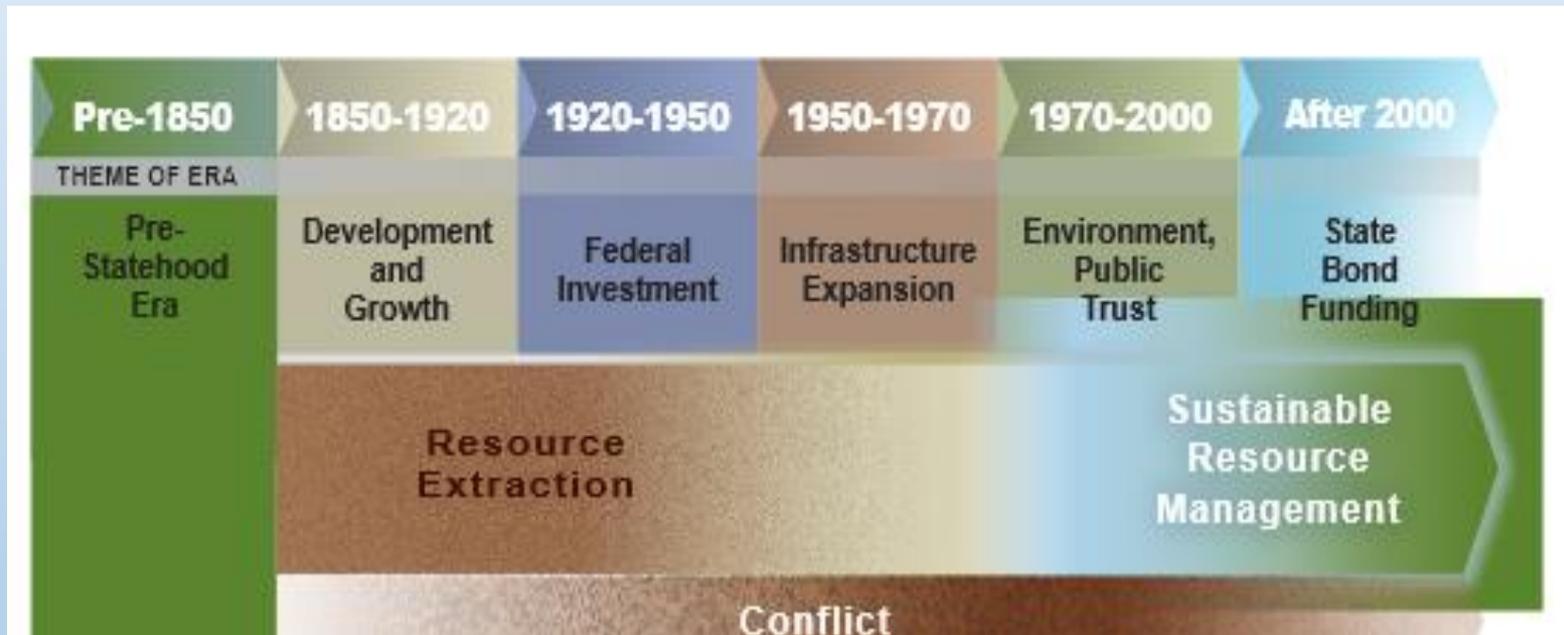
c) AVERAGE NUMBER OF DAYS/YR TO OBTAIN HALF OF TOTAL PRECIPITATION, WY 1951-2008



days/year



History of Resource Development Philosophy in the 21st Century



California Water Development



Hetch Hetchy System

San Francisco PUC

1913 - Raker Act

Los Angeles Aqueduct

Los Angeles DWP

1913

Mokelumne River Aqueduct

East Bay MUD

1929

Central Valley project

U.S. Bureau of Reclamation

1940 (C.C. Canal first)

Colorado River Aqueduct

MWD of So. Cal.

1941

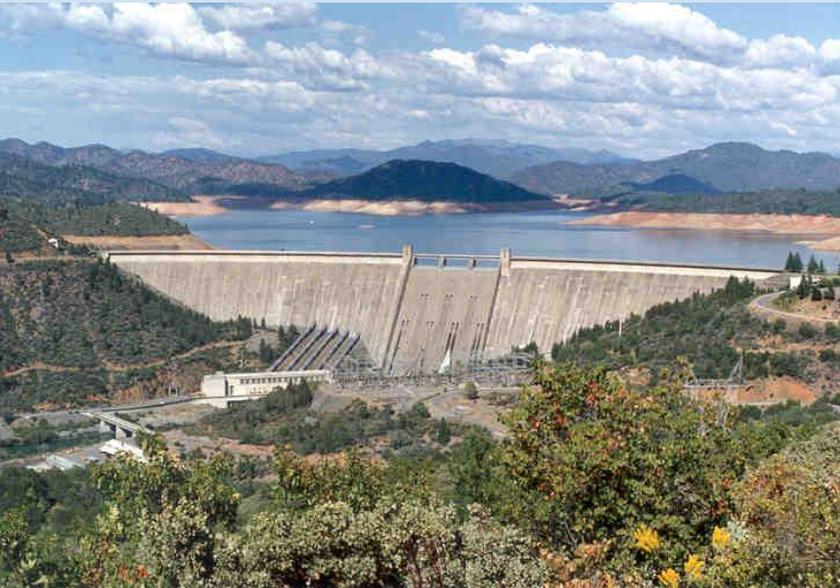
State Water Project

California DWR

1960 - Burns Porter Act

Federally Funded Projects

💧 35 federally funded dams, reservoirs and canals. Built by U.S. Army Corps of Engineers and U.S. Bureau of Reclamation



Shasta Dam

💧 Central Valley Project (CVP), begins on the Sacramento River at Shasta Dam and ends near Bakersfield.

Federally Funded Projects - CVP



- 💧 90% used to irrigate farms in Central Valley

- 💧 Some water to urban residents in the Bay Area

Financing

- 💧 1902: Reclamation Act – 160 acre service limitation
- 💧 1982: Act increased service limitation to 960 acres
- 💧 1992: CVPIA added environment as specific purpose created water account for environment

State-Funded Projects - SWP



Gov. Pat Brown at Oroville Dam

1961 – construction begins

Facilities were built from north to south – Oroville Dam to Southern California.

The State Water Project is the largest state-financed water project ever built.

Committed to the State Water Project



Governor Pat Brown was elected in 1958.

Gov. Brown made authorizing, financing, and building the State Water Project a priority of his administration.

“I was absolutely determined that I was going to pass this California water project.”

Burns-Porter Act



1959 - The state Legislature authorized construction of the State Water Project through the California Water Resources Development Bond Act, also known as the Burns-Porter Act

State Water Project



- 💧 SWP includes 34 storage facilities; 20 pumping plants; 4 pumping-generating plants; 5 hydroelectric power plants; and about 700 miles of open canals and pipelines.
- 💧 Planned to deliver 4.2 MAF/year; currently delivers less than 3.0 MAF/year – reliability diminished due to lack of construction of some planned facilities and new regulatory requirements.
- 💧 About 30% of deliveries to agriculture in the San Joaquin Valley and 70% to urban Southern California, Bay Area and Central Coast.

Financing the SWP

- 💧 1960 - \$1.75 billion bond
- 💧 29 contractors pay all costs, including bond interest, energy and transmission charges per Water Supply Contracts
- 💧 No acreage limitations



San Luis Reservoir

Water and Energy

- 💧 20% of state's electricity is used to bring water to consumers and send it away for sewage treatment.
- 💧 SWP is single-largest power consumer in California
- 💧 SWP is the fourth-largest power generator in California, generating about two-thirds of electricity to run its facilities.



Hyatt Powerplant below Lake Oroville is in a cavern the size of two football fields.

Joint Operation of the CVP/SWP

- Upstream reservoirs capture water during wet season and snow runoff
- Stored water released to meet regulatory requirements and water deliveries to SWP and CVP customers
- Coordinated Operations Agreement
 - Joint responsibilities for Delta Water Quality Management
 - Sharing of access to unregulated surplus flows in Delta.

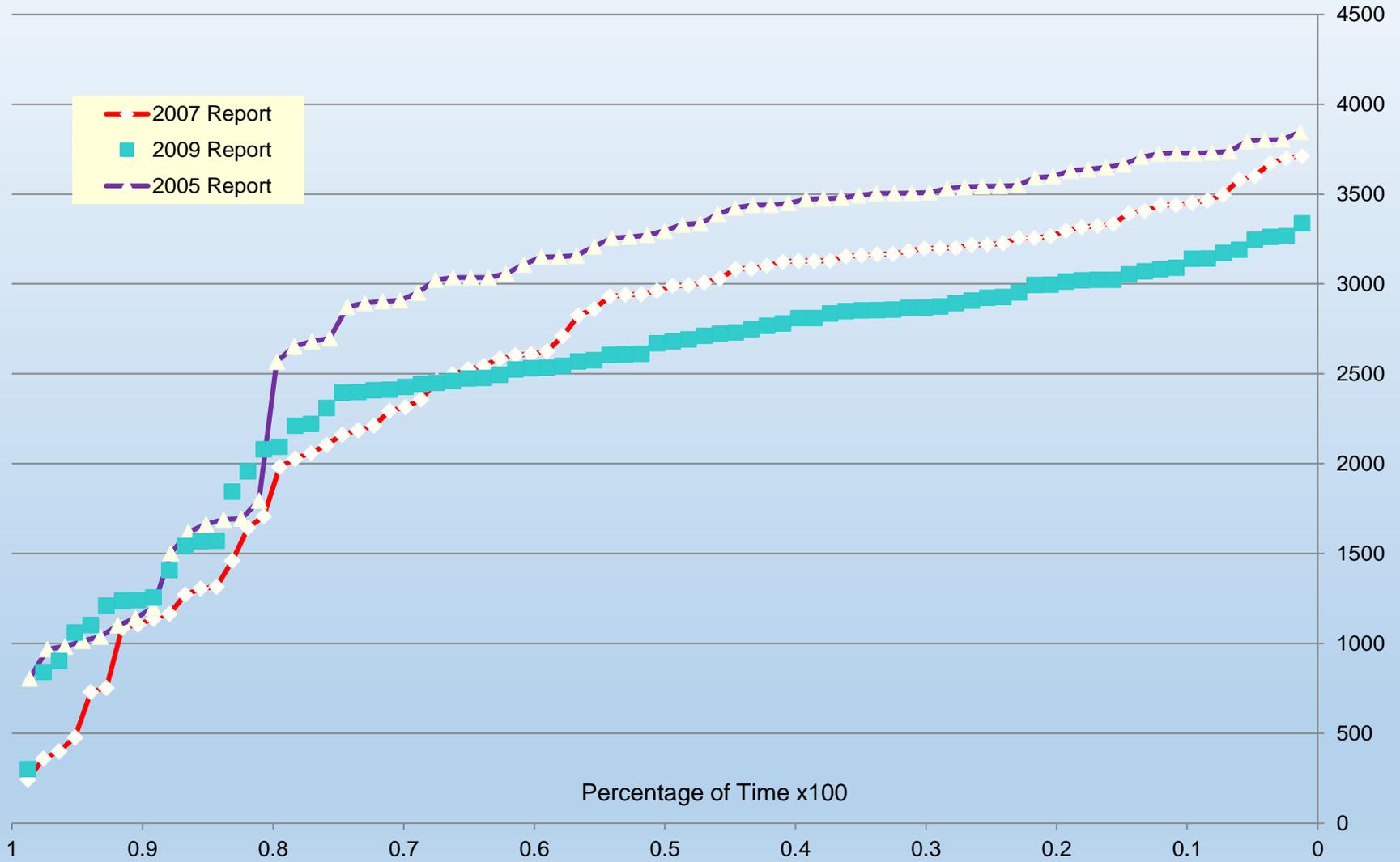
Operation of the CVP/SWP

- Water delivered to service areas by contract, subject to agreements with *senior* rights holders
 - *Sacramento River Settlement Contractors (CVP)*
 - *San Joaquin River Exchange Contractors*
 - *North Delta Water agency (SWP)*
 - *City of Sacramento*
 - Project contractors:
 - Tehama Colusa Canal, Sacramento area contractors, Contra Costa WD,
 - Export service: San Luis Delta Mendota Water Authority, Santa Clara Valley WD, EBMUD
- Reservoir storage, natural river conditions and regulatory requirements determine water available for export

Operation of the CVP/SWP

- Export supply determined by:
 - Snowpack
 - Reservoir storage
 - Instream flow requirements
 - Delta flow/water quality/fish protection regulations
 - Export pumping capacity
- If demand or available storage capacity exists and there is pumping capacity within requirements, water can be pumped.
- Over past decades, shift from demand limited system to regulatory constrained system.

Regulatory Restrictions Have Degraded SWP Water Reliability



Locally Funded Projects

600 cities and local agencies provide water through local projects and imported supplies.

Local systems:

- 💧 San Francisco's Hetch Hetchy Project
- 💧 East Bay Municipal Utility District's Pardee and Camanche Reservoirs and Aqueducts
- 💧 Los Angeles' Owens Valley and Los Angeles Aqueduct
- 💧 Metropolitan's Colorado River Aqueduct & Diamond Valley Lake





Hetch Hetchy

Raker Act (1913)

- Federal lands in the Sierra Nevada Mountains, including Hetch Hetchy Valley in Yosemite, used to build the water system
- The Bay Area Water Supply and Conservation Agency (BAWSCA)
- 1.7 million citizens and businesses

More Local Systems

💧 Metropolitan Water District of Southern California - largest local district
- operates Colorado River Aqueduct.

💧 Other local projects serve farmers, such as Glenn-Colusa Canal in the Sacramento Valley.



Diamond Valley Lake (MWD photo)



SAN DIEGO AQUEDUCT
2ND BARREL NORTH SECTION
THE LAST PIPE

DESIGNED United States Bureau of Reclamation
FOR San Diego County Water Authority
FINANCED United States Navy
WATER FROM Metropolitan Water District of So Calif
BUILT BY Johnson Western Constructors

Major Water Projects



Environmental Protection Law



American River

- 💧 1972 State Wild and Scenic Rivers Act - no dams or diversion facilities on the Smith River and parts of Klamath, Trinity, Van Duzen, Scott, Eel, Salmon, Feather and American
- 💧 In 1980, some rivers added to the Federal Wild and Scenic Rivers System
- 💧 Today parts of other rivers included

Environmental Protection Law

- Federal and State Endangered Species Acts
- Federal Energy Regulatory Commission
- Clean Water Act
- Porter Cologne water quality act
- Fish and Game code
- California Environmental Quality Act

Groundwater

Groundwater exists in aquifers – water bearing permeable rock or unconsolidated gravel, sand or silt

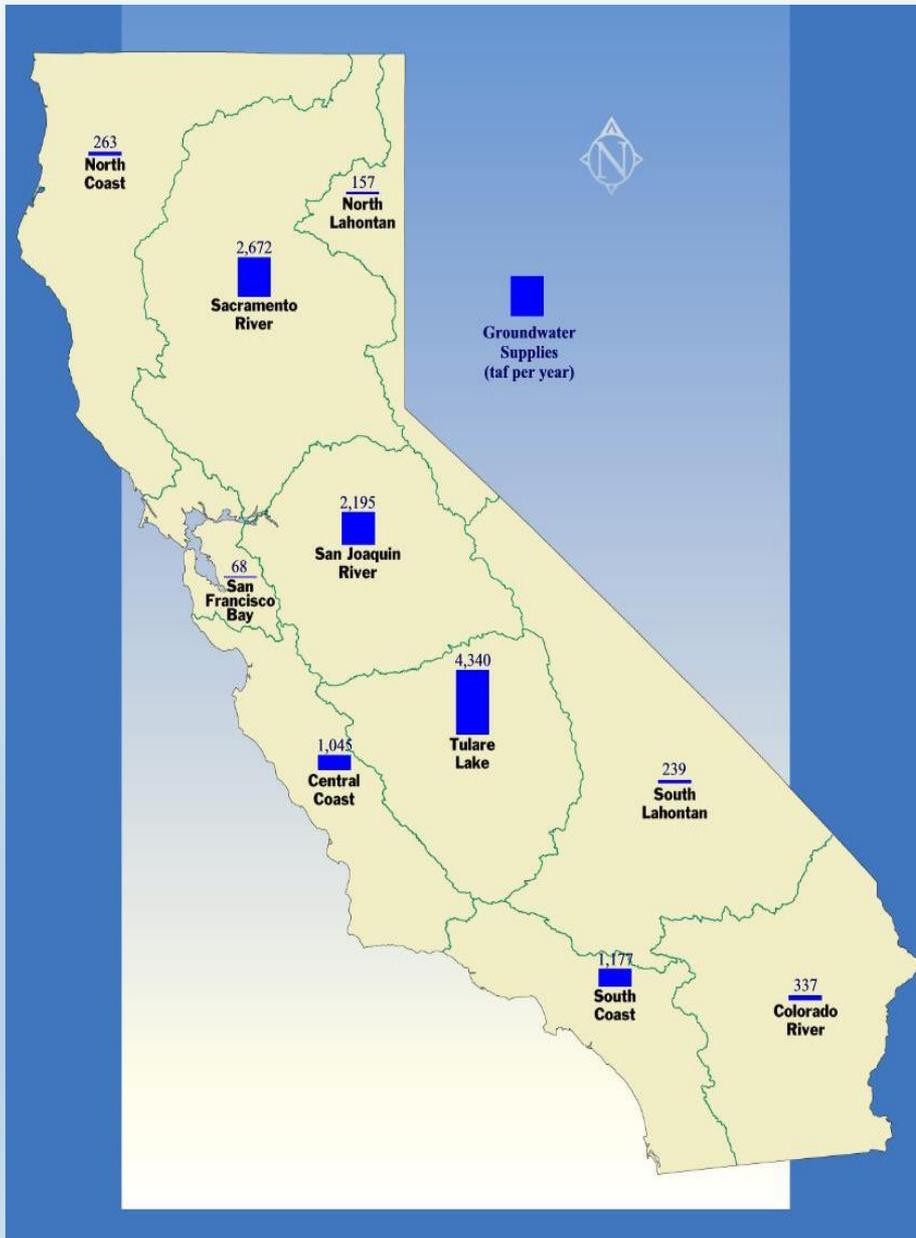
💧 About 30% of state's ag and urban water supply comes from groundwater in normal years; more in dry years.

💧 California uses more groundwater than any other state – about 40% of population gets drinking water from groundwater

💧 Groundwater that is “conjunctively managed” with surface water is an important source of agricultural supply



Groundwater Supplies



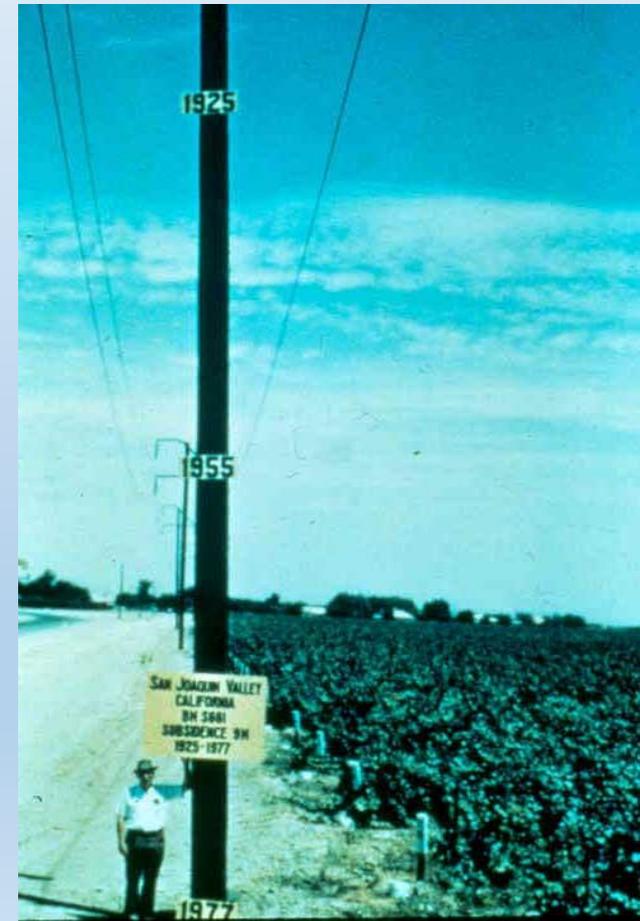
Where is the groundwater?

More than 400 groundwater basins hold about 850 MAF of water. Only a fraction of that total minority that is economically usable.

Groundwater Overdraft

Overdraft is taking more water out of an aquifer than is recharged over a long term (multi-year) time span

- 💧 Historical overdraft in Central Valley led to construction of Central Valley Project
- 💧 NASA - Central Valley has pumped enormous amounts of groundwater from 2003-2009 - 24.3 million acre feet since 2003 – enough to fill Lake Powell, 2nd largest reservoir in USA
- 💧 Even greater amounts pumped during recent historic drought.



USGS scientist shows overdraft in San Joaquin Valley, 1970s

Groundwater Management

- 💧 In Southern California, many groundwater basins have been adjudicated, with courts establishing the pumping rights of many parties.
- 💧 Historic regulation of groundwater – 2014 Sustainable Groundwater Management Act provides local authority and responsibility to manage groundwater.

Groundwater Pollution

Pollution is a serious threat. All the state's groundwater basins are contaminated to some degree.

- 💧 Trichloroethylene (TCE) - Used in adhesives, lubricants, paint products, pesticides, adhesives, rug-cleaners
- 💧 Perchlorate - Primary ingredient of solid rocket propellant
- 💧 Methyl tertiary butyl ether (MTBE) - added to gasoline to reduce air pollution in 1990s
- 💧 Groundwater overdraft can mobilize polluted groundwater



Flood Management

💧 Floodplain Management

- In next 25 years population increase of about 14 million. Development will impact floodplains

💧 Levee Repairs

- Nearly 250 levee repair sites identified and work progressing

💧 Climate Change

- Warming ocean water and melting ice = sea level increase by 1.6 feet by 2050 along coastlines. By 2100 sea rise could be more than 3 feet. Recent warming running ahead of predictions and estimates may be low



Flood Management: Levees

2005 – Hurricane Katrina

2006 – California Reacts to Flood Risk

Gov. Schwarzenegger declares a State of Emergency for California's levee system

- Flood Bonds passed

2012 – Central Valley Plan

Strategic Plan for improving flood management in Central Valley

2013 – Statewide Plan

Strategic Plan for improving flood management statewide



Diversifying Water Supply

- Governor Brown's California Water Action Plan founded on "all of the above" approach to improving water supply reliability
- State guidelines for Integrated Regional Water Management Plans require analysis of:
 - Ocean Desalination
 - Wastewater Recycling
 - Water Conservation
 - Stormwater Capture
 - Water Transfers

Ocean Desalination

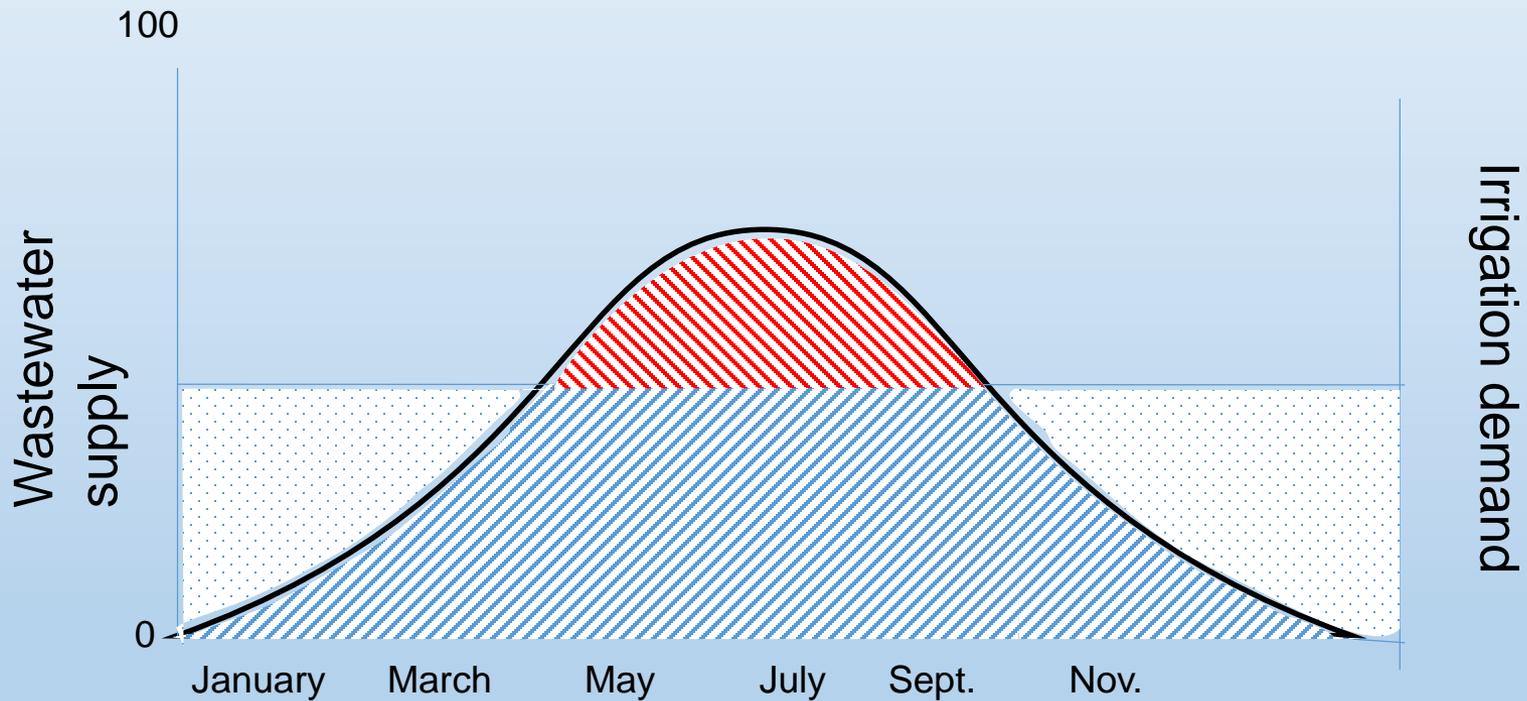
- Popularly viewed as ‘ultimate’ solution
- Process is reliable but expensive
- Energy/Greenhouse Gas considerations
- Limited application
 - For additional baseload supply where imported water is expensive and unreliable
 - For isolated coastal urban locations
- Uneconomic for agriculture or urban irrigation
- Expect more, but limited application in future

Wastewater Recycling

Process of recycling treated sewage for non-potable and potable uses

- Requires separate plumbing system for non-potable applications
- Economic justification includes consideration of reliability and offset in treated wastewater disposal costs
- Expect more in future, particularly with incentive of state and federal cost shares

Conceptual Recycled Water Potential Typical Urban Location



Water Conservation

- Reduction in use/demand management
- Role in water supply reliability planning – long term efforts
- Role in drought response – temporary use reductions
- Long term efforts cause ‘demand hardening’, limiting easy drought response
- Historic drought fueled movement for “Making conservation a California Way of Life”

Stormwater Capture

- Generally focused on urban areas
- Receiving re-look as other sources less available, costs rise
- Very site specific: capture opportunities, storage opportunities, treatment issues
- Link to sustainability planning – limiting hardscape, local water retention, infiltration strategies

Water Transfers

- Where one entity with excess supply transfers to another in need
- Common inter and intra-district strategy in agriculture
- Increasingly a way to shore up urban supplies
- Transfers using CVP/SWP infrastructure
 - Temporary land fallowing
 - Transfers from water storage
- Complicated due to legal and physical constraints

Water Transfers

- Legal issues:
 - Real water test
 - Source of water and water rights:
 - location, pre-'14 water right no SWRCB jurisdiction, lead agency under CEQA is transferring agency; one-year exemption
 - If a post-'14 water right SWRCB lead agency and exempt from CEQA for one year transfer 'SWRCB equivalent process'
- Physical issues: *can you move it through the Delta?*

Summary

- California's historical development and its supporting water development was shaped by unique geography
- Development and management of water supply in California involves a complex mix of Federal, State, Local and private interests operating under an increasingly complicated regulatory regime seeking balancing of water demands with natural resource protection
- Water supply planning has evolved from “gap analysis” to “risk analysis” and an integrated water management approach that values diverse portfolios to maintain supply reliability
- A growing population, competing demands, and climate change effects will make water resources management an ongoing challenge