Issues in the Provision of Sanitation Services and Wastewater Reuse

Iranian/US Workshop on Water Management

William R. Mills, General Manager, Retired (1987-2002)

Orange County Water District

August , 2008

Or -
Water Recycling

- A New Water Supply for Domestic Use

- Increasing Reliability for Economic Growth and Sustainability

Outline of Presentation

- California Economy and Water Resources
- Water Development
- Southern California
- Santa Ana River Watershed
- The River
- Water Recycling
- Water Reliability

Rainfall is unevenly distributed in CA

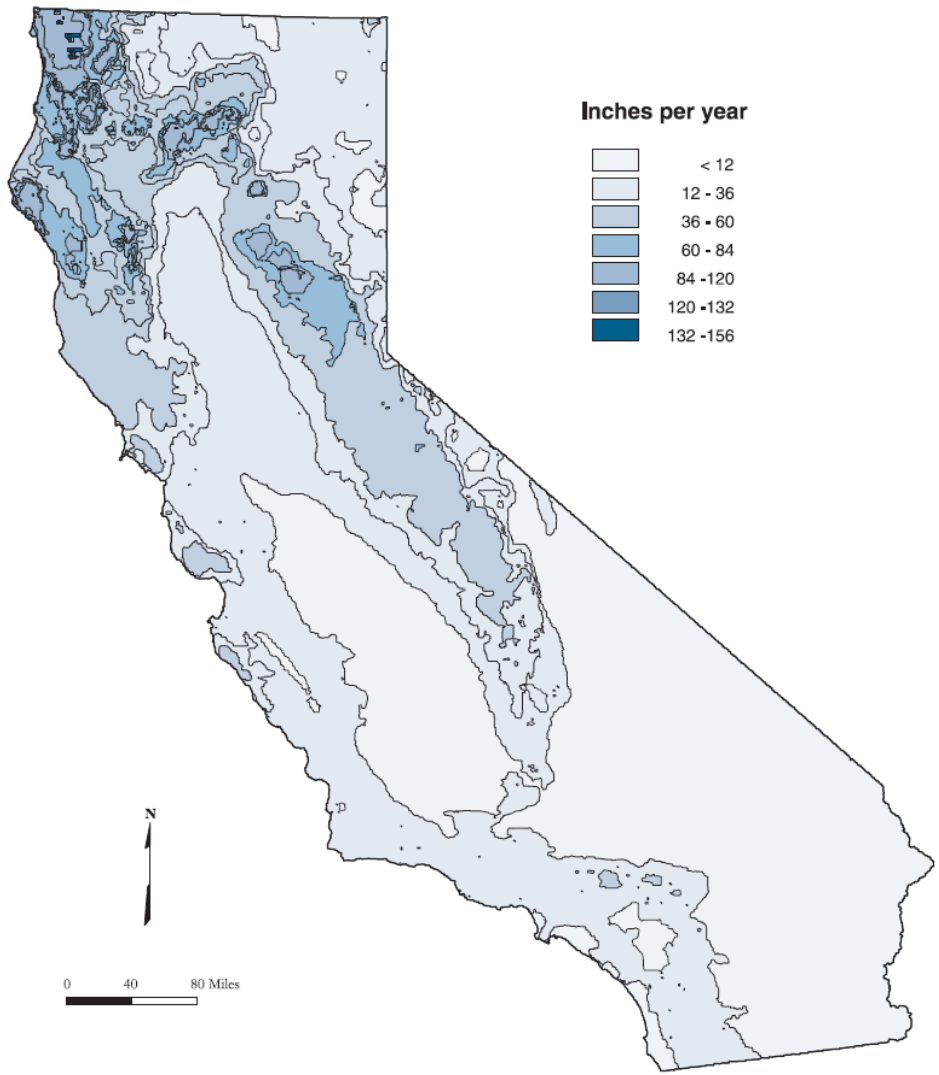


Figure 2 Mean annual precipitation in California, 1961 to 1990

Response

- Constructed Large Water Distribution Systems across the state
  - Central Valley Project
  - State Water Project
  - Colorado River Project

Development of CA's Major Water Systems

Central Valley Project (8,600 Mm^3/yr)

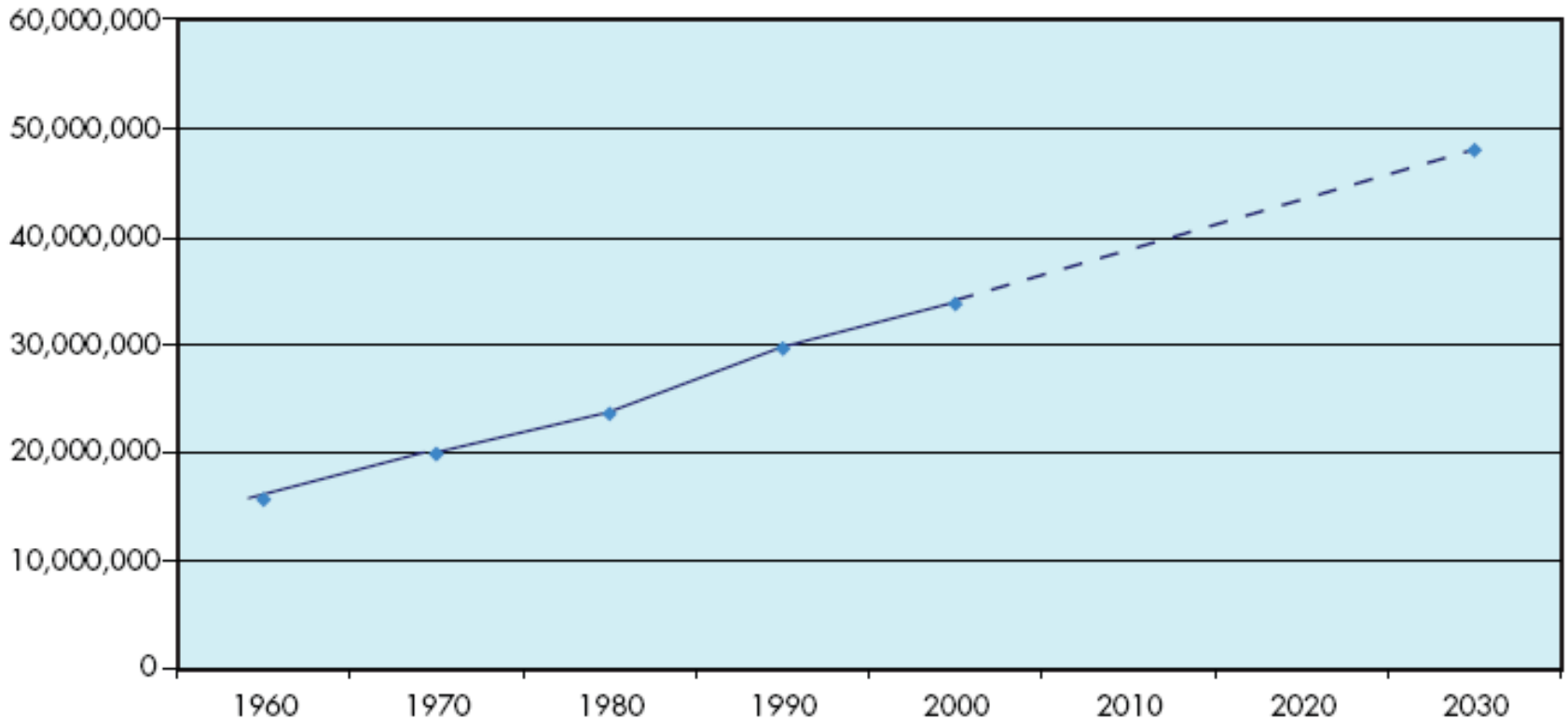
FIGURE 3-15
Major Central Valley Project Facilities

State Water Project (3,700 Mm^3/yr)

State Water Project –the missing segment


Colorado River Basin
WY
UT
NV
CO
CA
NM
AZ
MEXICO
RIVER
UPPER BASIN
LAKE POWELL
LEE FERRY
LAKE MEAD
LOWER BASIN
LAKE MOJAVE
LAKE HAVASU
COLORADO
COLORADO RIVER AQUEDUCT
All-American Canal
GILA RIVER
COLORADO RIVER DELTA
GULF OF CALIFORNIA

Population forecast – 48 Million by 2030



Surface Water Supply Systems are unreliable to meet future water needs.

- Environmental Issues – Delta Smelt
- Population Growth
- Alternatives:
  - Reallocation of Ag Water
  - More Storage Facilities
  - Ocean Desalting
  - Wastewater Recycling

Groundwater is major water supply in CA

- Provides 1/3's of total demand Statewide in average year.
- Provides 1/2 of total demand Statewide in drought years.
- Provides 1/3 of total demand in Southern CA.

Groundwater in CA

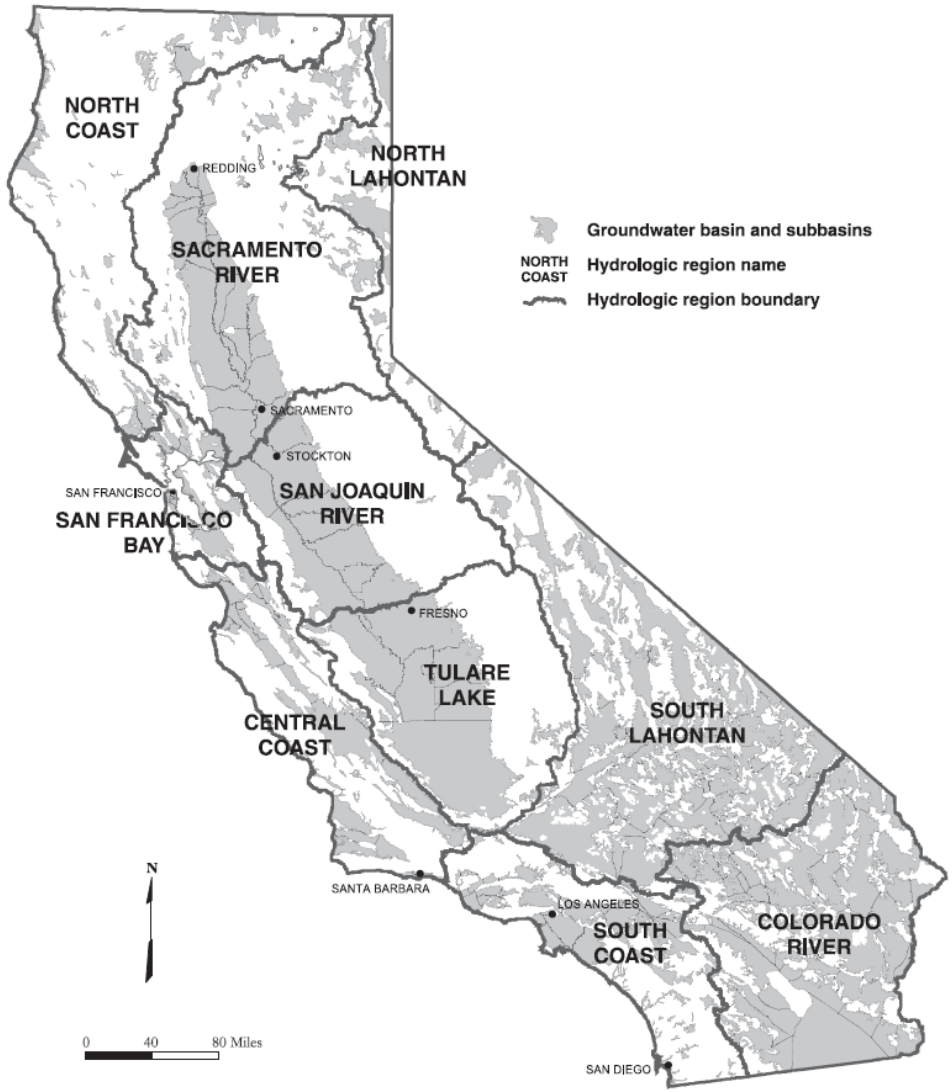
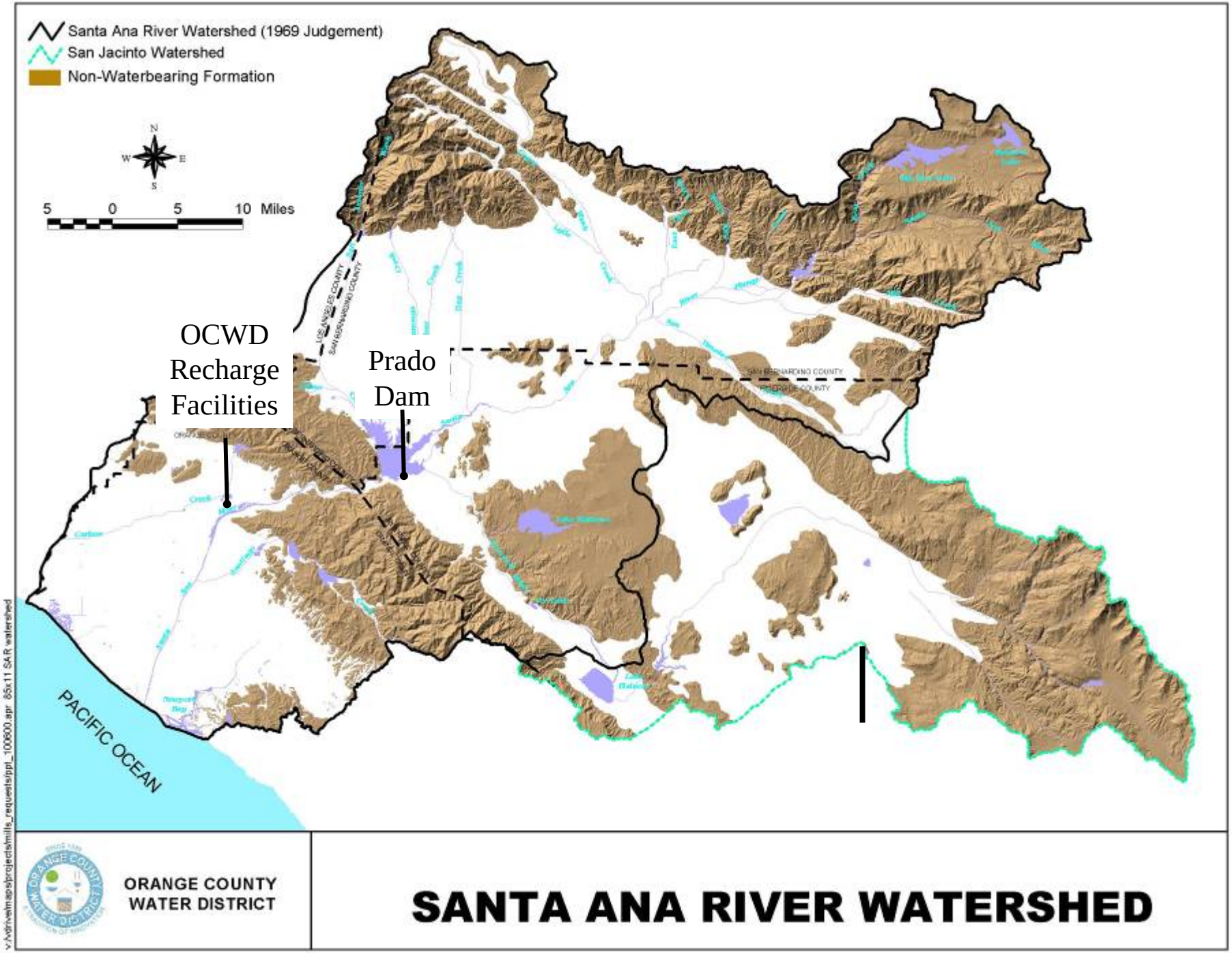


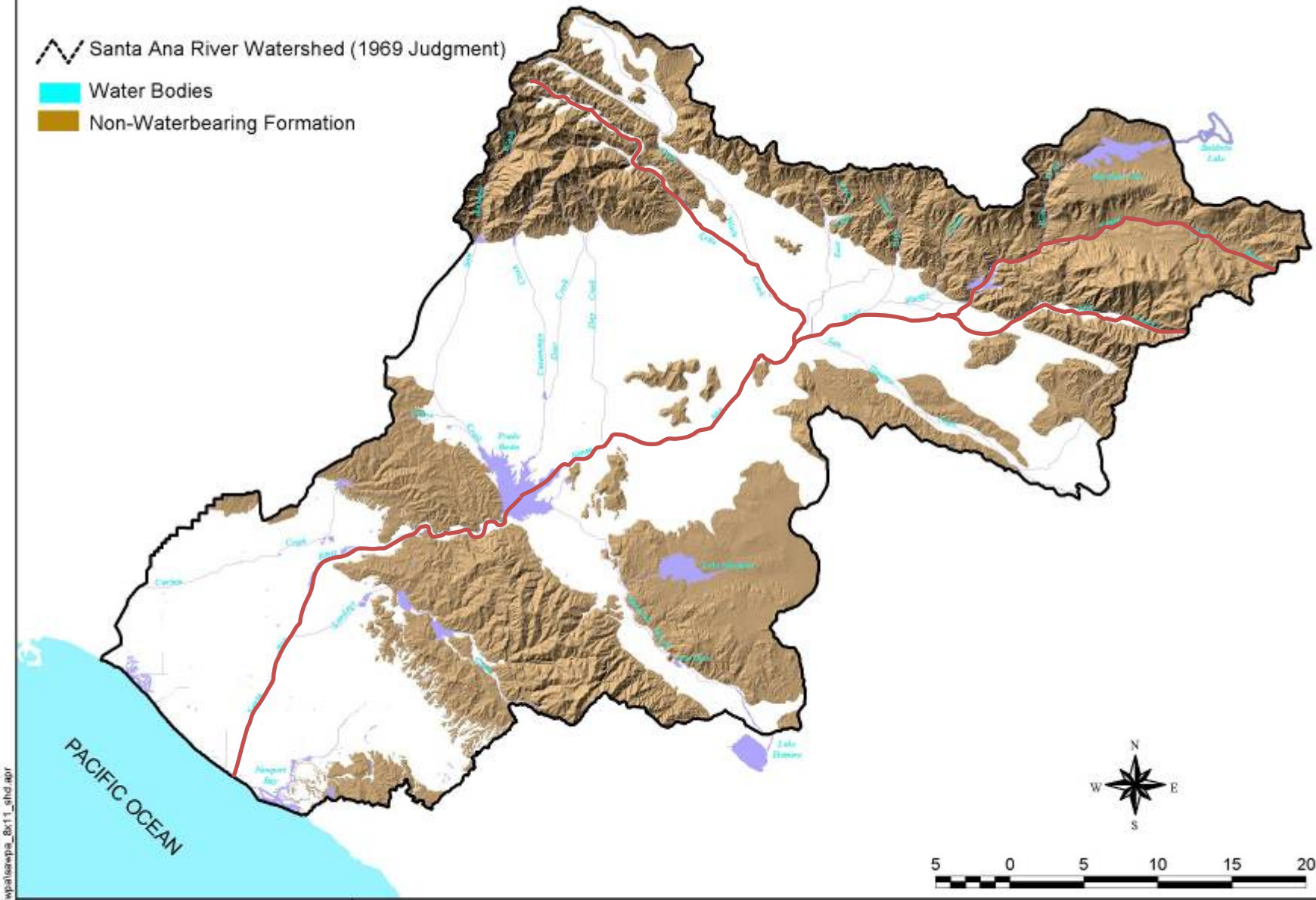
Figure 3 Groundwater basins, subbasins and hydrologic regions

Southern California's Imported Water


Los Angeles County
San Bernardino County
SANTA ANA RIVER WATERSHED
Riverside County
ORANGE COUNTY WATER DISTRICT
Orange County
San Diego County
N
W
E
S
5 0 5 10 15 Miles


Santa Ana River Watershed (1969 Judgement)
San Jacinto Watershed
Non-Waterbearing Formation
N
W
E
S
5 0 5 10 Miles
OCWD Recharge Facilities
Prado Dam
PACIFIC OCEAN
ORANGE COUNTY WATER DISTRICT
SANTA ANA RIVER WATERSHED

Prado Dam on Santa Ana River



SANTA ANA RIVER WATERSHED

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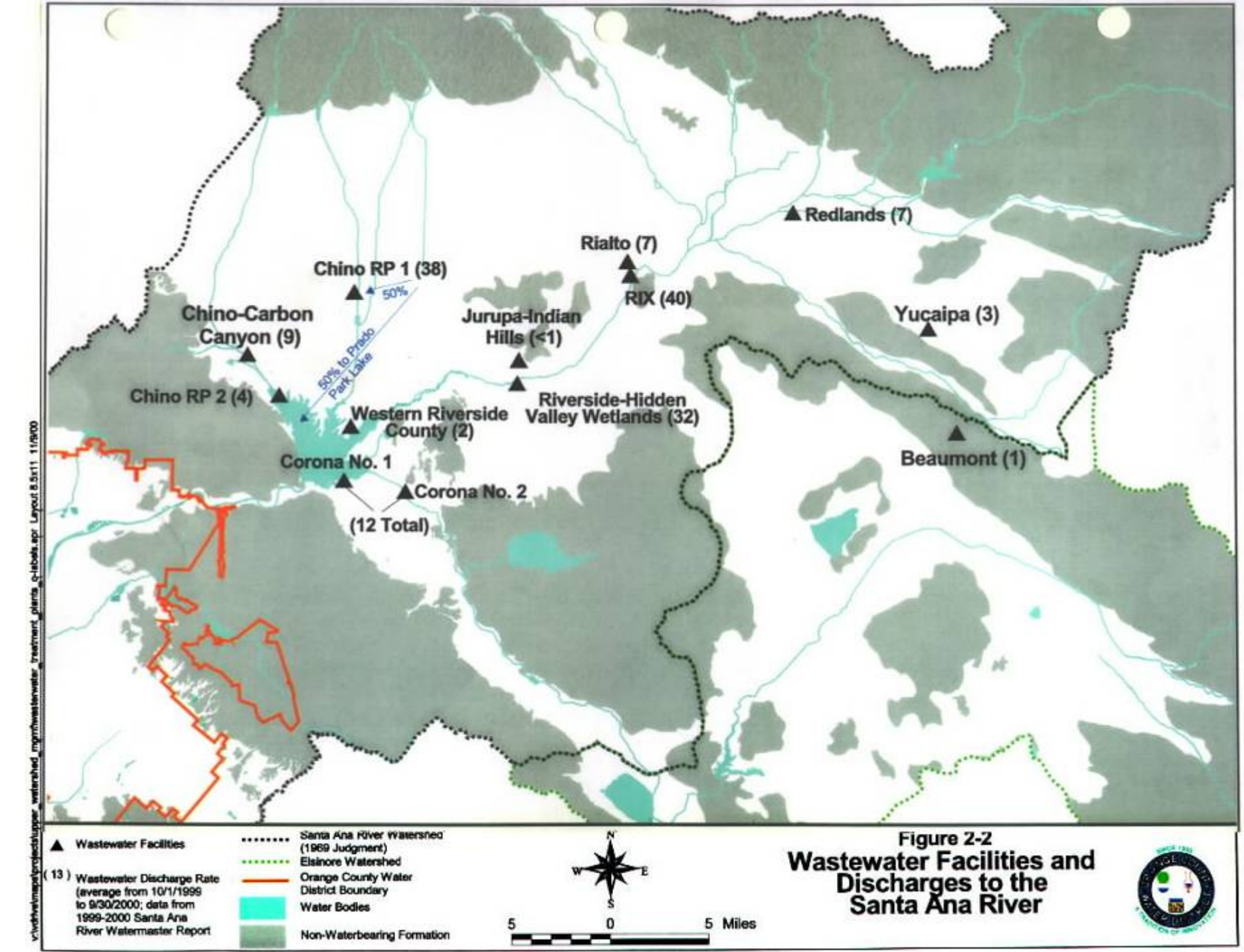


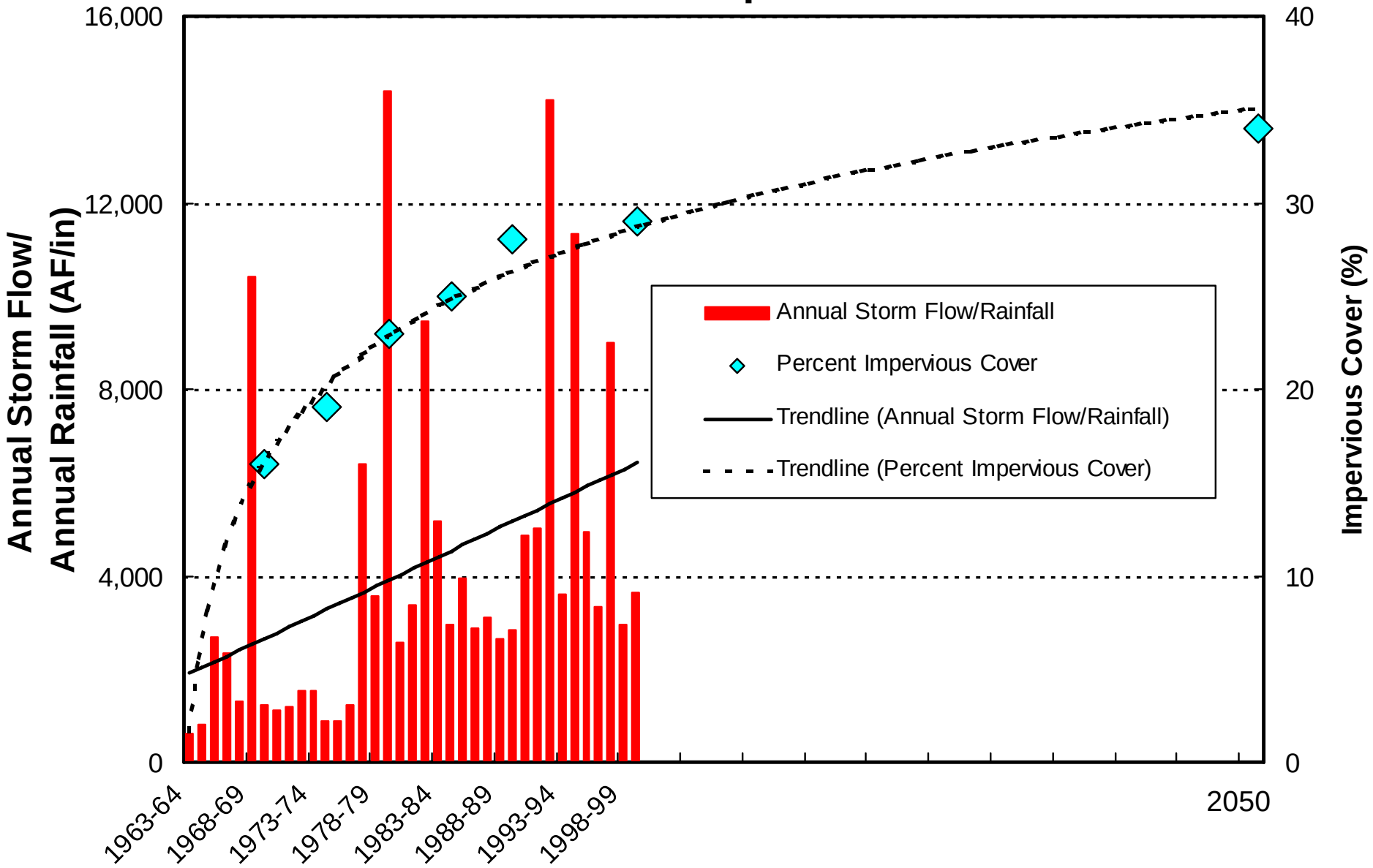
Figure 2-2
Wastewater Facilities and Discharges to the Santa Ana River

v:\vdrive\maps\projects\upper_watershed_mgmt\wastewater_treatment_plants_o-labels.apr Layout 8.5x11 11/9/00

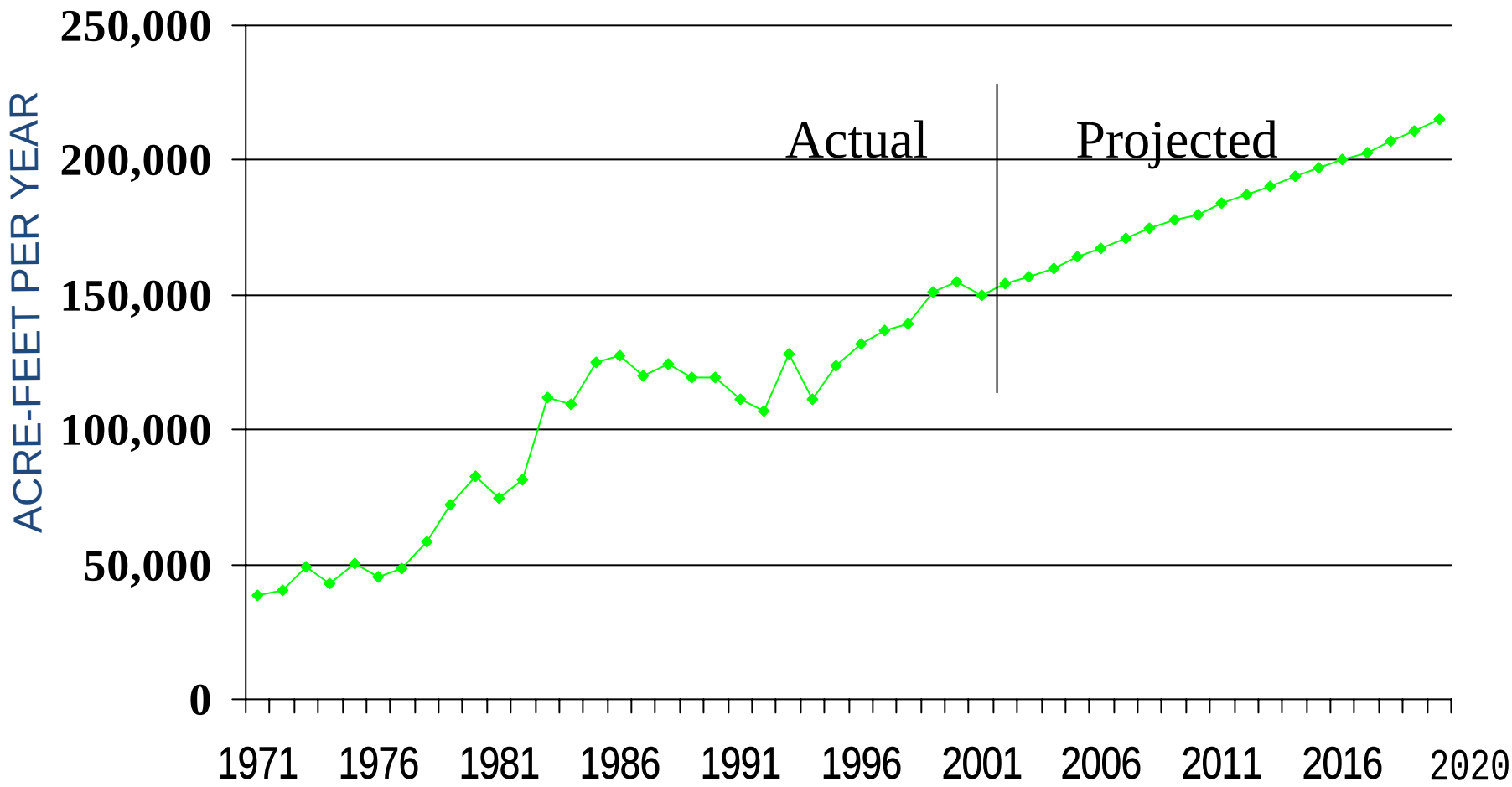
The Santa Ana River

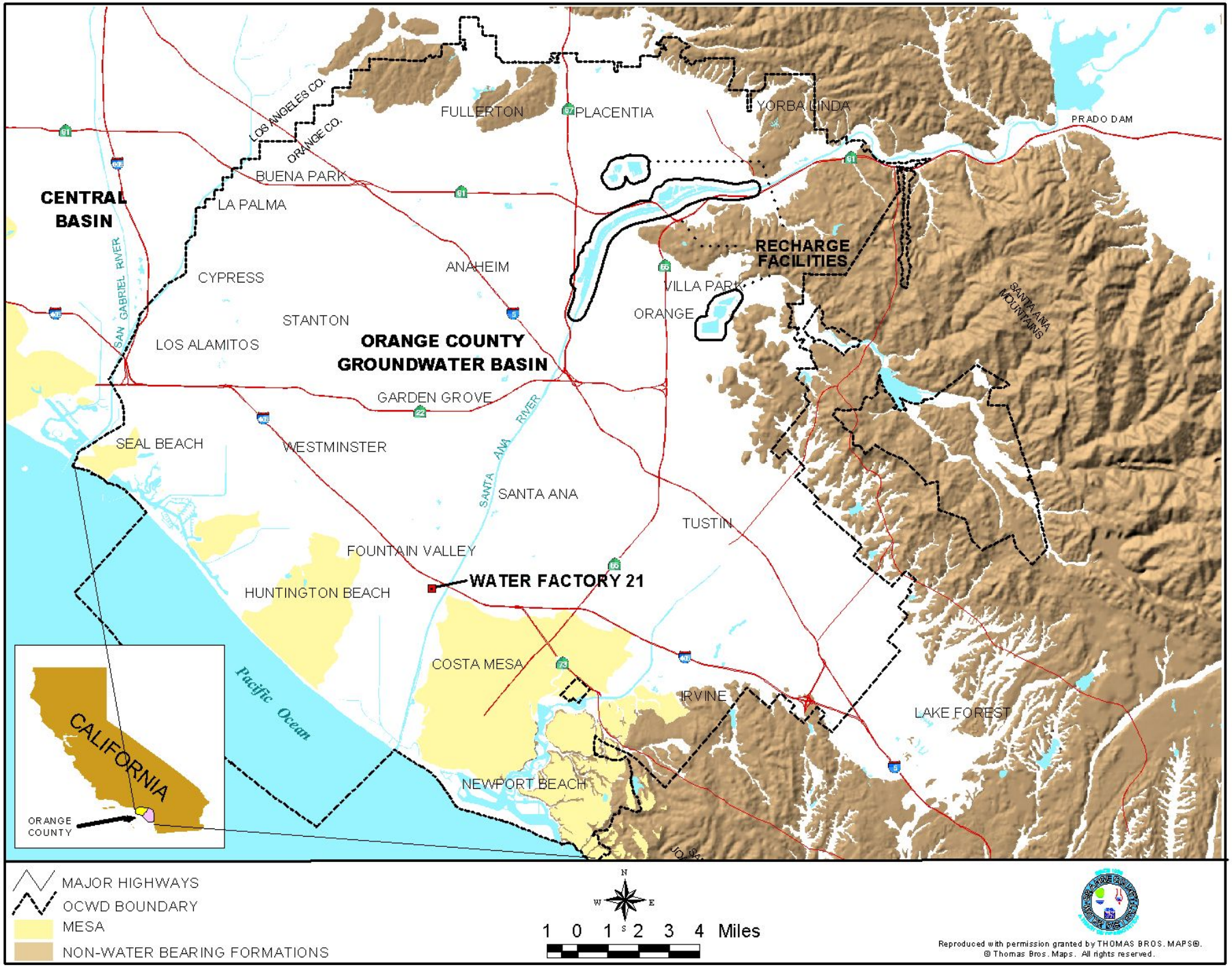
- Composed of :
  - Wastewater
  - Storm Water

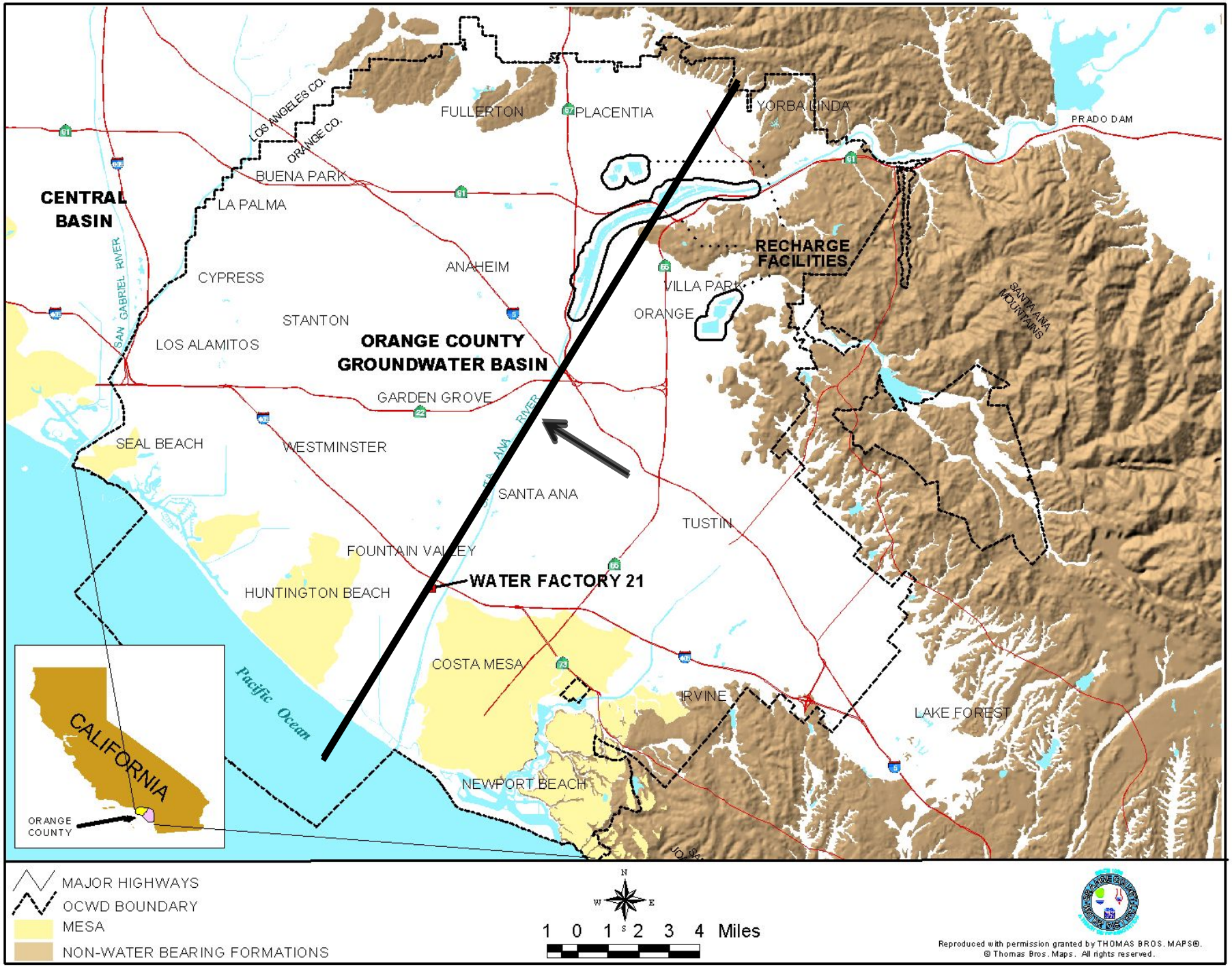
Santa Ana River Storm Flows at Prado and Percent Impervious Cover



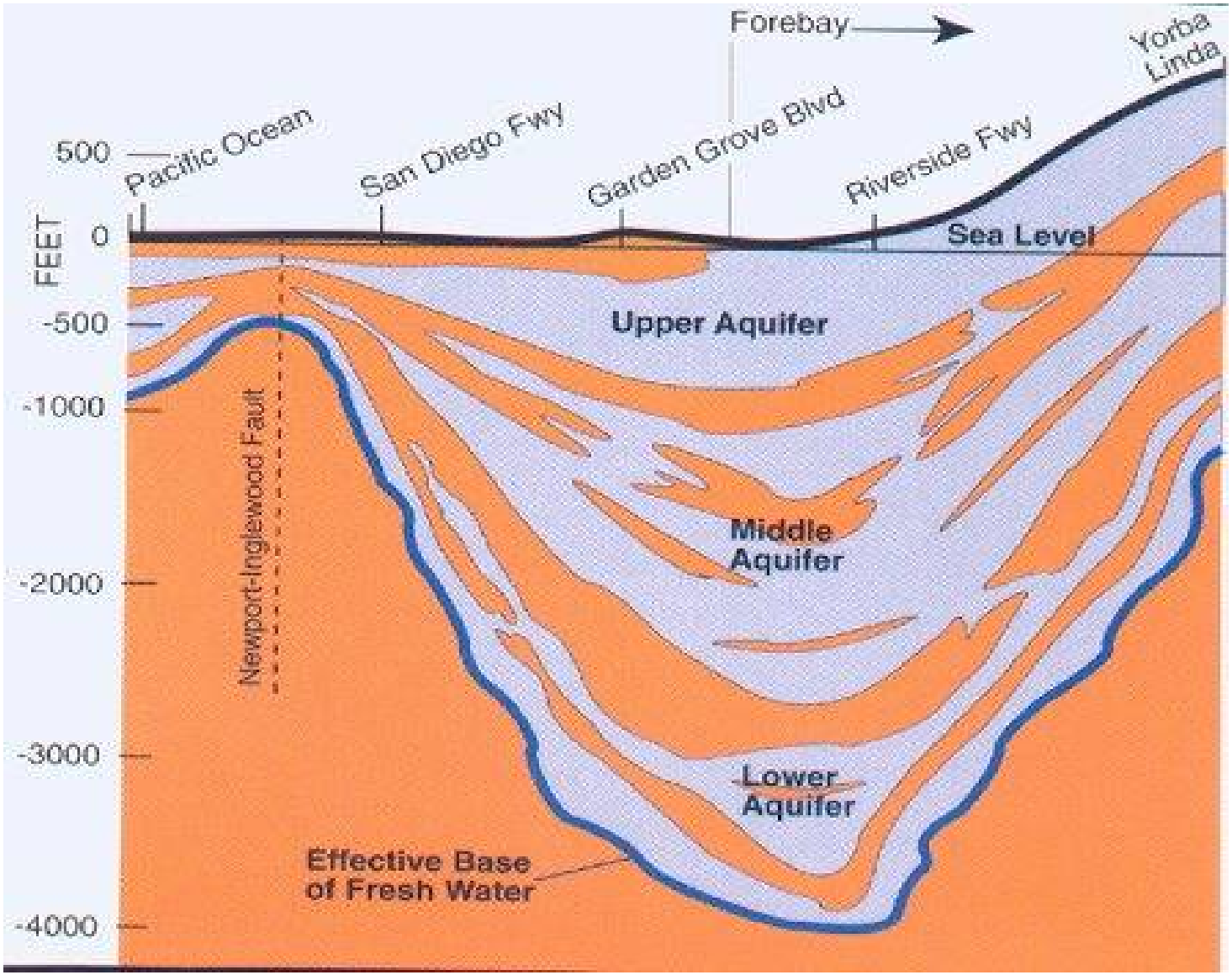
SANTA ANA RIVER BASE FLOWS



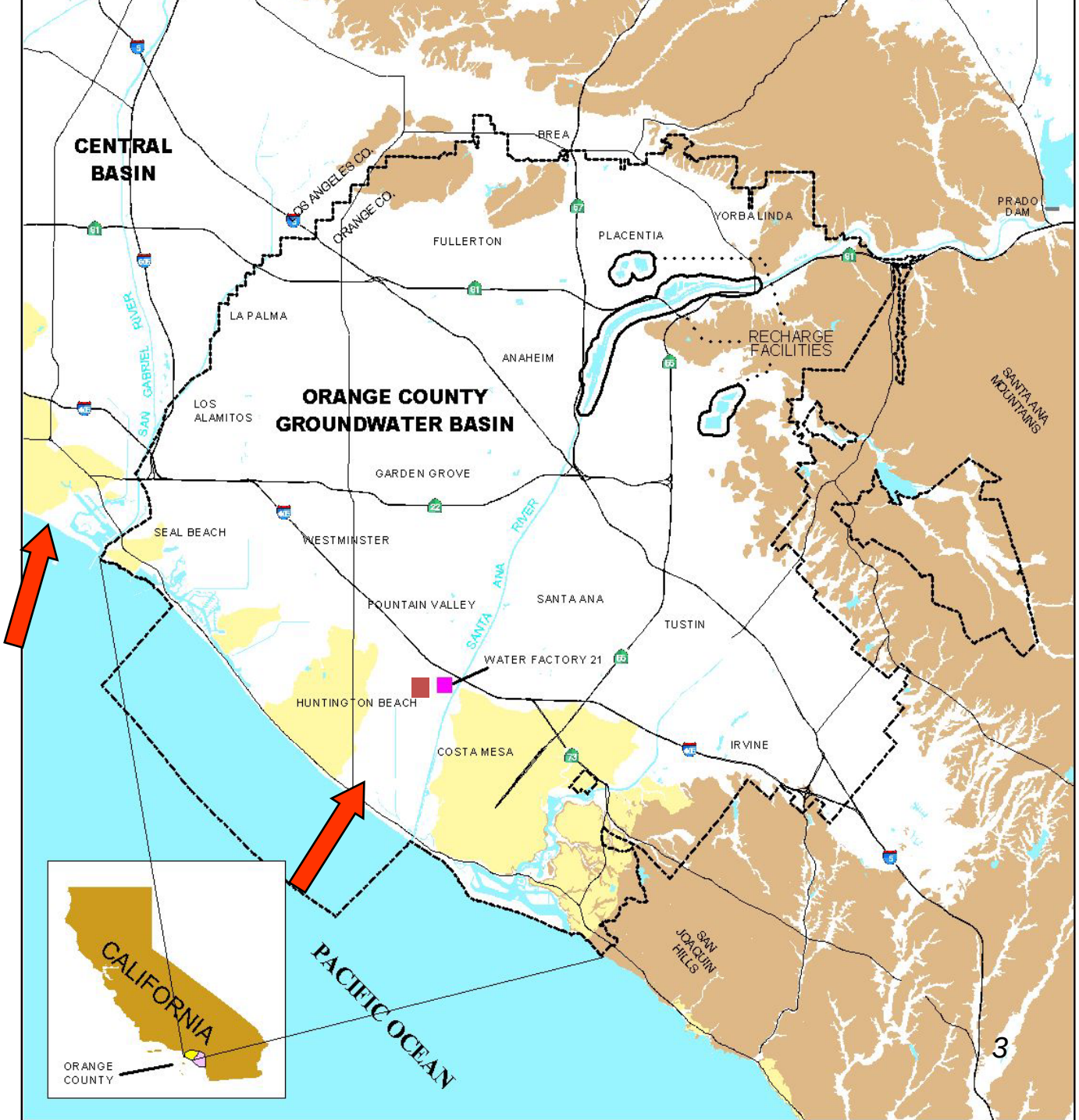


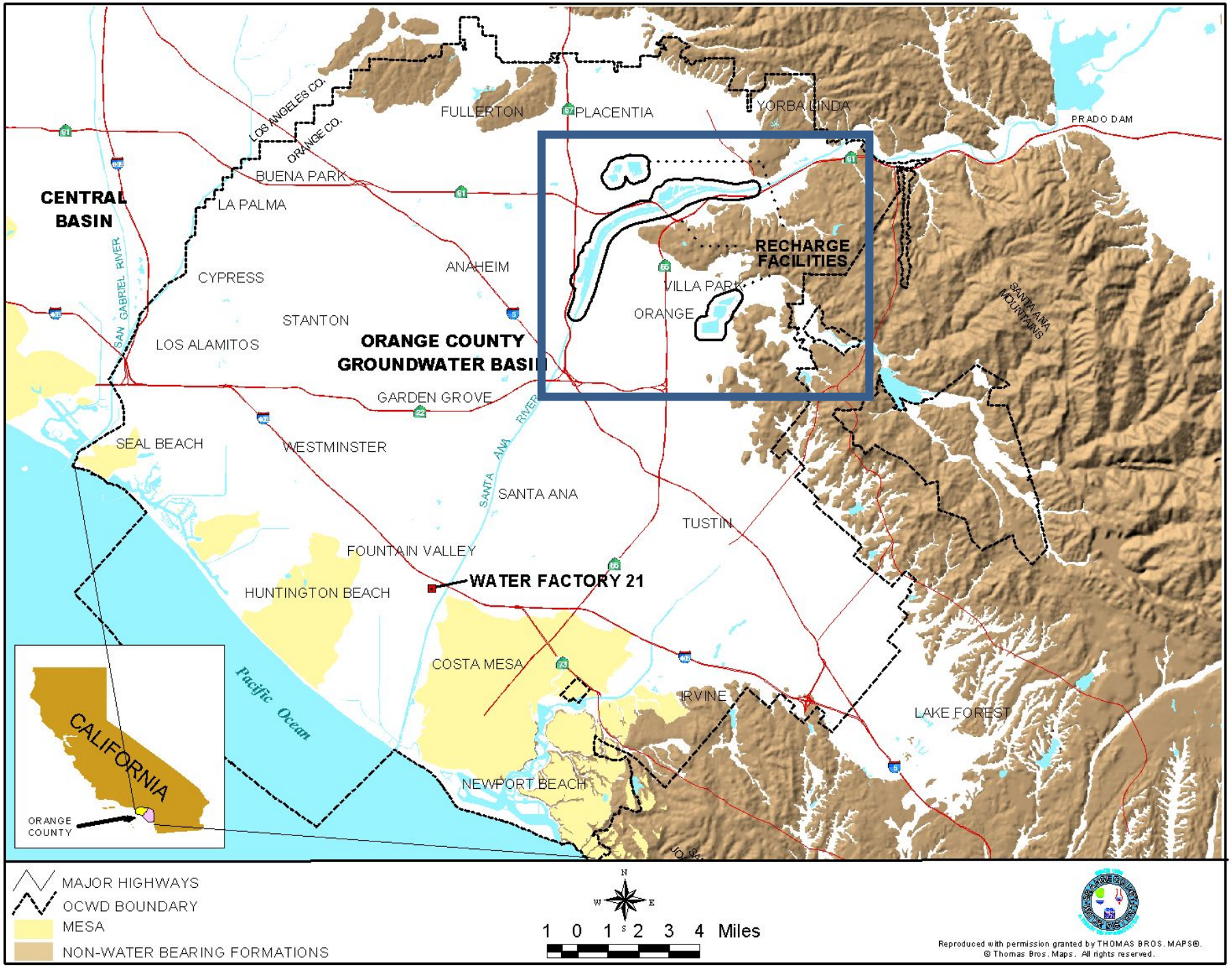


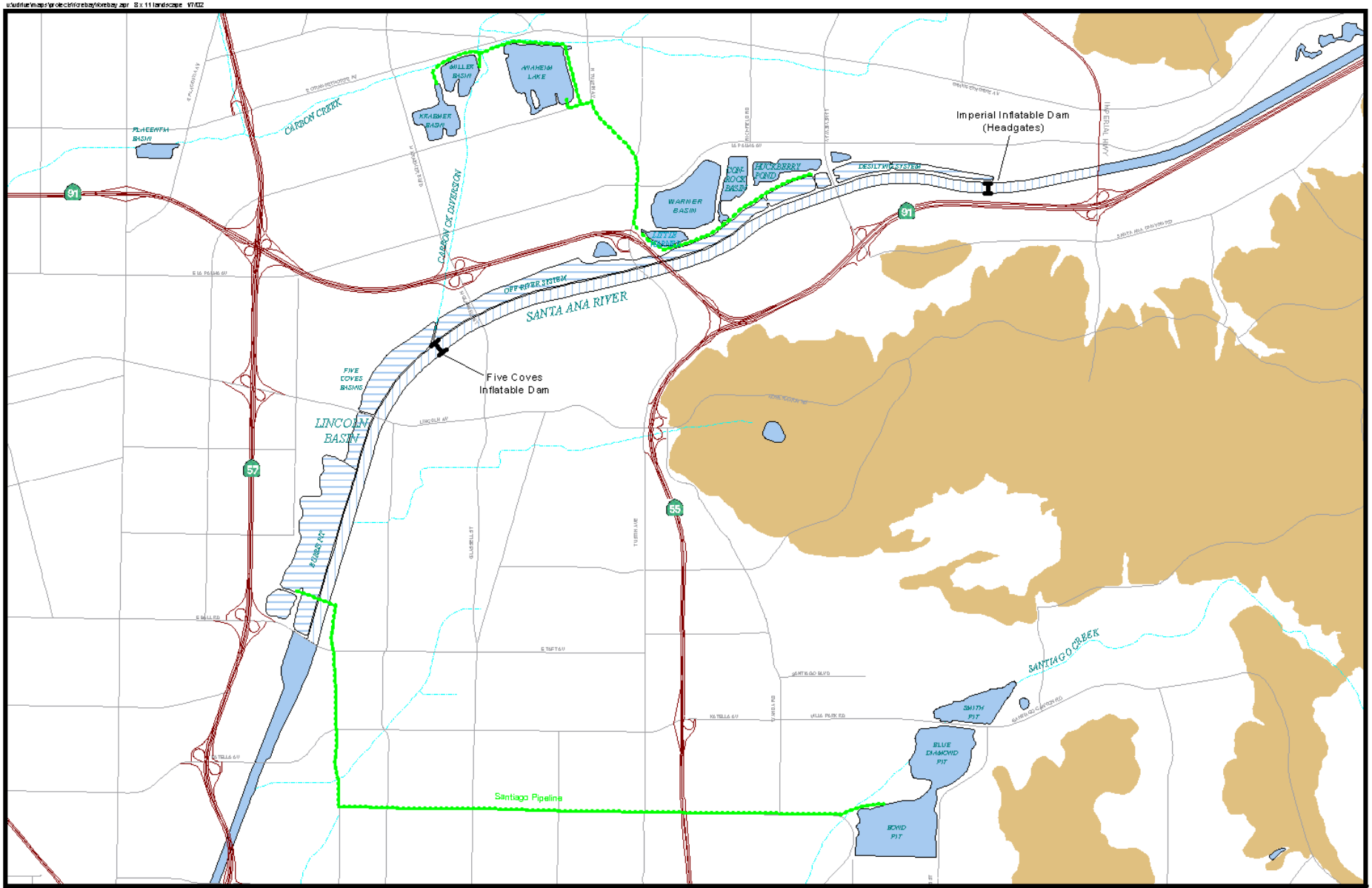
Orange County Groundwater Basin



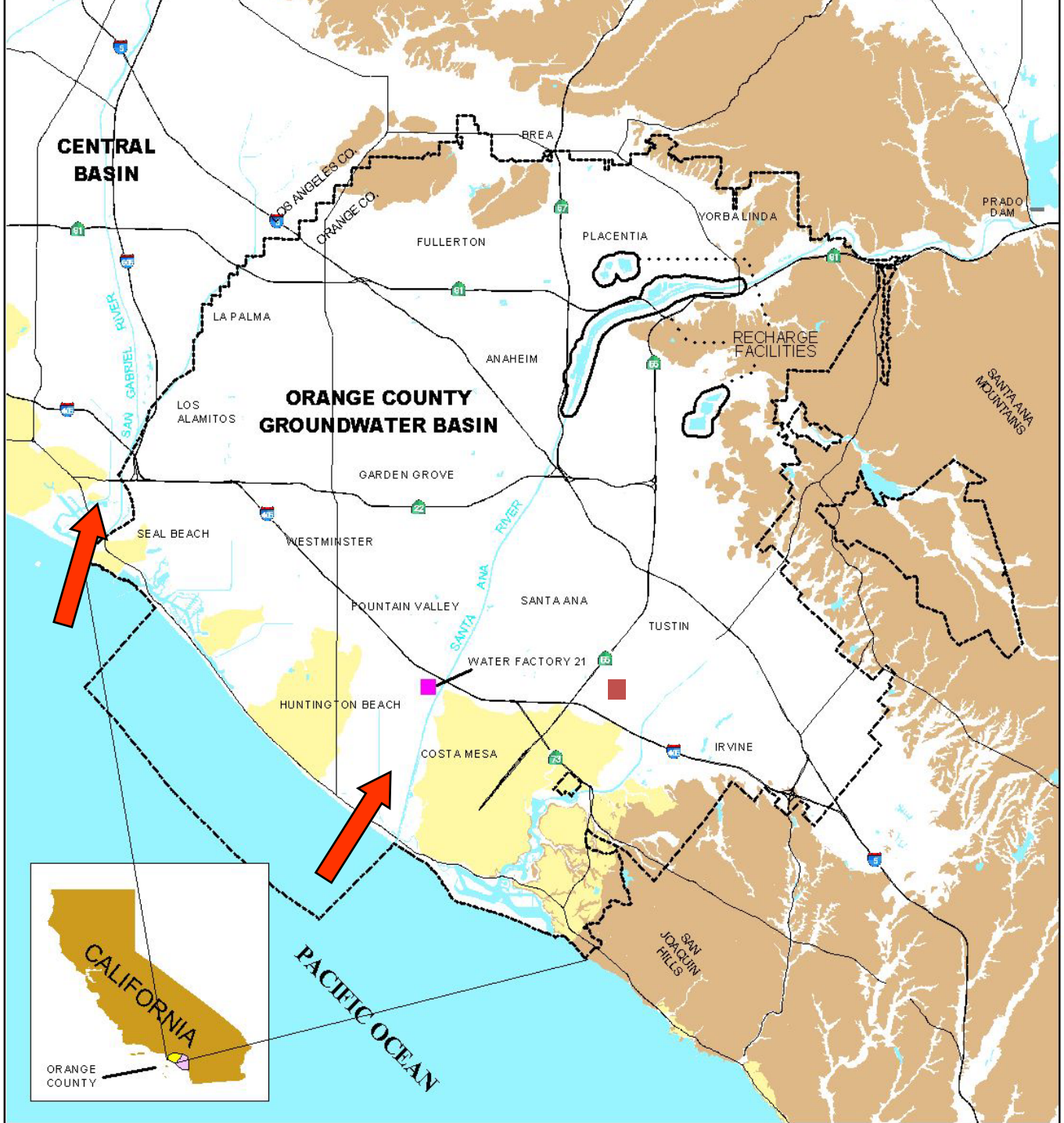
Coastal geologic gaps act as conduits for potential seawater intrusion





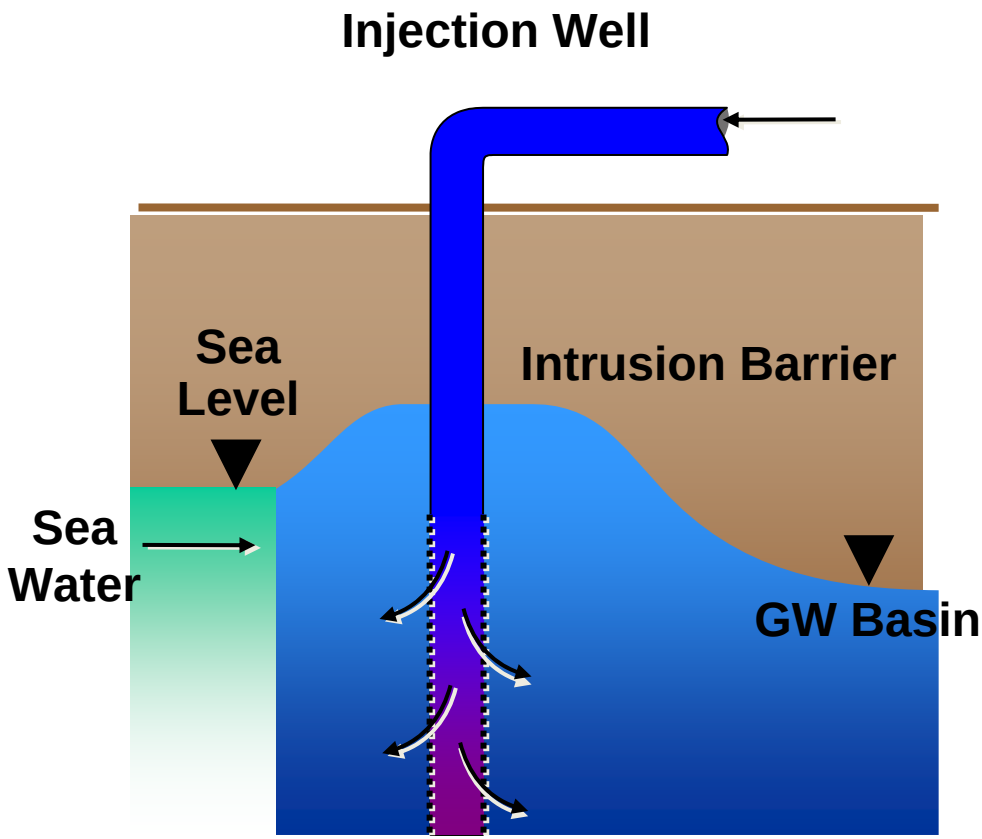


OCWD Recharge Facilities


CENTRAL BASIN
ORANGE COUNTY GROUNDWATER BASIN
LOS ANGELES CO.
ORANGE CO.
BREA
FULLERTON
PLACENTIA
YORBA LINDA
PRADO DAM
LA PALMA
ANAHEIM
RECHARGE FACILITIES
SAN GABRIEL RIVER
LOS ALAMITOS
SANTA ANA MOUNTAINS
GARDEN GROVE
SEAL BEACH
WESTMINSTER
SANTA ANA RIVER
FOUNTAIN VALLEY
SANTA ANA
TUSTIN
WATER FACTORY 21
HUNTINGTON BEACH
COSTA MESA
IRVINE
SAN JOAQUIN HILLS
PACIFIC OCEAN
CALIFORNIA
ORANGE COUNTY

Sea Water Intrusion Barrier Facilities

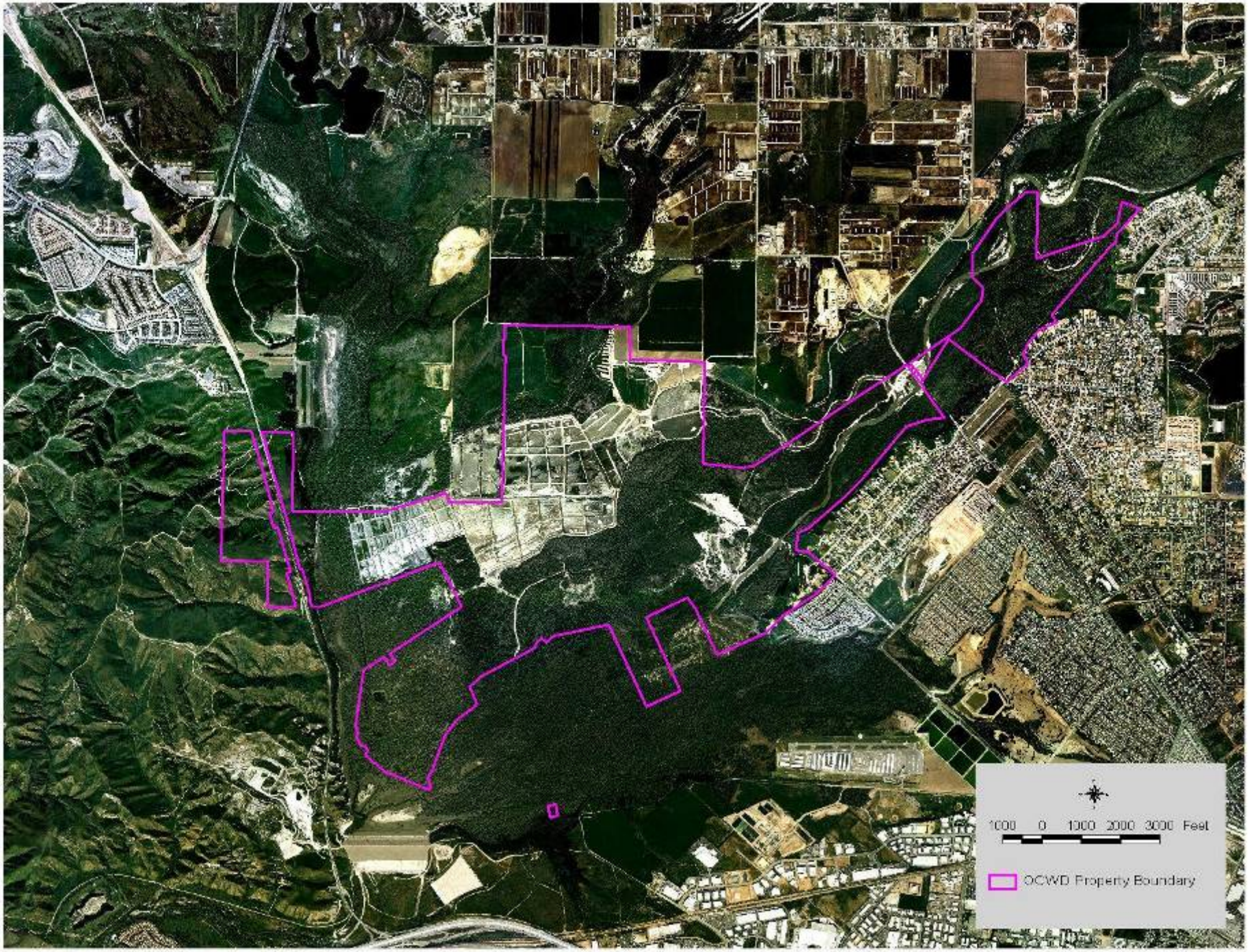
Water is injected along the coast to form a pressure ridge that blocks the landward movement of sea water



Sources of supply to the Basin

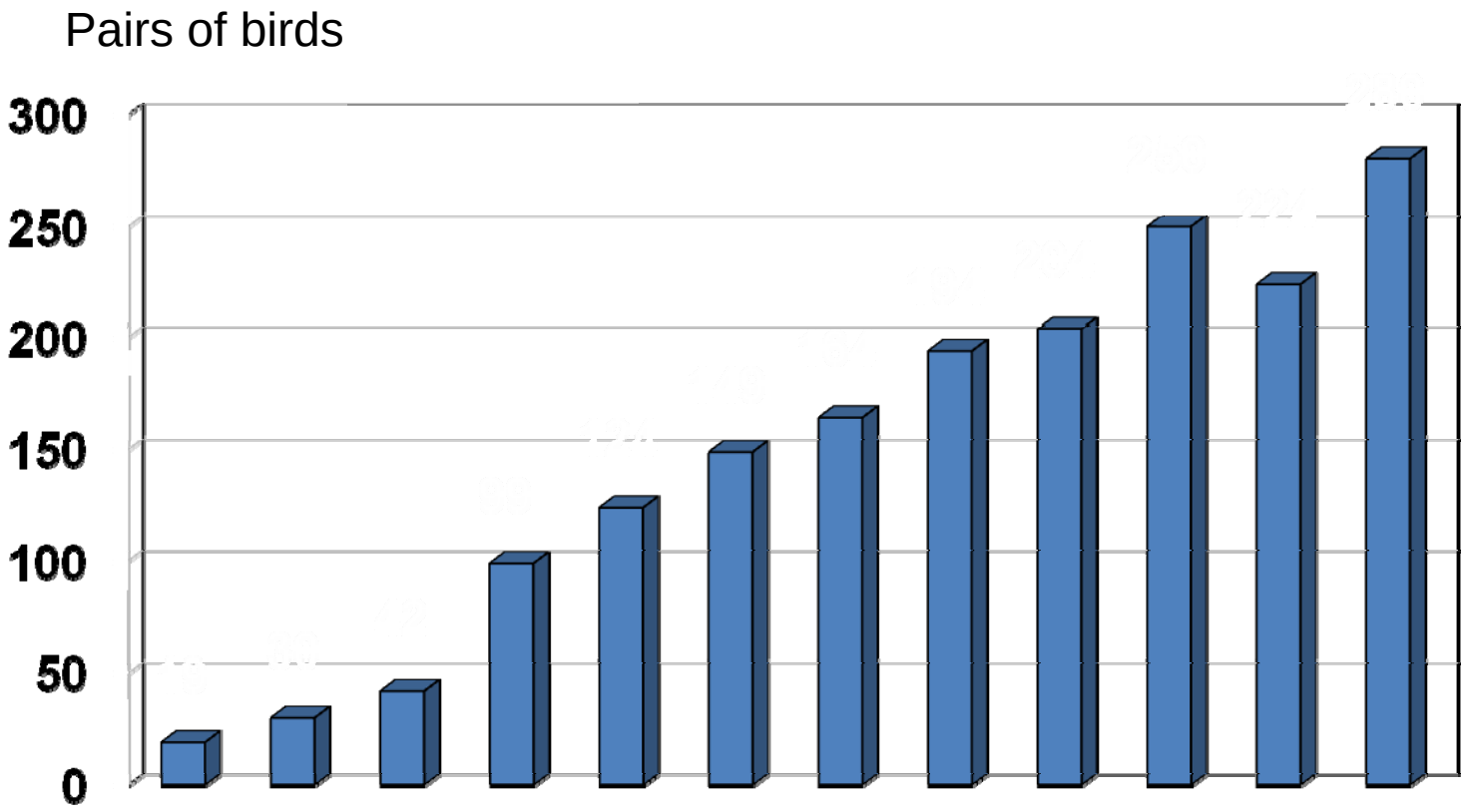
- Recycled water
- Santa Ana River storm water
- Santa Ana River

Constructed Wetlands Provide Nutrient Removal


1000 0 1000 2000 3000 Feet
OCWD Property Boundary

Least Bell's Vireo Population

Increase at Prado Dam



Health Studies

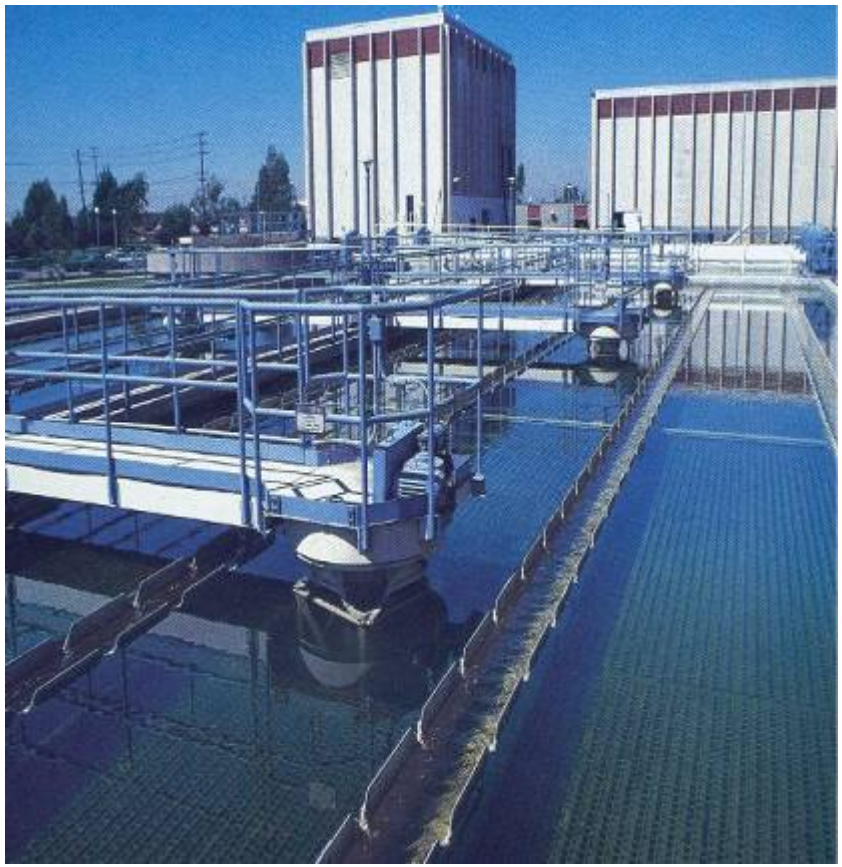
- In the summer season, the River is composed almost entirely of wastewater discharges
- During major storm events, the River receives runoff from urban and dairy lands
- OCWD assembled a team of experts:

  -Toxicology, epidemiology, hydrology, etc.

  -Universities, US Geological Survey, Lawrence Livermore Lab.
- Eight Year Study, $10 million directed by team
- Focus on chronic health issues.

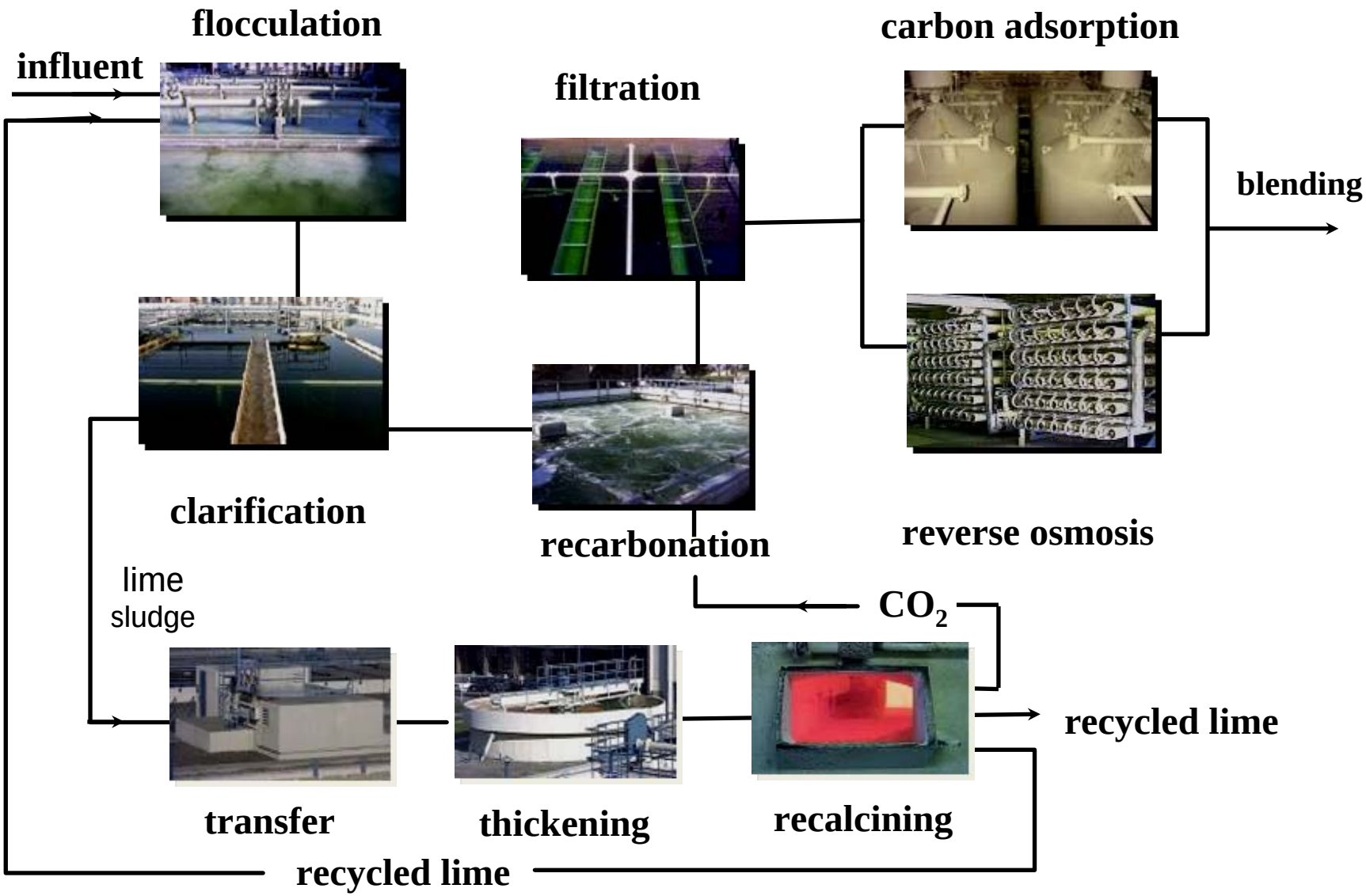
Medaka Fish are Indicators of Endocrine Disruption

Water Factory 21 – an advanced wastewater recycling facility, supplied fresh water for sea water barrier

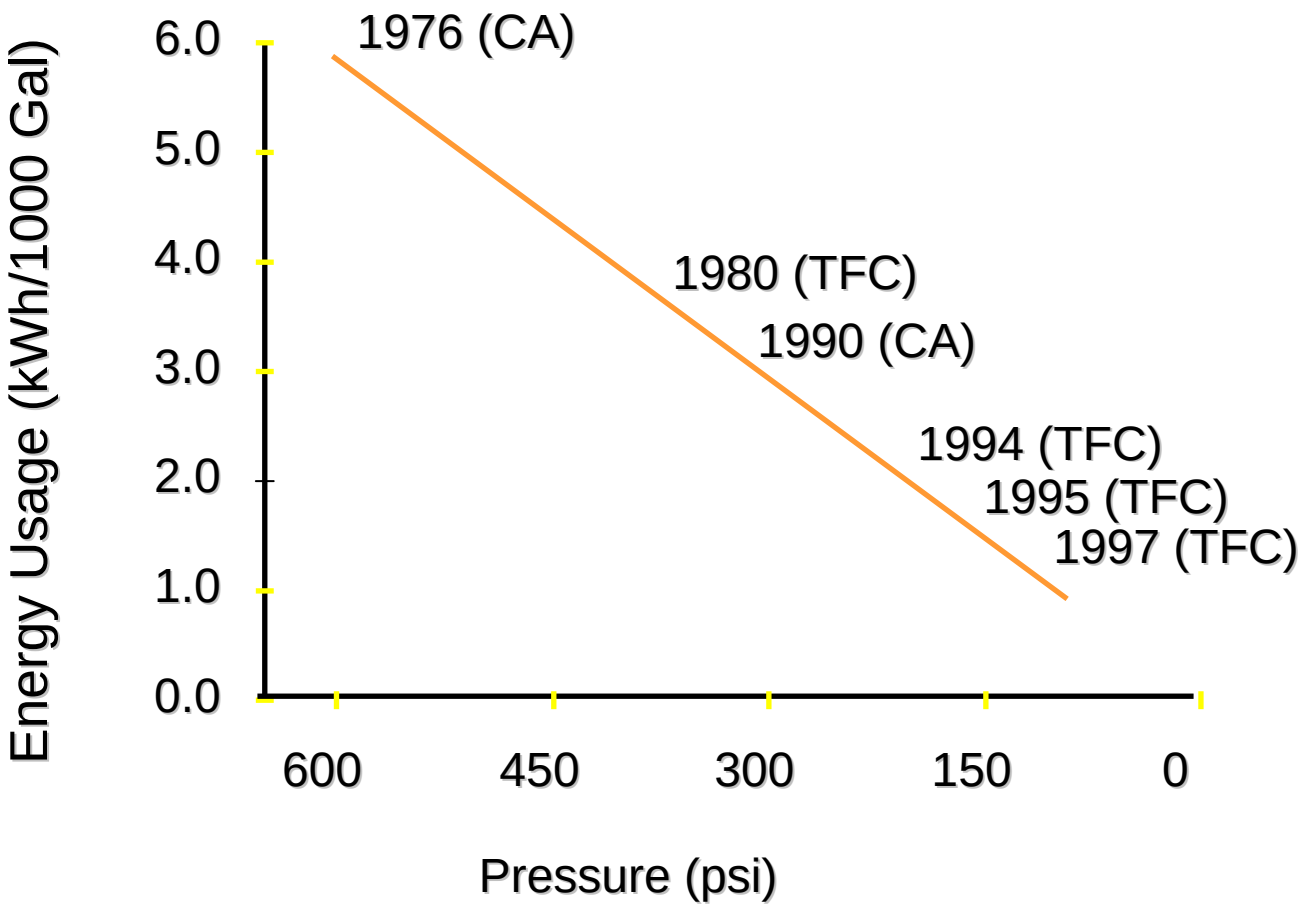


- Operated between 1975 and 2005
- Blended with deep groundwater
- Over 30 years of operating experience
- 1/3 of product water from reverse osmosis; 2/3 from activated carbon
- Met all drinking water standards

Water Factory 21

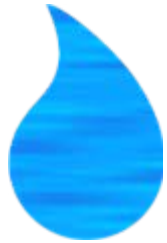


Water Factory has led to membrane technology improvements



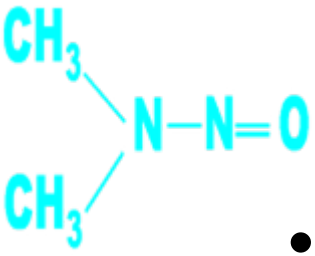
Cellulose Acetate (CA) Thin Film Composite (TFC)

Regulating NDMA in Water



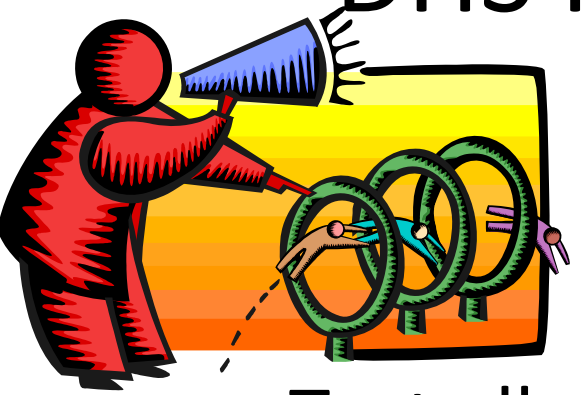
- No State or Federal drinking water standards exist
- DHS, in 1999, set an interim action level of 20 parts per trillion (ppt)
- Action level
  - Above 20 ppt: governing board must be notified
  - Above 200 ppt: source must be shut off
- DHS & EPA have yet to approve a standard testing method

NDMA is a Newly Regulated Compound for Water



- N-Nitrosodimethylamine (NDMA) is found in a variety of products from cosmetics to beer and hot dogs
- CA Dept. of Health Services (DHS) found low levels of NDMA in treated drinking water in 1999
- EPA calls NDMA a probable human carcinogen, based on animal testing

DHS Requirements for OCWD on NDMA



- Test all drinking water wells
- Determine extent of NDMA in Orange County groundwater
- Notify utility boards above 20 ppt
- Inject <20 ppt by July 1, 2000
- Produce <20 ppt in reclaimed water by June 1, 2001

OCWD Preliminary Testing of NDMA

- Since 1975, recycled water from Water Factory 21 (WF21) has been injected into the Talbert seawater barrier
- In 1999, NDMA was found in other reclamation plants
- NDMA found in WF21 > 150 ppt led to further investigation

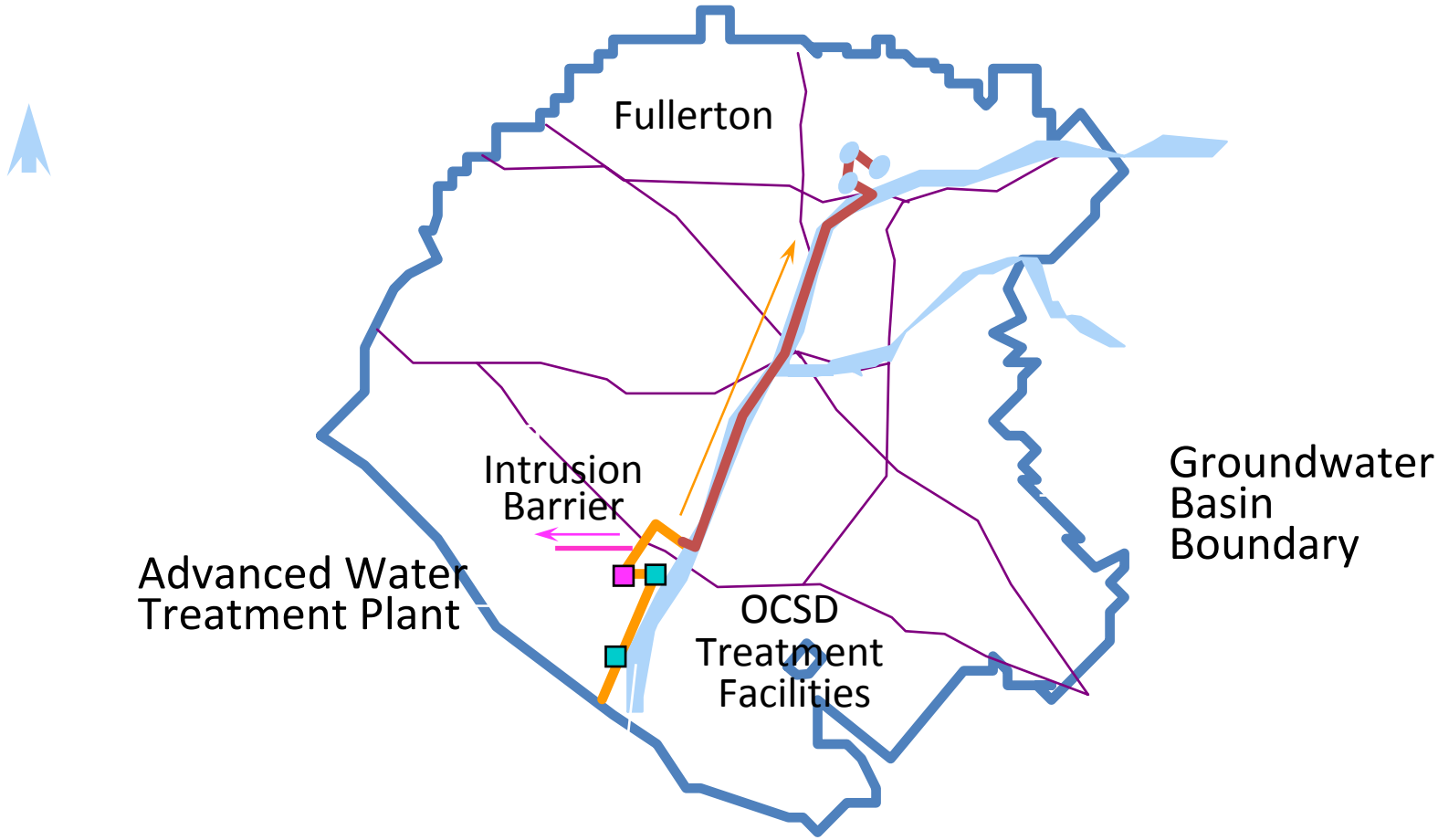
OCWD Preliminary Testing of NDMA

- Since 1975, recycled water from Water Factory 21 (WF21) has been injected into the Talbert seawater barrier
- In 1999, NDMA was found in other reclamation plants
- NDMA found in WF21 > 150 ppt led to further investigation
- Throughout 1999, screened all Orange County drinking water wells.
- No NDMA found (20 ppt detection limit)

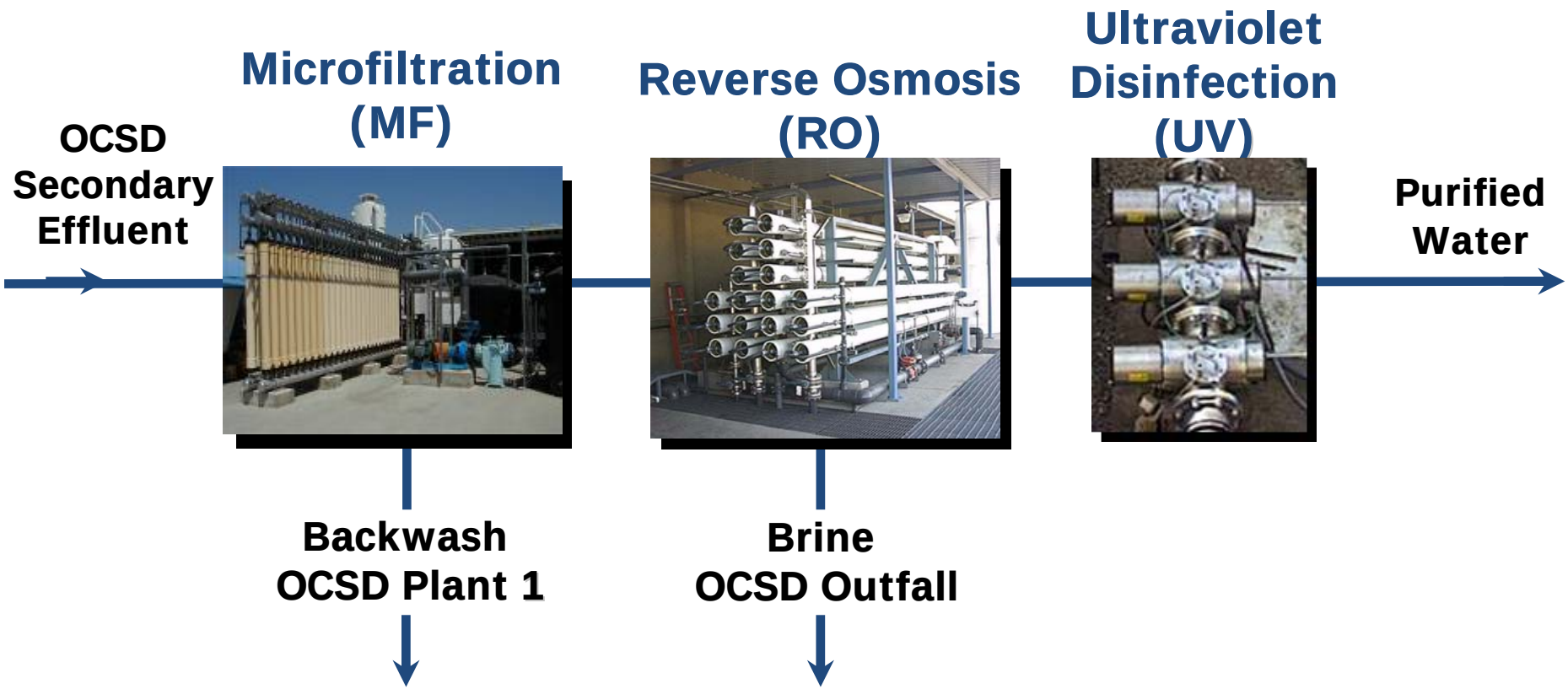
Groundwater Replenishment System

- Replaced Water Factory 21 with technology advances it helped to create
- Expands water recycling concept by a factor of nearly 4

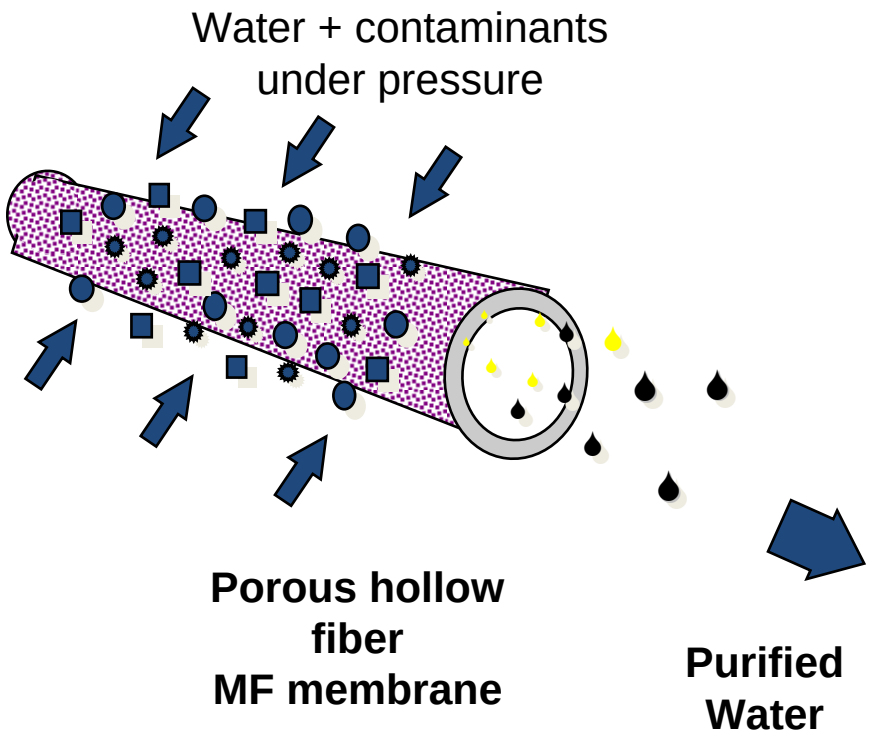
Groundwater Replenishment System Delivery System



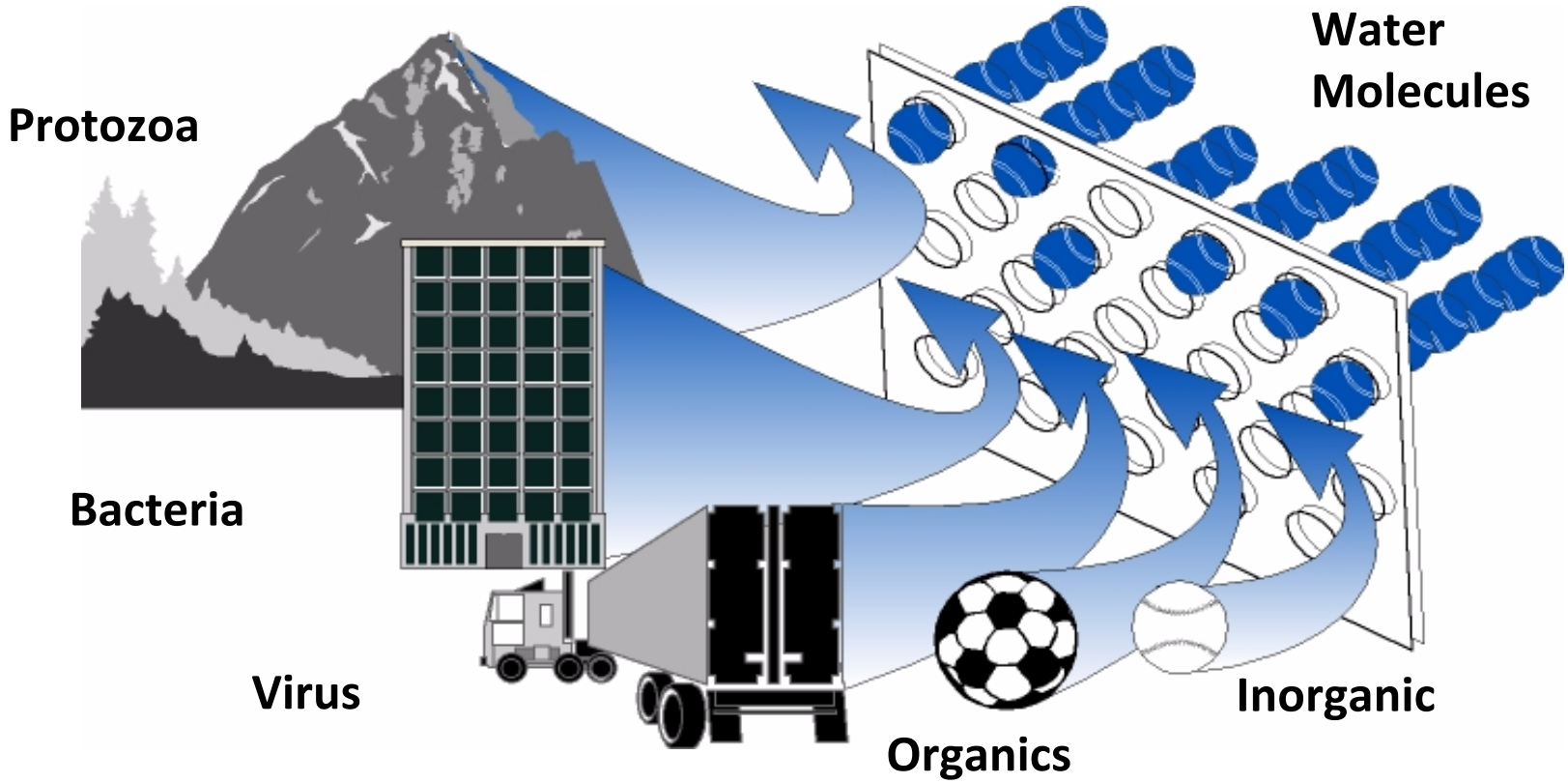
GWR System Advanced Water Treatment Flow Diagram



Microfiltration

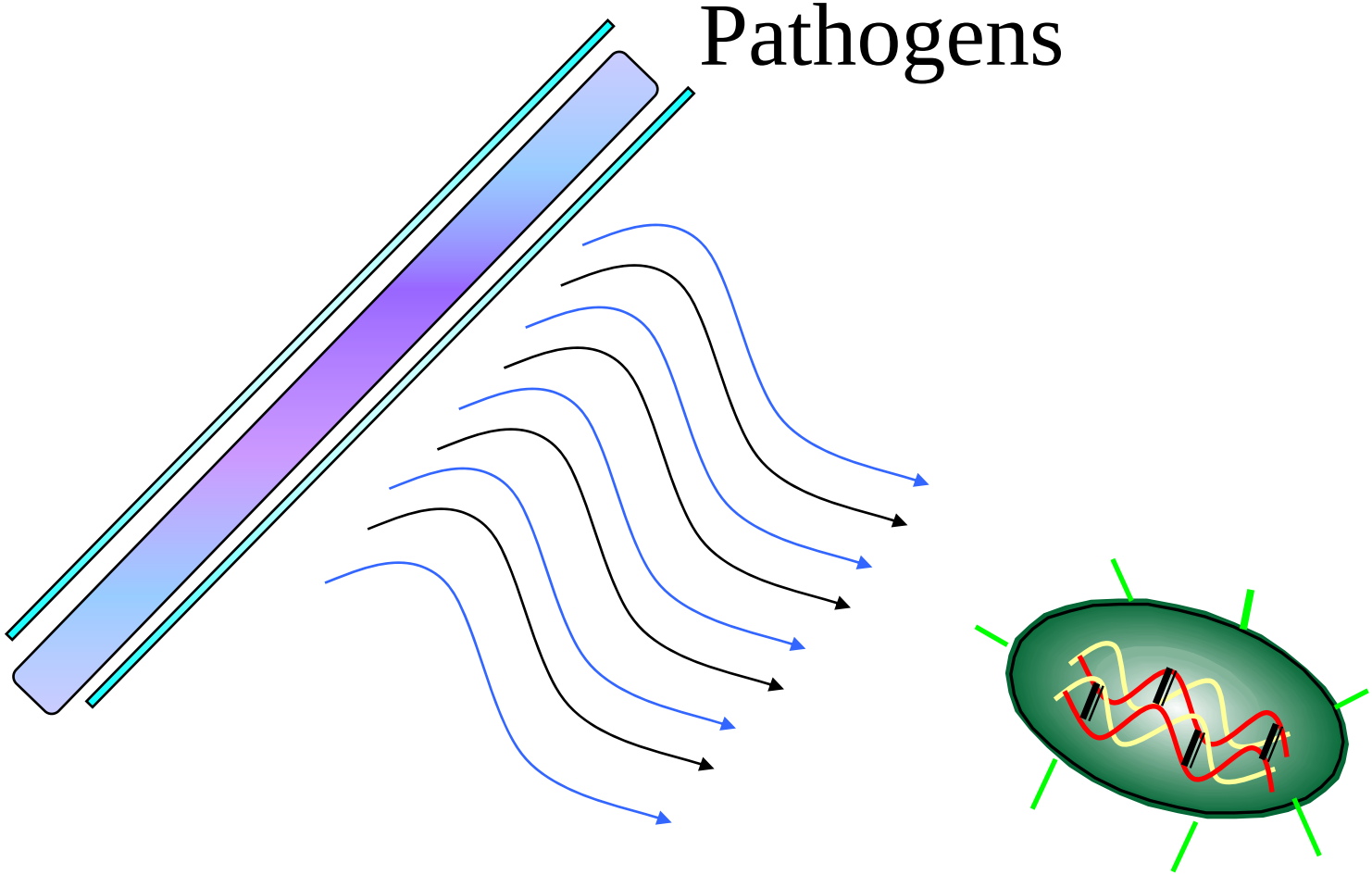


RO Membrane Is Like a Microscopic Strainer - Allows Only Water Molecules to Pass – All Water Treated by RO



PROTEC
PROTEC
PROTEC

Ultraviolet Light Disinfects through Destruction of Genetic Material of Pathogens



UV is Also Effective in Removing Trace Organics and PhACs

GWRS Health Studies

- OCWD formed another panel of experts
- Panel estimated the risk associated with each water supply used for groundwater basin recharge.
- Imported Water from both the SWP and Colorado River and Santa Ana River Water
- Concluded that GWRS water would pose less or equal risk to that of other recharge waters.

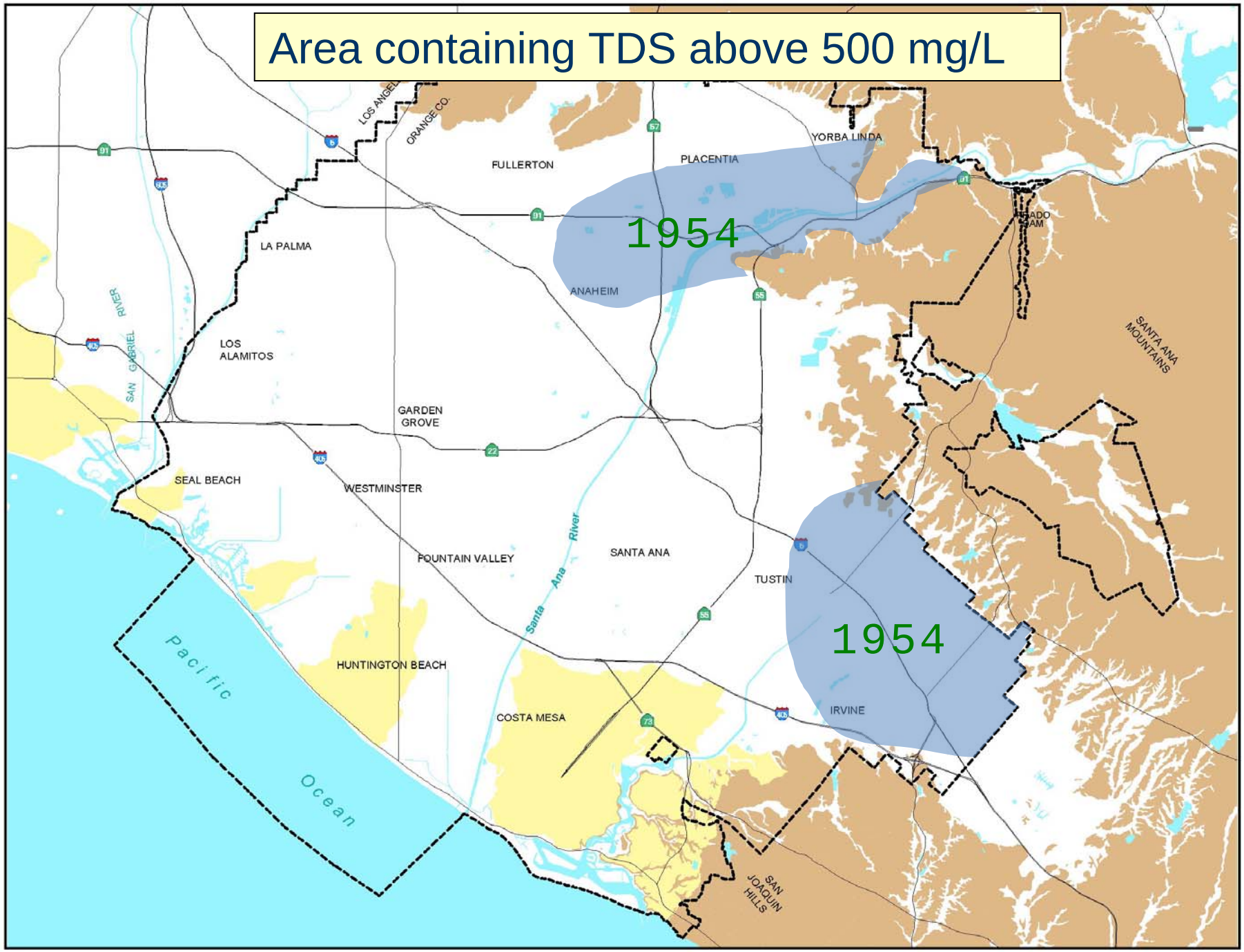
Benefits to Orange County

1. Improves **water quality**
2. Expands **underground barrier**
3. Provides a new, supplemental and **drought-proof future water supply**
4. Delays building another **ocean outfall**

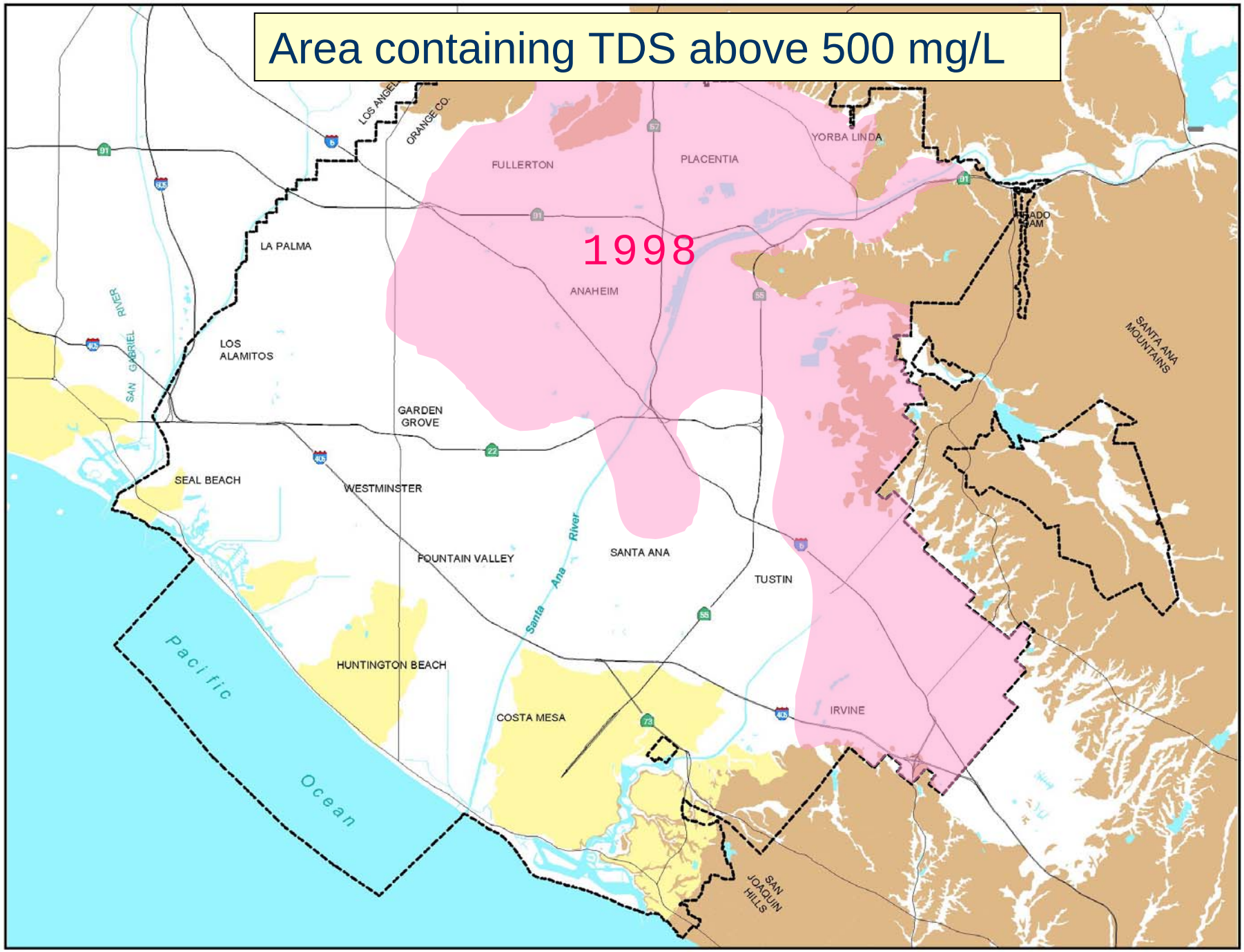
The GWR System will Improve Orange County's Water Quality

- Santa Ana River and the Colorado River are the major sources of water to replenish the basin—both sources are high in minerals
- Each year, more minerals go into the basin than come out—about 62,000 tons every year
- The process produces high quality, near distilled water
- Start to counteract mineral buildup

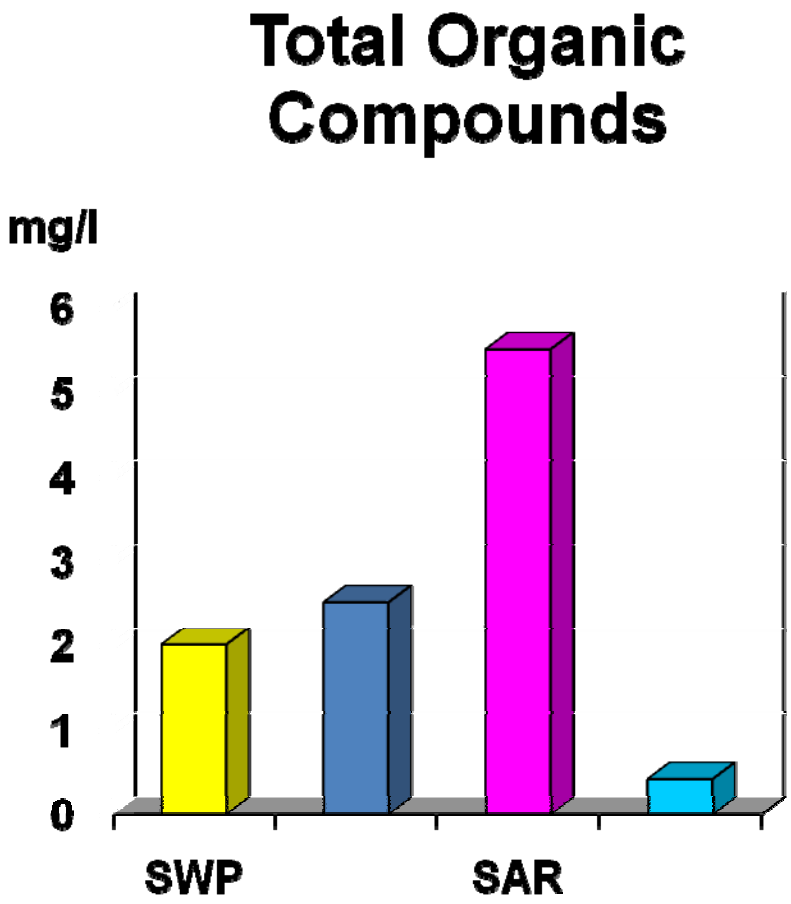
Area containing TDS above 500 mg/L

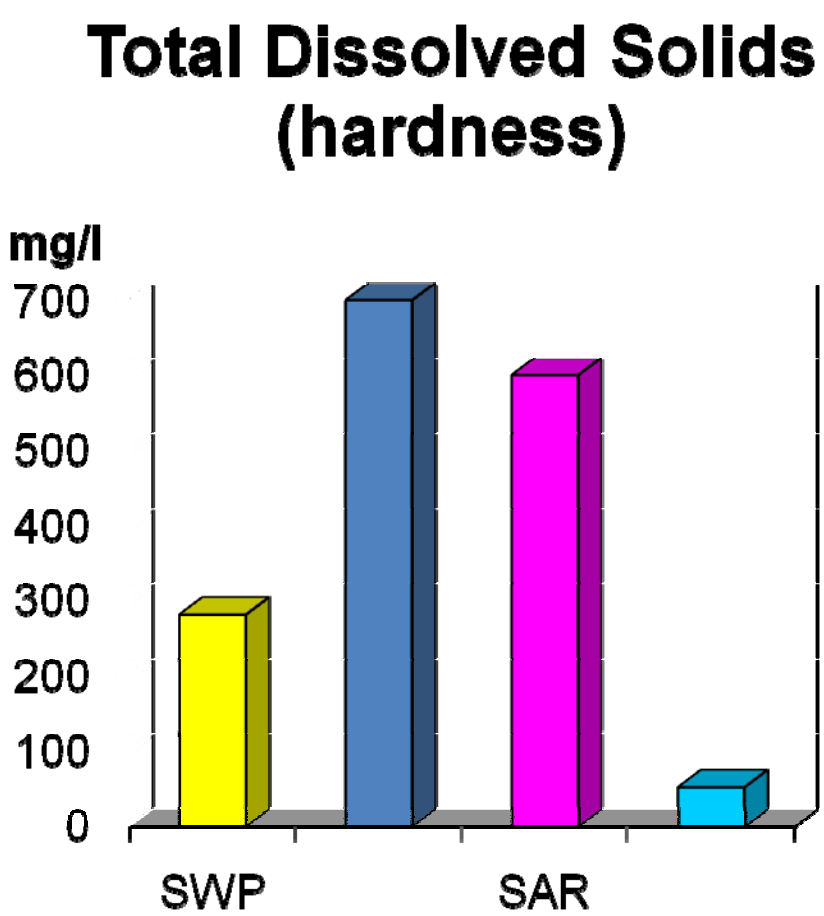


Area containing TDS above 500 mg/L



Water Quality Comparison





Delays Building Another Ocean Outfall

- Without this project, Orange County Sanitation District would have to build another ocean outfall to handle increased flows through sewage treatment plants during storm events
- The outfall would cost $170 million dollars
- A new outfall would take eight years to plan, design and build and may have difficulty getting environmental approval

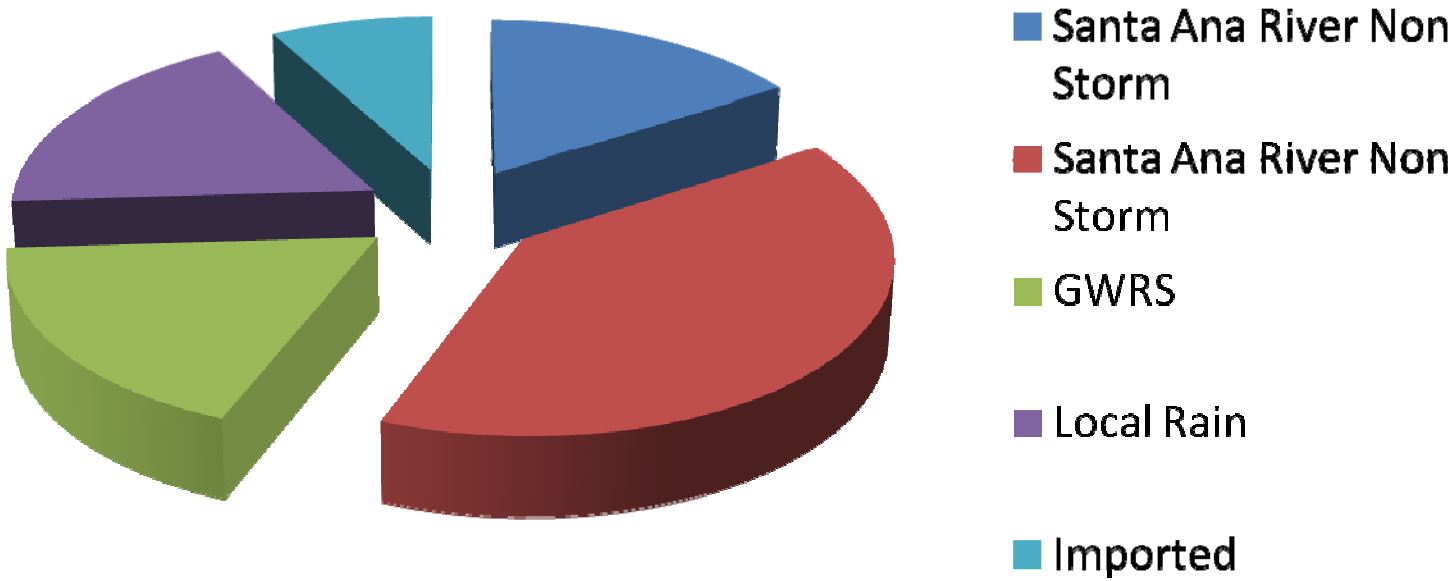
Saves Energy

- **1 gallon of GWR System water = 1 gallon less pumped from Northern California**
- **Pumping water from Northern California requires twice the electrical power of GWR System water**
- **GWR System will save 125,000,000 kilowatt hours each year—enough electricity to light 21,000**

GWR System can produce water using less than ½ of the energy required to transport water from Northern California

	Kilowatt Hours per Acre-foot		
	Colorado River Aqueduct	**State Water Project**	**GWR System**
Delivery	2200	3500	200
GWR System			1100
Reuse Conveyance			400
Total	2200	3500	1700

Components of Recharge to OCWD Basin




Thank you and enjoy a cool glass of GRRS water!