

# MANAGING CLIMATE CHANGE UNCERTAINTY IN THE BUNKER HILL GROUNDWATER BASIN

Southern California Groundwater and Climate Workshop  
University of California, Riverside  
February 24, 2012

Bob Tincher, P.E.  
Manager of Engineering and Planning

- Who?
- Why?
- What?
- Resources

## Background

## Management

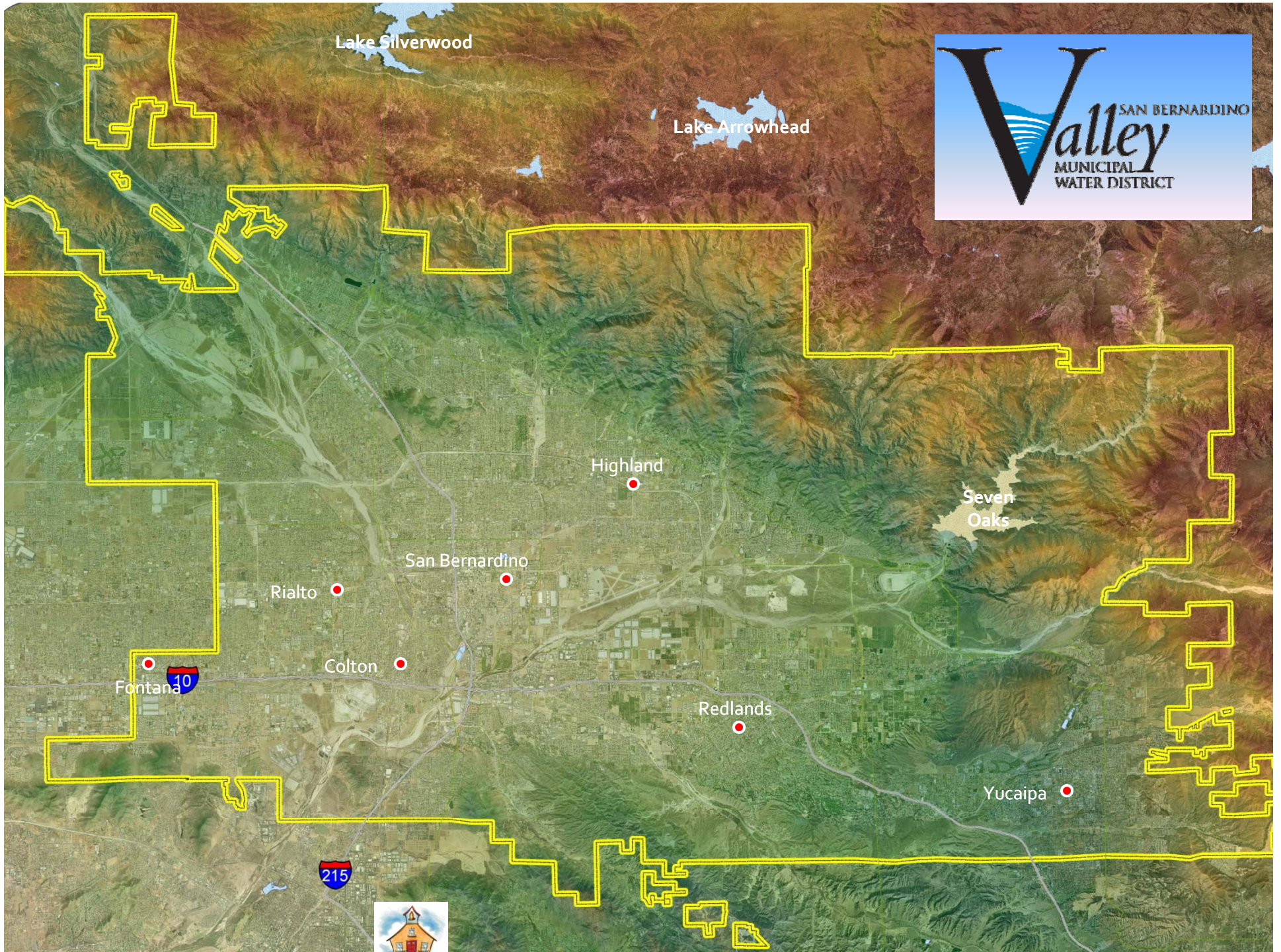
- Objectives
- Uncertainties
- Strategies

- Supplies
- Demands

## Projections







Lake Silverwood

Lake Arrowhead



Highland

Seven Oaks

San Bernardino

Rialto

Fontana

Colton

Redlands

Yucaipa

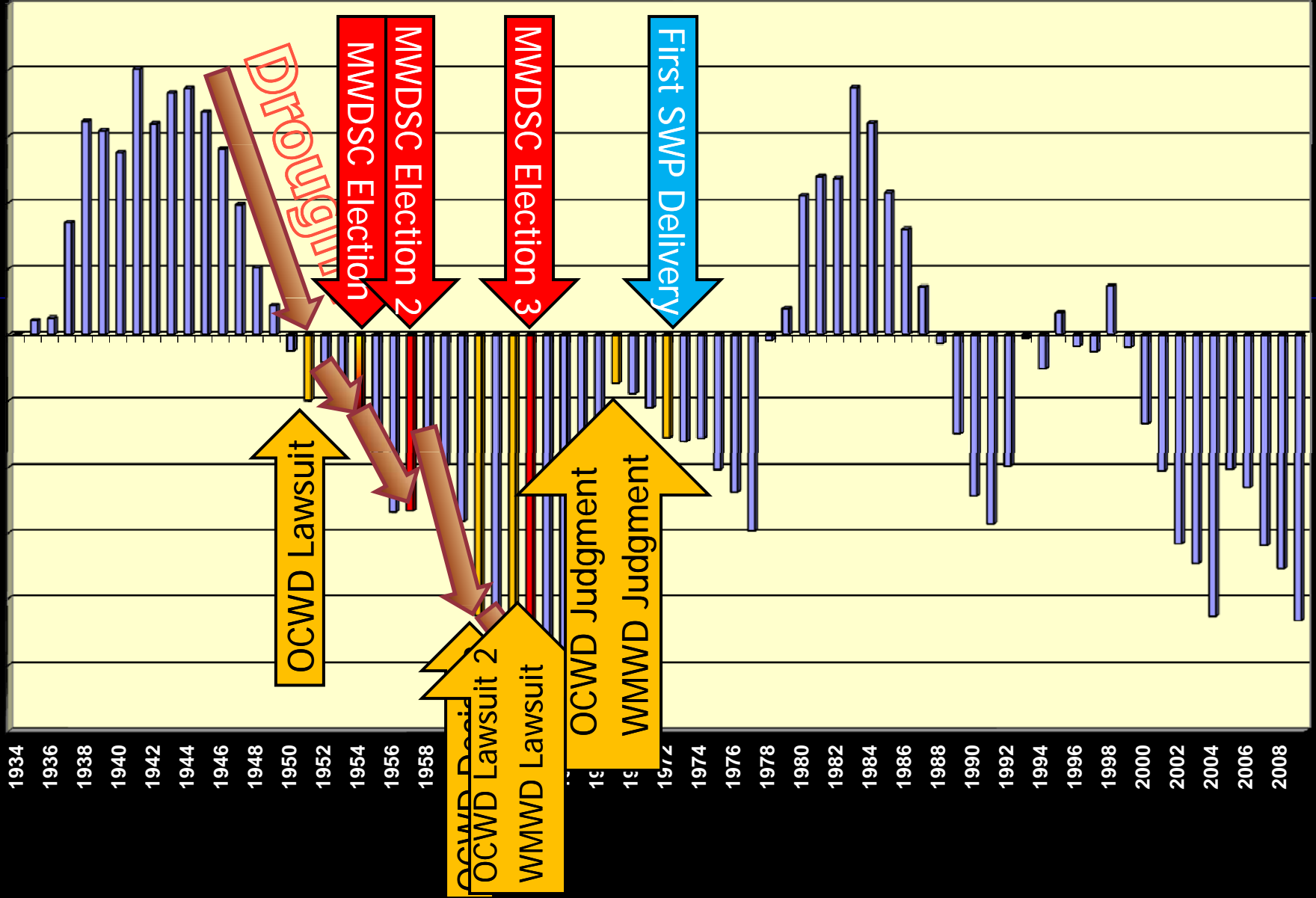
215

10





# Valley District History





# FINAL

# The San Bernardino Daily Sun

A Newspaper for San Bernardino County.

1964 APRIL 1964						
Sun.	Mon.	Tue.	Wed.	Thur.	Fri.	Sat.
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30		

VOL. LXX—38 PAGES, 2 SECTIONS

(AP)—Associated Press  
(UPI)—United Press International

Telephone Tlrner 9-9666

\$2.25 a Month  
Ten Cents a Copy

WEDNESDAY MORNING, APRIL 29, 1964

# VOTERS DEFEAT JOINING MWD

## Hand Decisive Victory to Foes Of Annexation

### Total Votes Recorded By Precincts

Here is the precinct-by-precinct vote in yesterday's San Bernardino water election, with precinct number listed first, followed by the address of the polling place:

- 1—824 Valley View Dr. Yes 61; No 97
- 2—662 Bunker Hill Dr. Yes 89; No 211
- 3—1572 Poplar St. Yes 77; No 156
- 4—1235 Congress St. Yes 84; No 221
- 5—1277 King St. Yes 110; No 177
- 6—202 Meridian Ave. Yes 106; No 170

San Bernardino voters yesterday decisively defeated annexation to Metropolitan Water District.

The complete unofficial tabulation for the 93 consolidated precincts was:

No — 15,163; Yes — 11,302

City Clerk Jack T. Felton reported that 68.2 per cent of the registered voters turned out—the highest percentage in the city's history.

The percentage division in the vote was 57 per cent no, 43 per cent yes.

The town's citizens thus voted against the recommendations of

## Education Board Pushes Initiative Rule

By LEIF ERICKSON  
SAN FRANCISCO (AP)

### 5 Workers Die In Flash Fire On Ferry Ship

#### Huge Flareup Is Confined to Hold, Crew Unhurt

MOBILE, Ala. (AP)—A flash fire in the hold of the aircraft ferry vessel *Croatian* killed five shipyard workers yesterday.

The 496-foot vessel was in drydock for routine repairs at Alabama Dry Dock & Shipbuilding Co. A shipyard official said it sustained comparatively minor damage.

The vessel is operated by the Military Sea Transport Service to take military supplies and





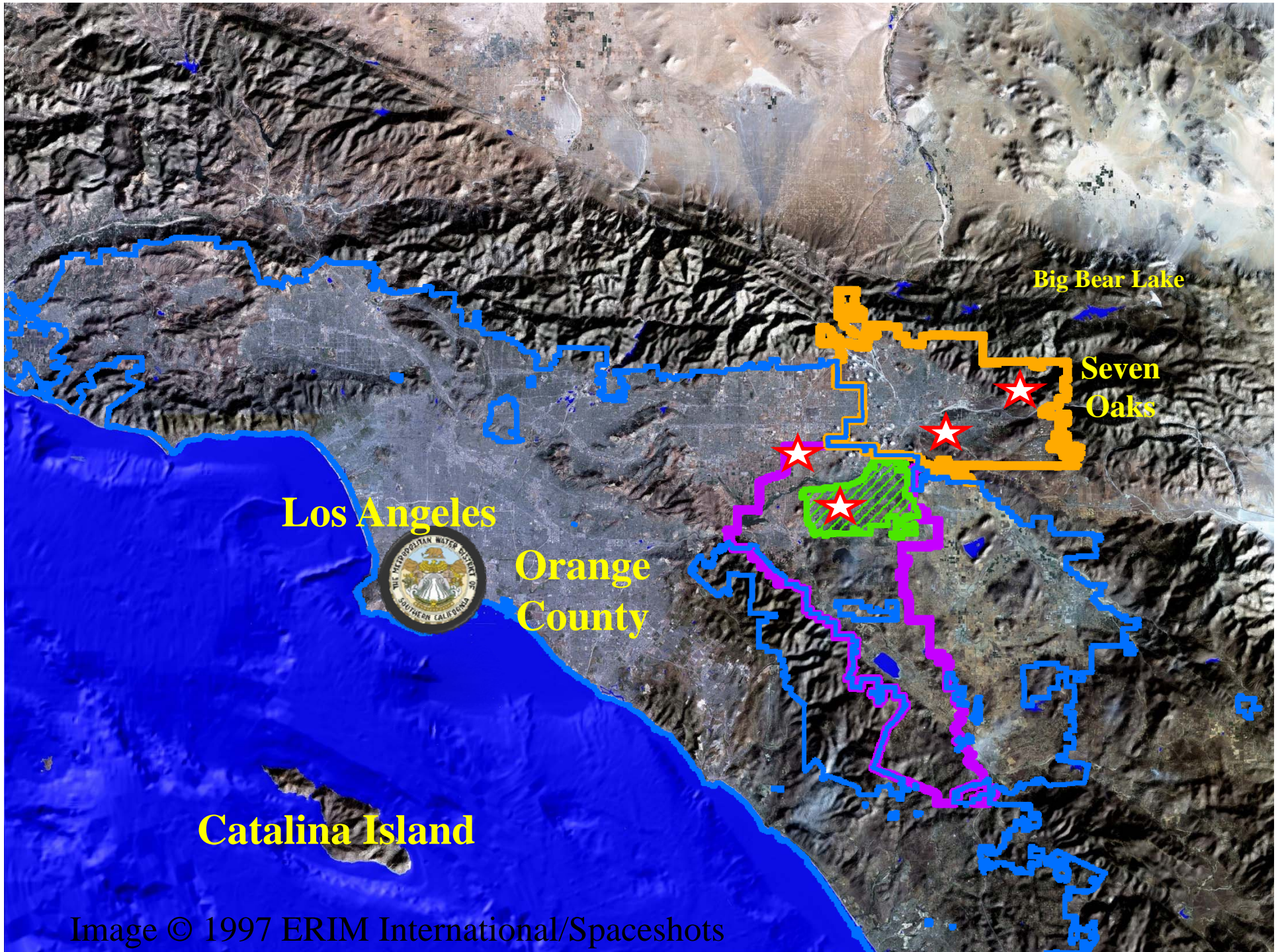
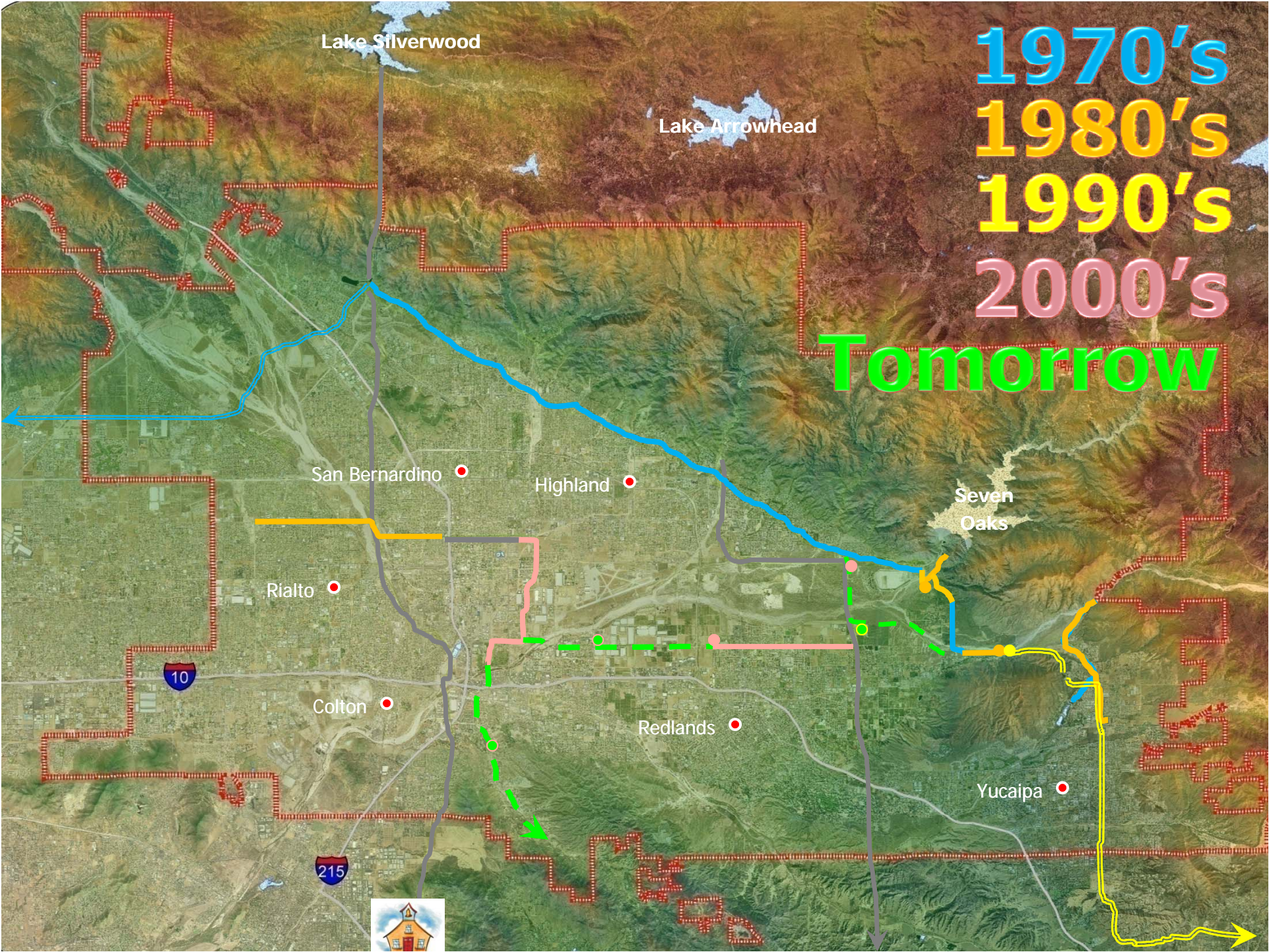


Image © 1997 ERIM International/Spaceshots





Lake Silverwood

Lake Arrowhead

1970's

1980's

1990's

2000's

Tomorrow

San Bernardino

Highland

Seven Oaks

Rialto

Colton

Redlands

Yucaipa





# Responsibilities

## Responsibilities:

- Provide supplemental water.
- Maintain the safe yield of the San Bernardino Basin Area (Bunker Hill and Lytle).
- Maintain water levels in the Colton Basin Area and Riverside Basin Area.
- Maintain minimum flows in the Santa Ana River.

## Current sources:

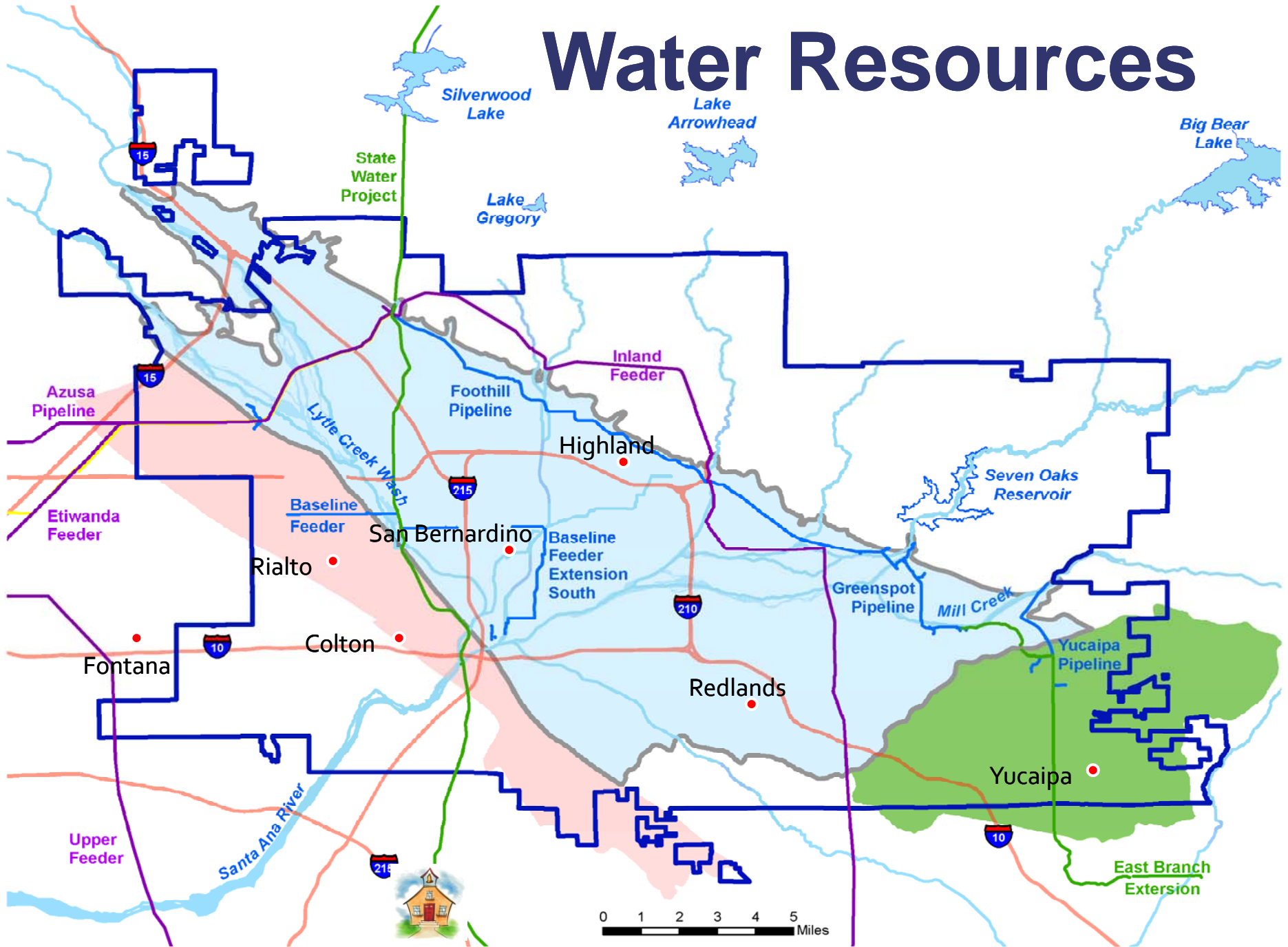
State Water Project  
Storm water capture  
Precipitation

Precipitation

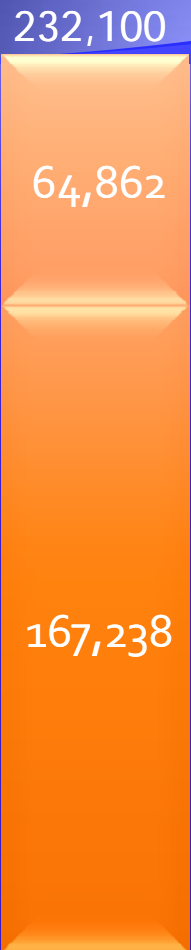
Treated Wastewater



# Water Resources



# Estimated Annual Safe Yields



Bunker Hill/Lytle



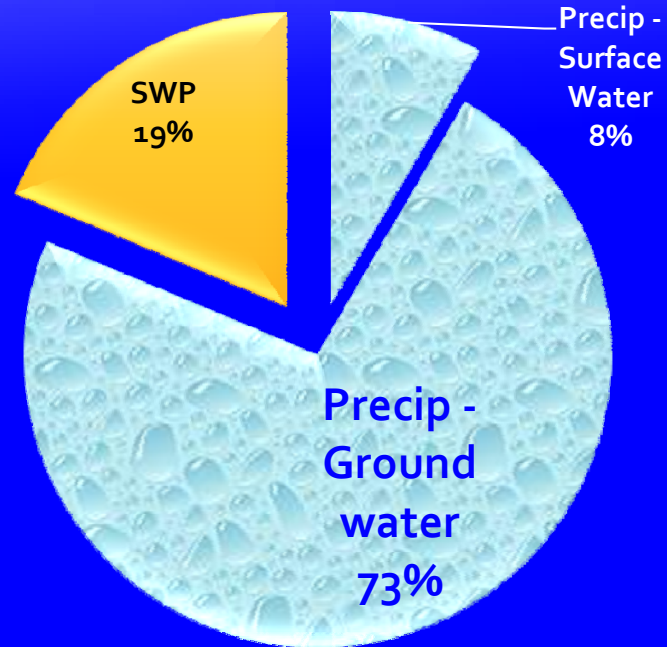
Rialto-Colton



Riverside North



Yucaipa and others





# Management

The diagram consists of two overlapping circles. The left circle is labeled 'Integrated Regional Water Management Plan (IRWMP)' and is associated with '(Multiple Discipline)'. The right circle is labeled 'Regional Urban Water Management Plan (RUWMP)' and is associated with '(Water)'. The overlapping area between the two circles is shaded in a darker blue, indicating a shared or integrated focus.

**Integrated  
Regional  
Water  
Management  
Plan  
(IRWMP)**

**(Multiple Discipline)**

**Regional  
Urban Water  
Management  
Plan  
(RUWMP)**

**(Water)**

# Water Management Objectives



- ◆ Improve Water Supply **Reliability**
- ◆ Protect **Water Quality**
- ◆ Ecosystem **Restoration** and Environmental **Improvement**





# Biggest **Threats** to Water Supply Reliability



## Disaster

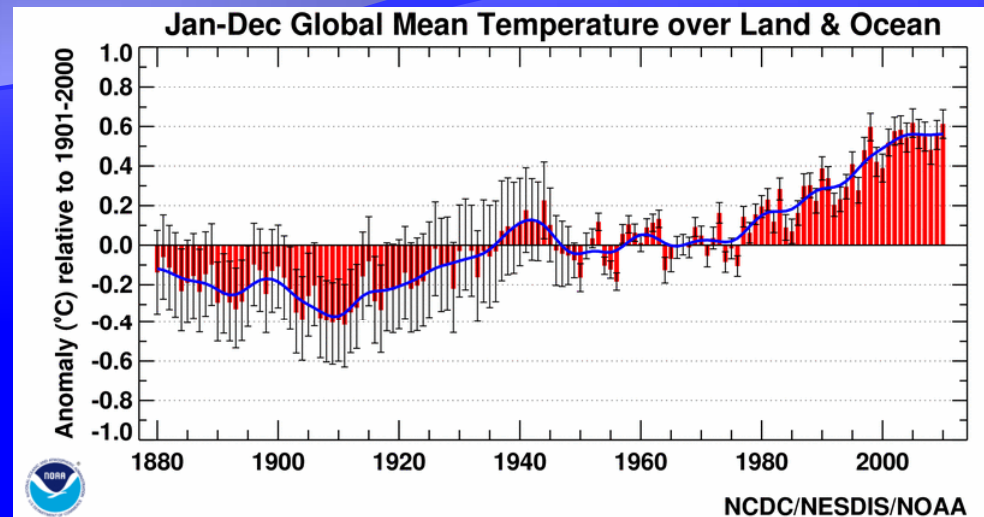
- ◆ Earthquake
- ◆ Power outage
- ◆ Delta levee failure



## Water Shortages

- ◆ Drought
- ◆ Legal constraints
- ◆ Climate Change

# Climate Change – Anticipated Impacts



## ◆ Changes

- ◆ Snowpack
- ◆ Runoff
- ◆ Groundwater recharge

## ◆ Increased demand

- ◆ Irrigation
- ◆ Reservoir evaporation

# Uncertainty (?)

*Less*

- Drought and legal constraints

-

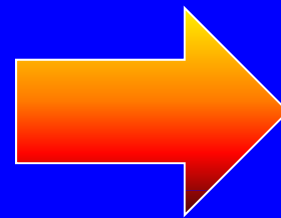
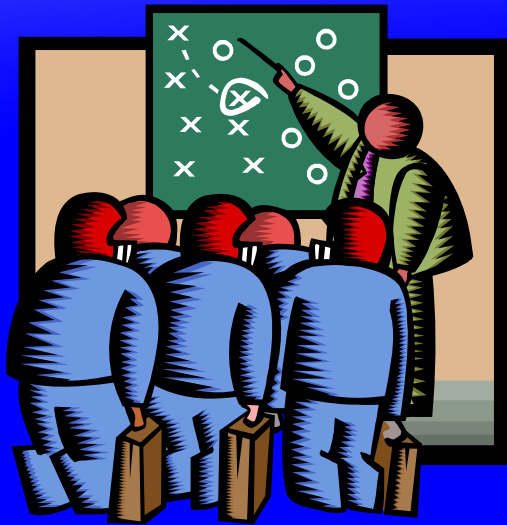
- Disasters

*More*

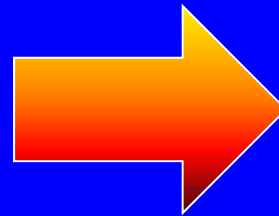
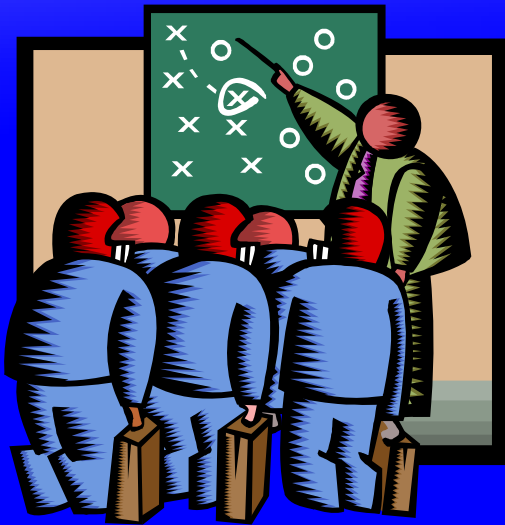
- Climate Change



# Managing Uncertainty (?)



# Management Strategies



# Management Strategies

## Optimize Local Supplies

- ◆ **Reduce Demand**
  - Increase water use efficiency (conservation)
- ◆ **Develop new sources of supply**
  - Capture more storm water
  - Increase the use of recycled water

## Optimize Imported Water

- ◆ **Increase utilization/reliability of imported water**

## Increase storage

(Surface, groundwater, water banking, etc.)

## Emergency Measures



# Multiple Benefits

<b>Management Strategies</b>	<b>Drought</b>	<b>Climate Change</b>	<b>Other Shortages</b>	<b>Disaster</b>
<b>Reduce Demand</b>	X	X	X	X
<b>Optimize Imported Water</b>	X	X	X	X
<b>Optimize Local Supplies</b>	X	X	X	X
<b>Increase storage</b>	X	X	X	X
<b>Emergency Measures</b>	X	X	X	X

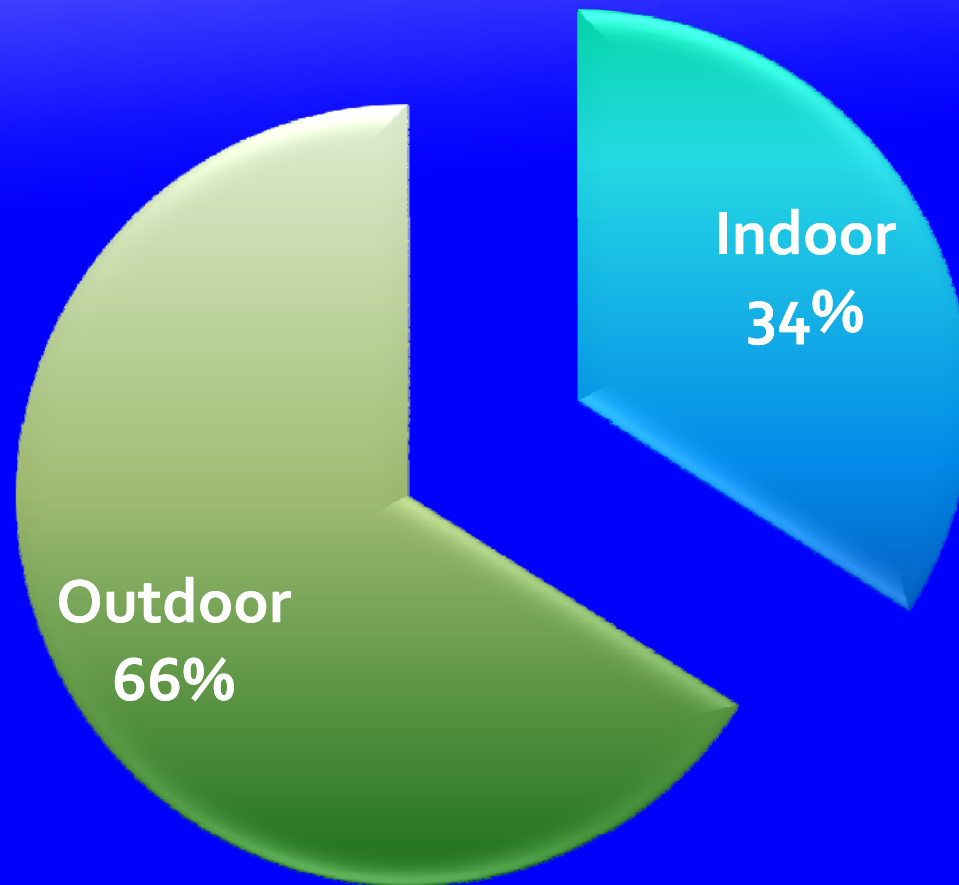
# Water Use Efficiency

- ◆ Senate Bill x7-7 (2009)
  - ◆ 10% reduction by 2015.
  - ◆ “20 by 2020”  
(20% reduction by 2020)





# Residential Water Use in the Inland Empire



# Outdoor Water Saving Strategies



"Smart" Controllers



Sprinkler Nozzles



# Water Efficient Landscaping























- WORKSHOPS
- PLANT SALES
- PLANT LISTS
- GARDENS
- SPONSORS
- WHO WE ARE
- EVENTS
- CONTACT
- [HOME](#)

## Inland Empire Garden Friendly



With the increasing uncertainty of our future water supplies in southern California, the public has become more aware of the need to utilize climate-appropriate plants. Unfortunately, most people **don't know where to begin.**

How Should I  
design my yard?

What plants should  
I use and where?

### Free Water Wise Landscaping Events

Landscape & Water  
Conservation Fair  
10/22/2011

Climate-appropriate Plant  
Selection and Care  
11/12/2011

Water Wise Landscaping  
Workshop – Preparation, Design  
& Plants  
11/12/2011

California Native Plant Sale  
11/12/2011

Integrated Pest Management  
for the Home Gardener  
12/10/2011

Guilt-free Rose Gardening,  
Climate-appropriate Roses  
12/10/2011

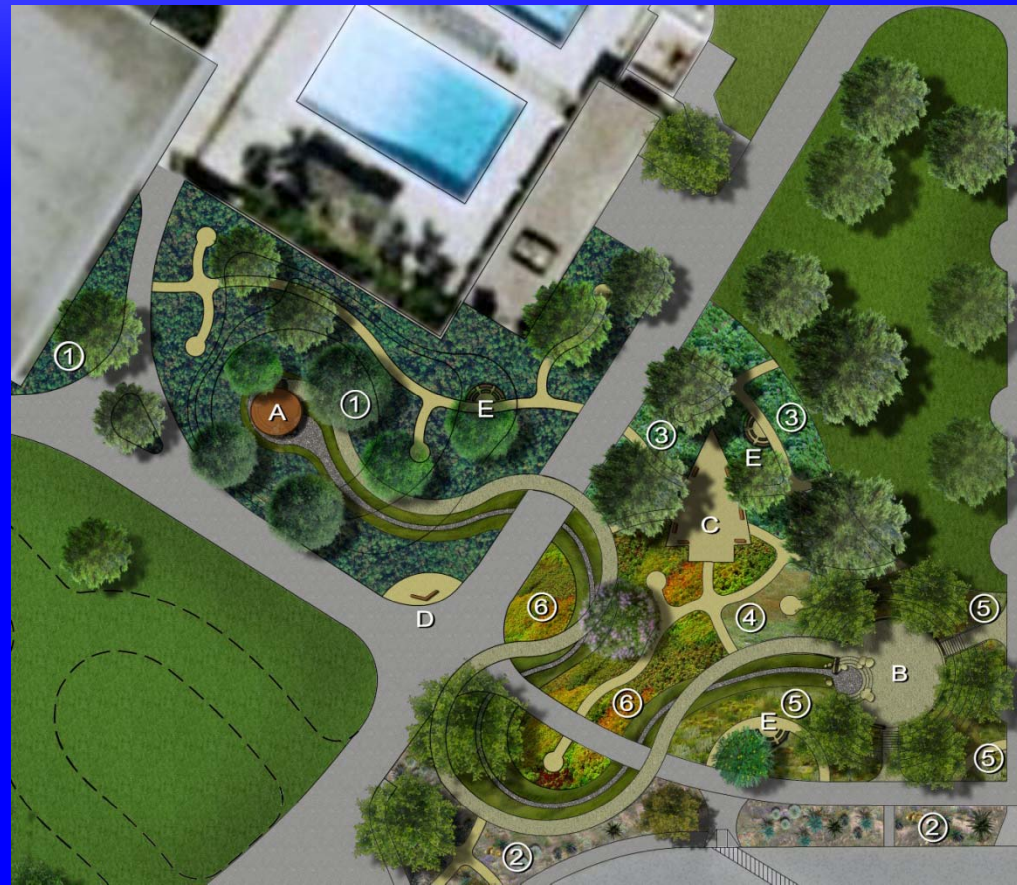


**Plant Sale**  
Saturday  
October 15, 2011

All Inland Empire Home Depot Locations

[Read More...](#)

# San Bernardino Valley Water Conservation Demonstration Garden





WESTERN WATER•WISE

# Landscape Contest

[RULES](#) [ENTRY FORM](#) [IDEAS](#) [SPONSORS](#) [AWARDS](#) [CONTACT](#) [HOME](#)

## 2011 regional winners

Judith Carlson  
FIRST PLACE

Patti Bonawitz  
SECOND PLACE

John & Deby Anderson  
THIRD PLACE

## 2011 local winners

Elvira Ostrander  
CITY OF CORONA

Scott Bradstreet  
EVMWD

Lucas Glese  
IEUS

Linda Richards  
SBVMWD

Joyce Johnson  
CITY OF UPLAND

[View the awards page for images](#)



Western Municipal  
Water District  
and its partners  
want to recognize  
**water-efficient  
residential  
landscapes!**

For excellent ideas, exhibits, resources and classes, visit Western's water conservation garden, Landscapes Southern California Styles located at 450 E. Alessandro Blvd. in Riverside. You can also or phone us at 951.789.5000.

**Show the region that using less water can be beautiful.**

Your masterpiece may be the one that gets selected from the entries to receive honors and prizes while also being showcased on our website!

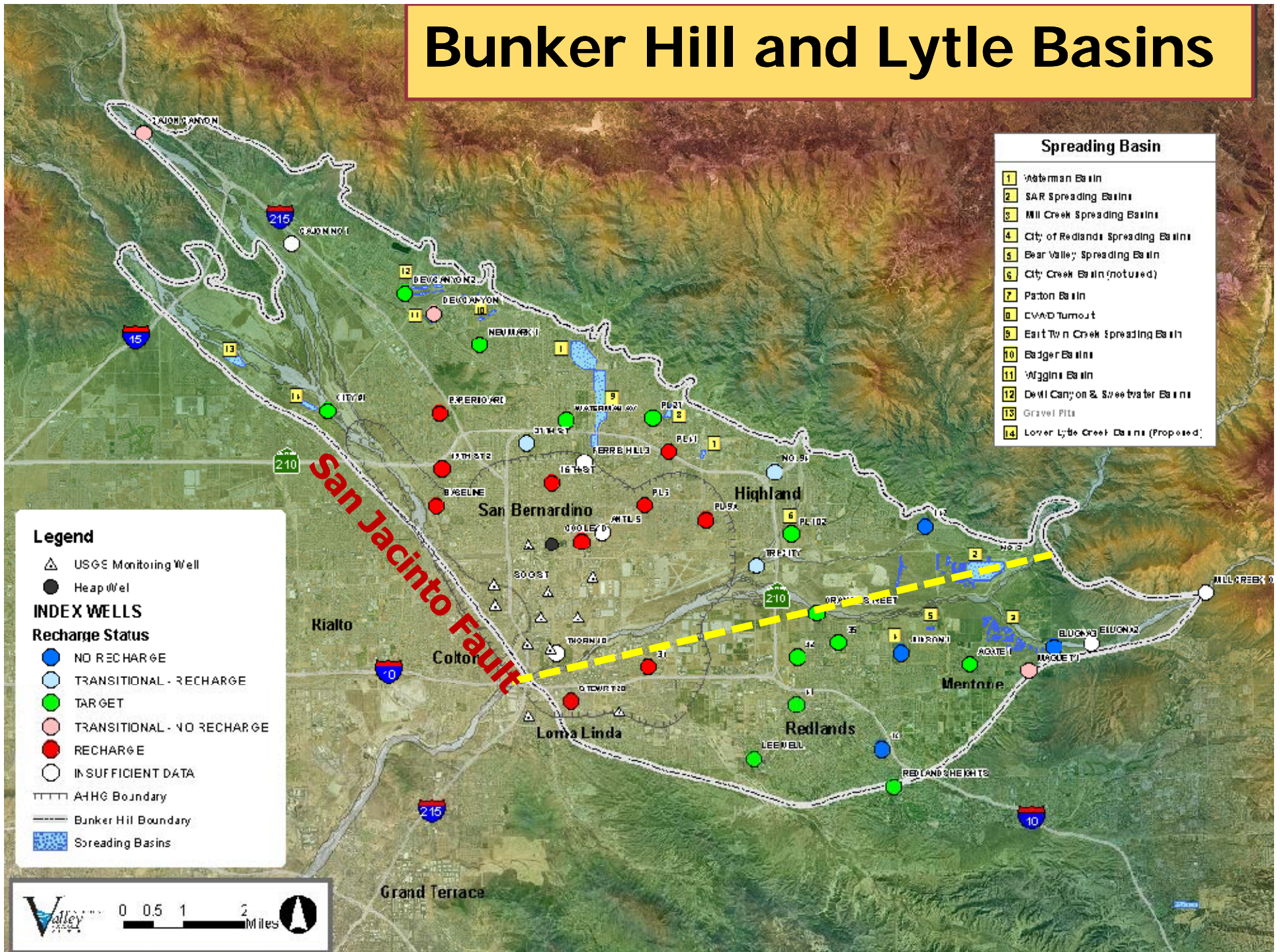
## WESTERN WATER•WISE Landscape Contest Sponsors:

**Water Agency Sponsors:** Western Municipal Water District . Eastern Municipal Water District . Inland Empire Utilities Agency . San Bernardino Valley Municipal Water District . City of Corona . Elsinore Valley Municipal Water District . Jurupa Community Services District . Rancho California Water District . Riverside Public Utilities . City of Upland **Corporate Sponsors:** Web Associates . Toro . Rainbird . Valley Soil, Inc. . Riverside County Flood Control & Conservation District . Chino Basin Water Conservation District . Inland Empire Garden Friendly . Riverside County Water Task Force . BeWaterWise.com

<http://www.westernlandscapecontest.com/>

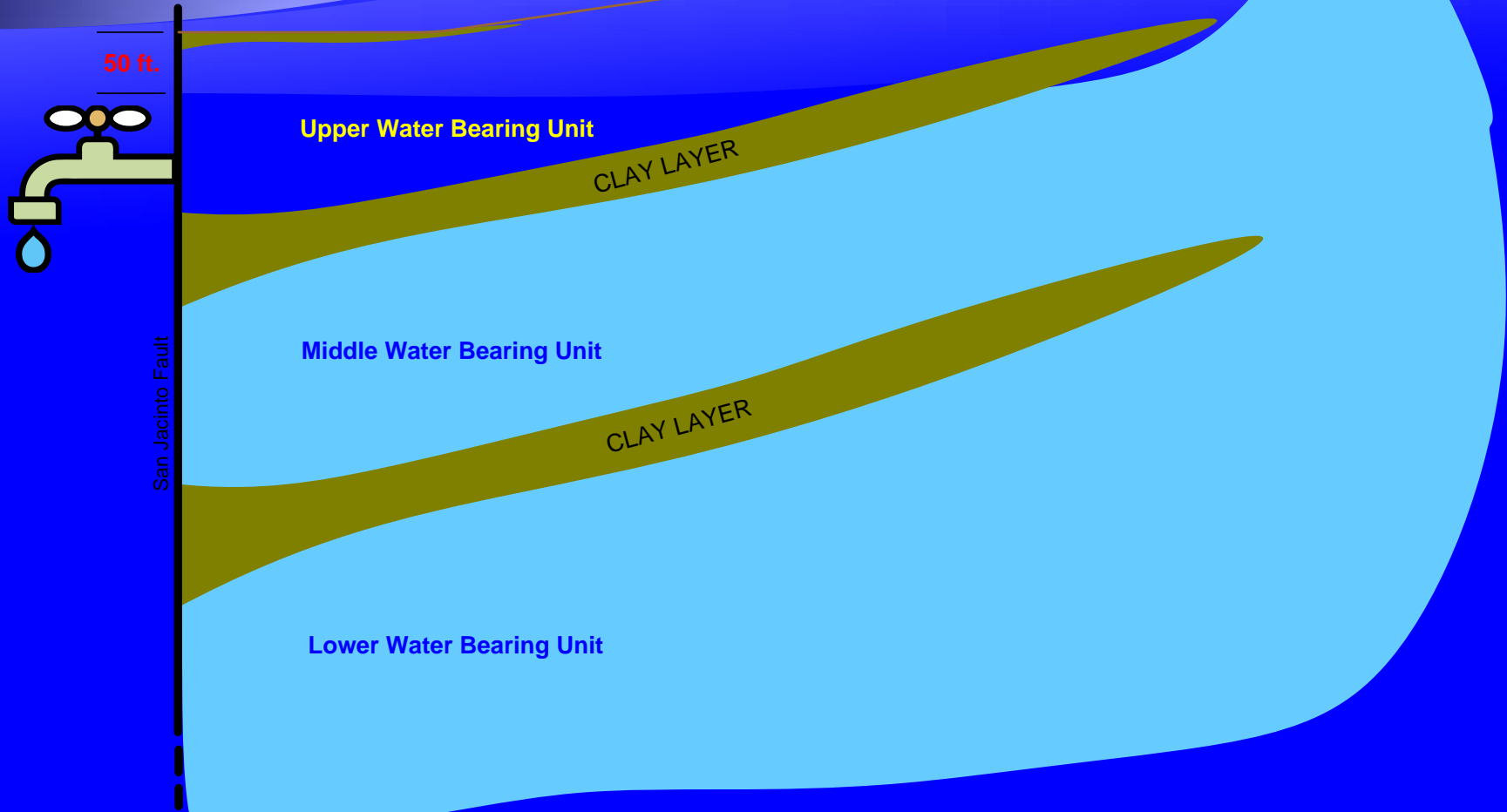


# Bunker Hill and Lytle Basins



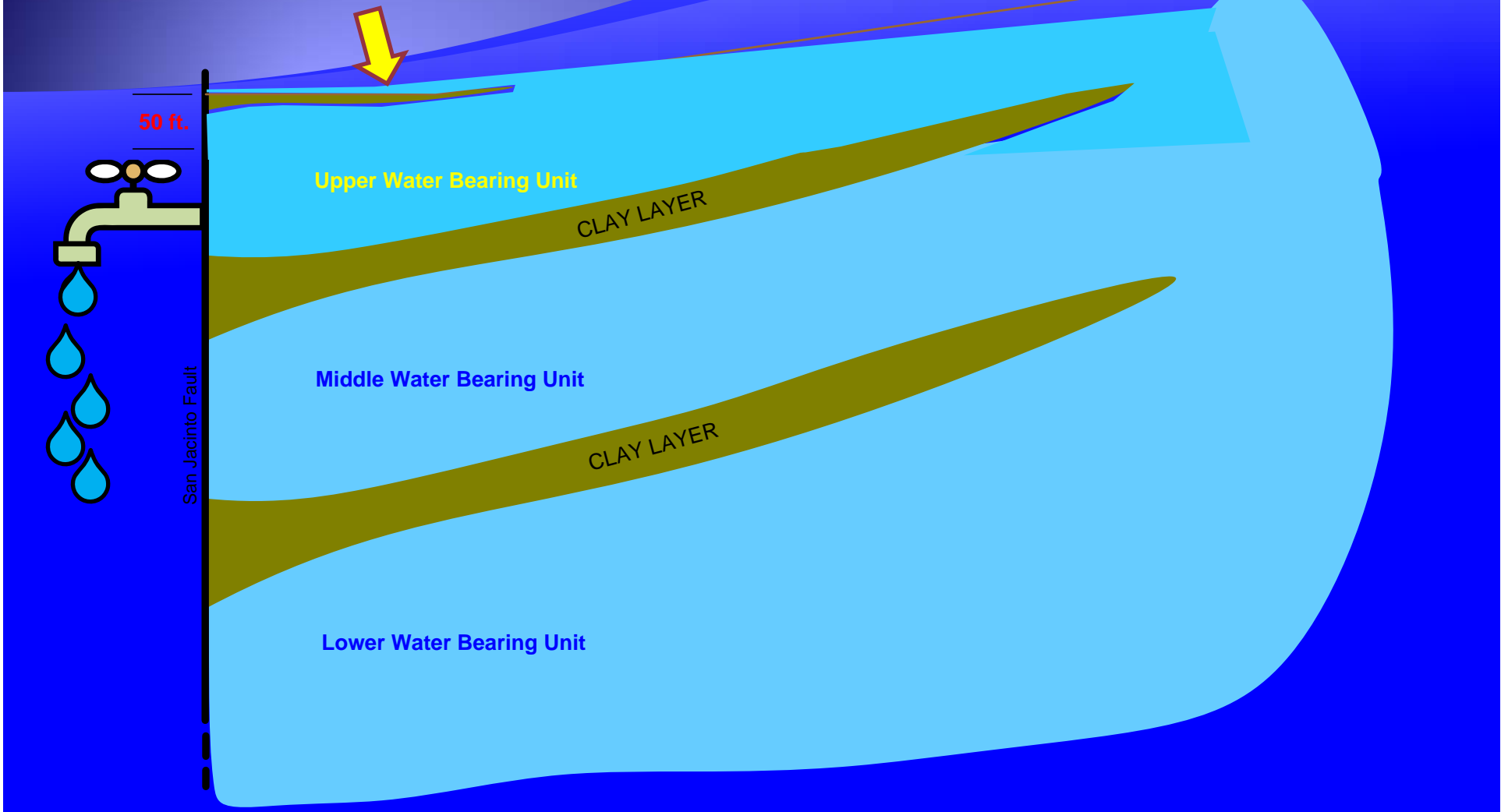


# Pressure Zone $\geq$ 50 ft bgs



**Liquefaction/Leakage = Low**

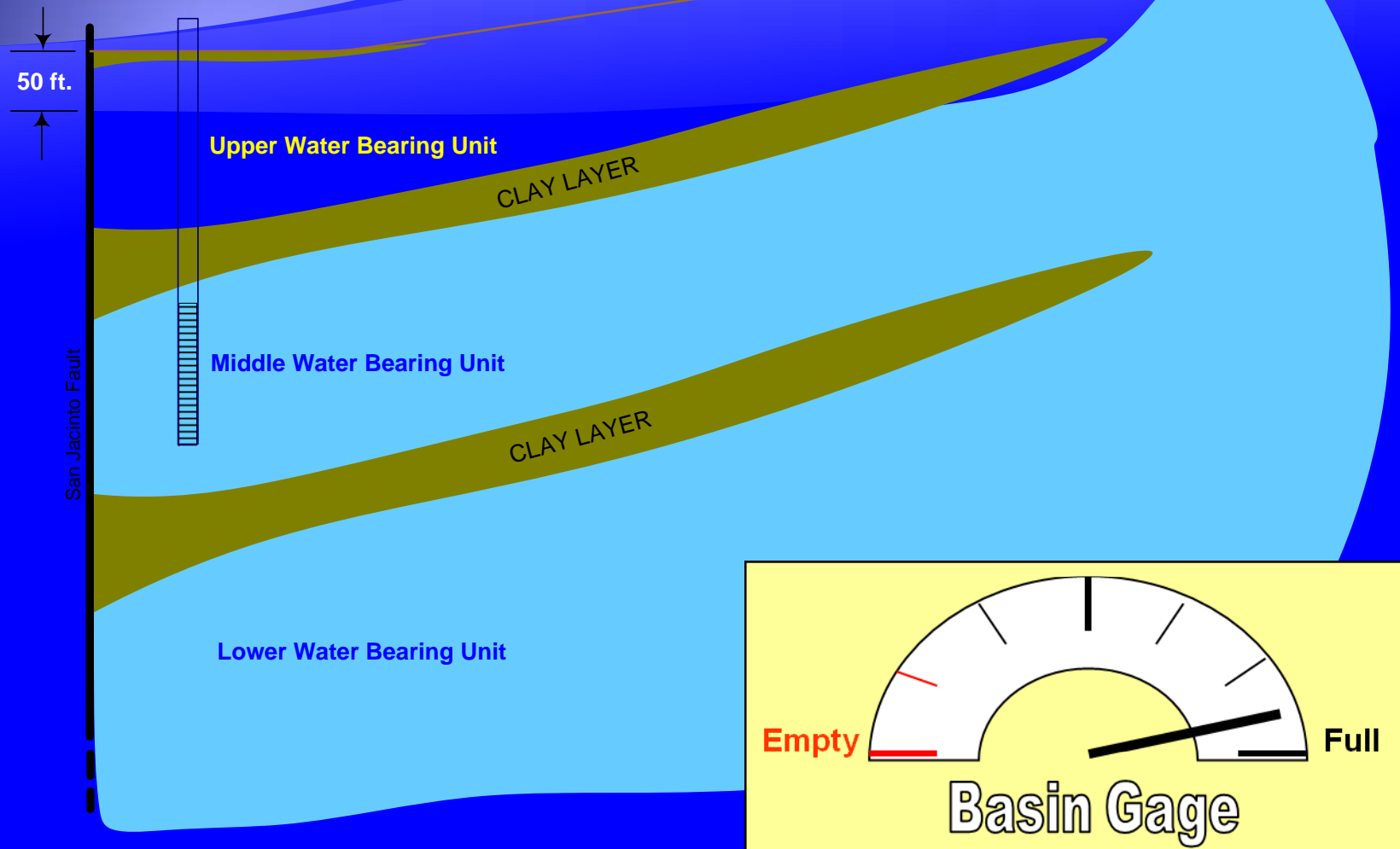
# Pressure Zone < 50 ft bgs



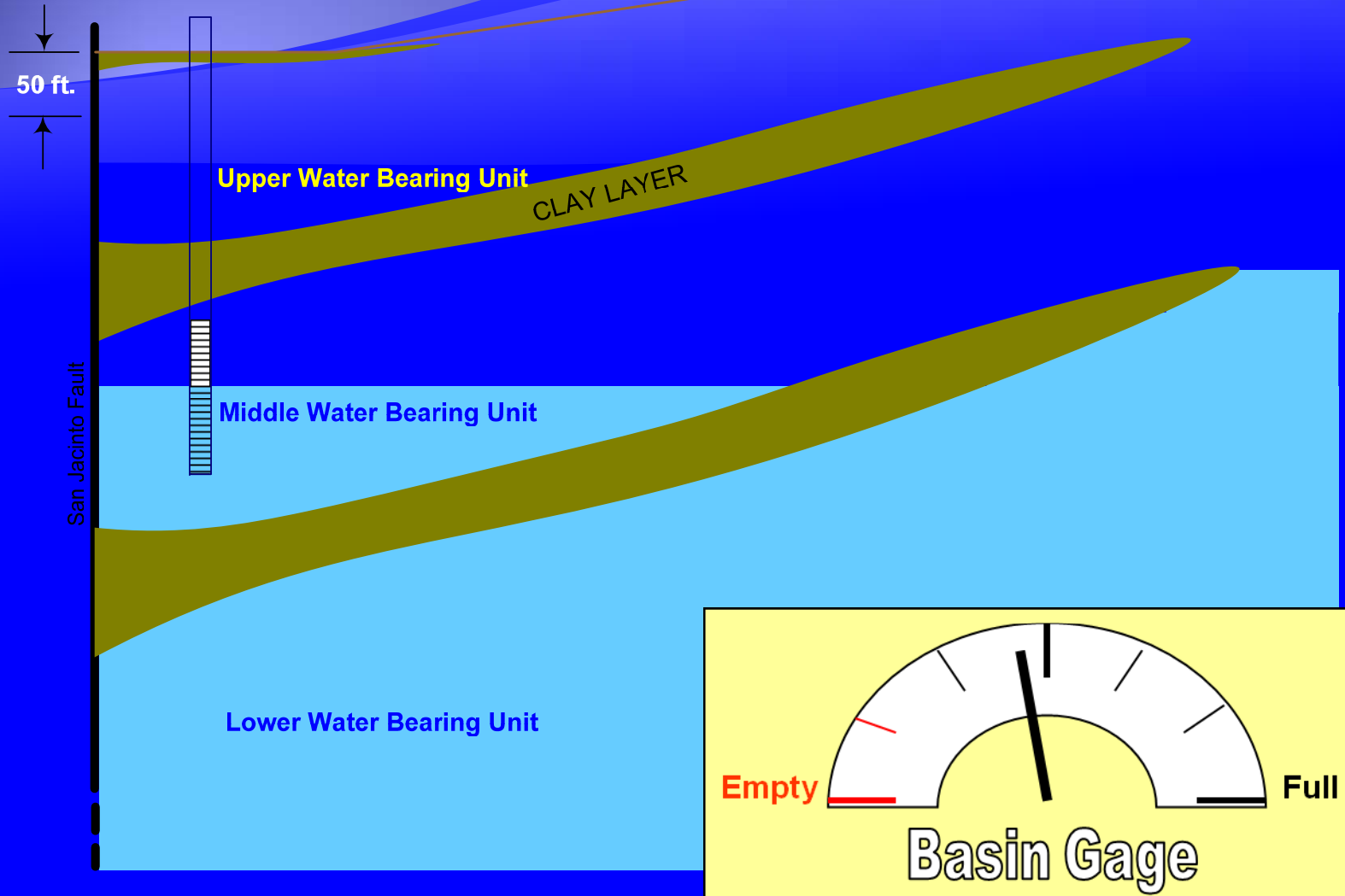
**Liquefaction/Leakage = Very High**



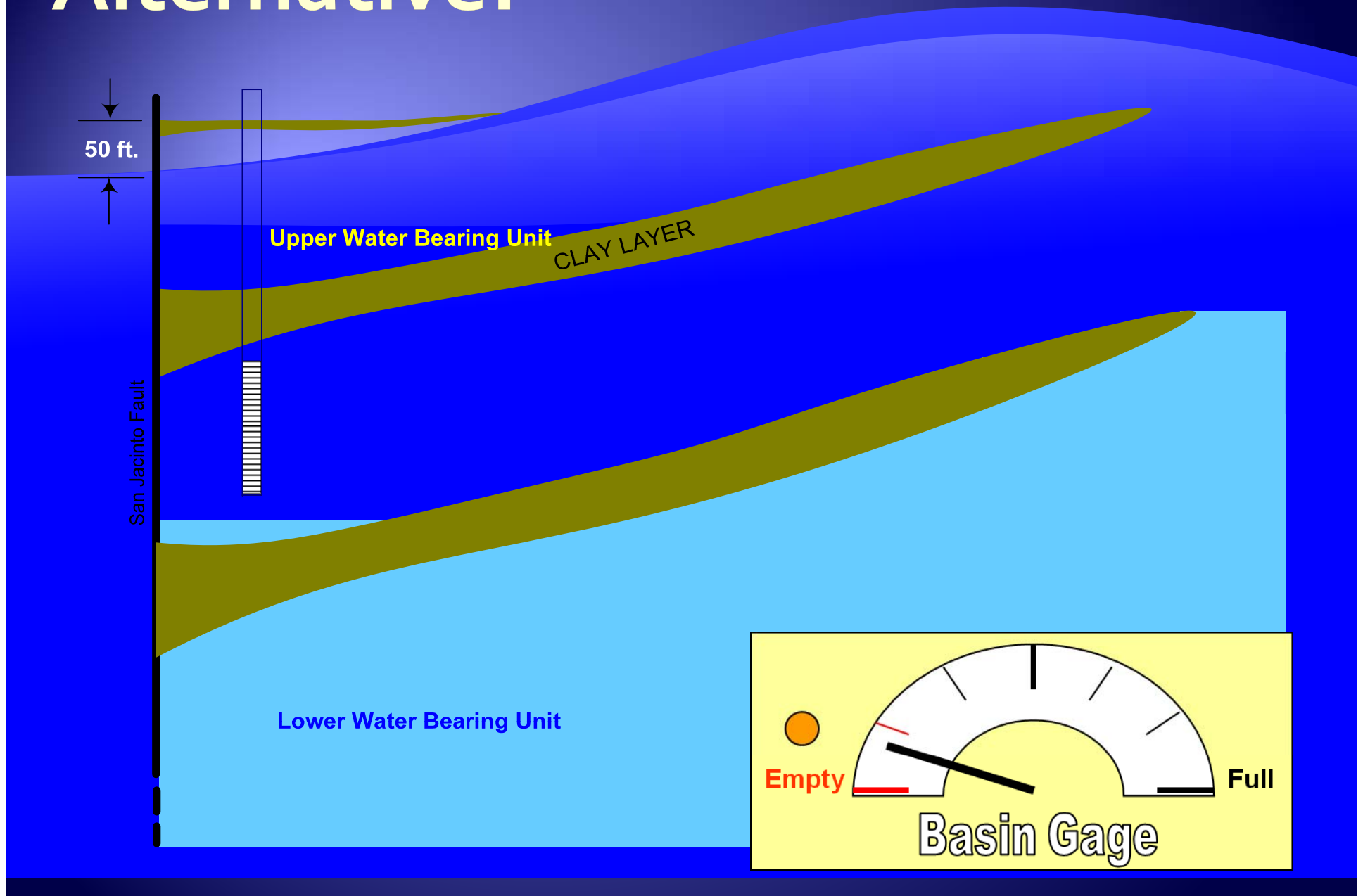
# "Tilted Water Table" Concept for SBBA **BEFORE** Drought



# “Tilted Water Table” Concept for SBBA **AFTER** Drought



# Alternative?





Basin Technical Adv

Mailing Address  
380 East Vandere  
San Bernardino

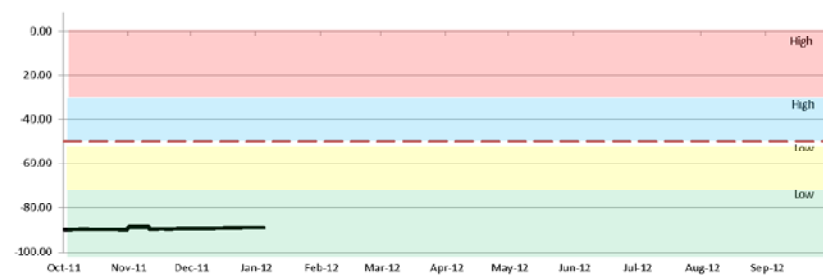
# 2012 Regional Water Manager

December 2011

## 2012 Regional Water Management Plan Jan 2012 Statement

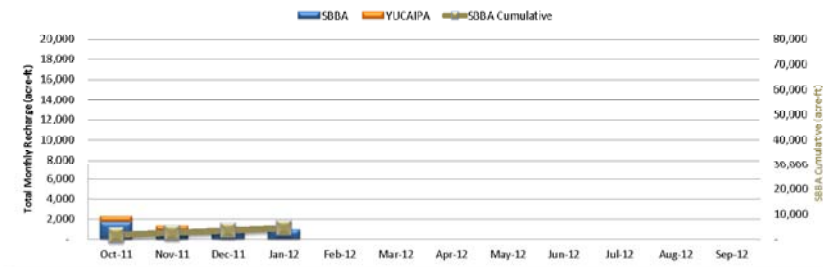
**LIQUEFACTION POTENTIAL IN THE SBBA (Avg. Backyard Well, D4, 5 and 6)**

**LOW**



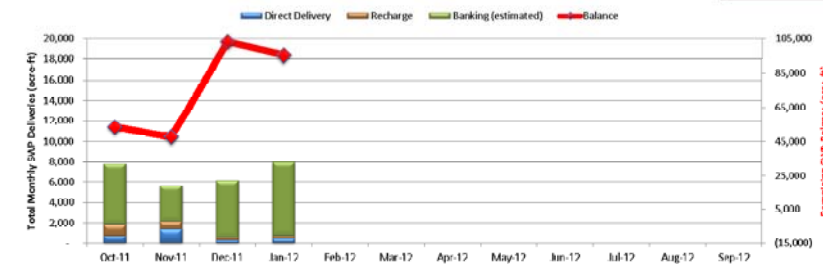
**ARTIFICIAL RECHARGE**

**4,480 AC/FT**



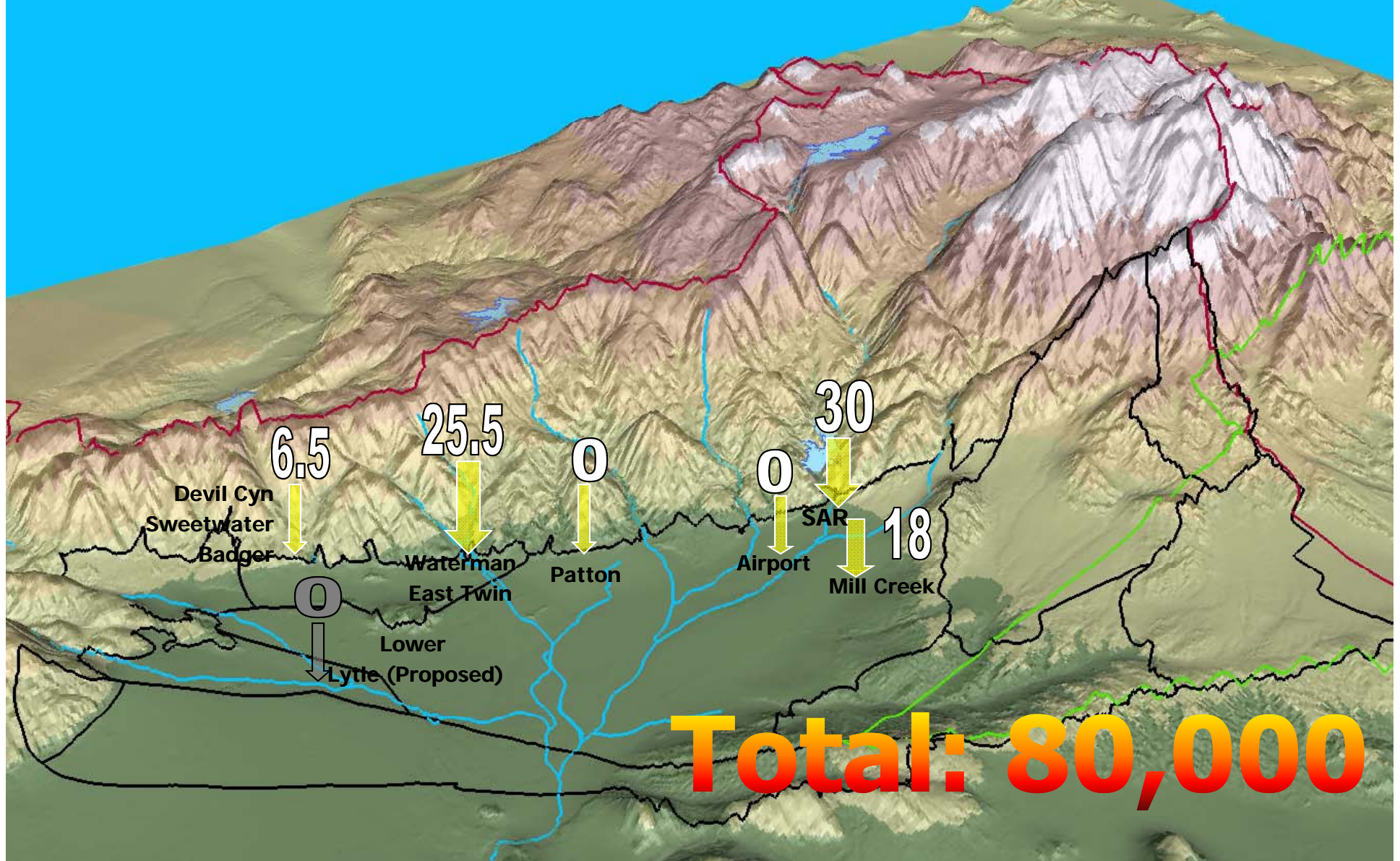
**STATE WATER PROJECT BALANCE**

**95,044 AC/FT**



# 2012 Spreading Maximums

Ref: 2011 Modeling Run 1: "Wet Scenario", 1,000s acre-ft

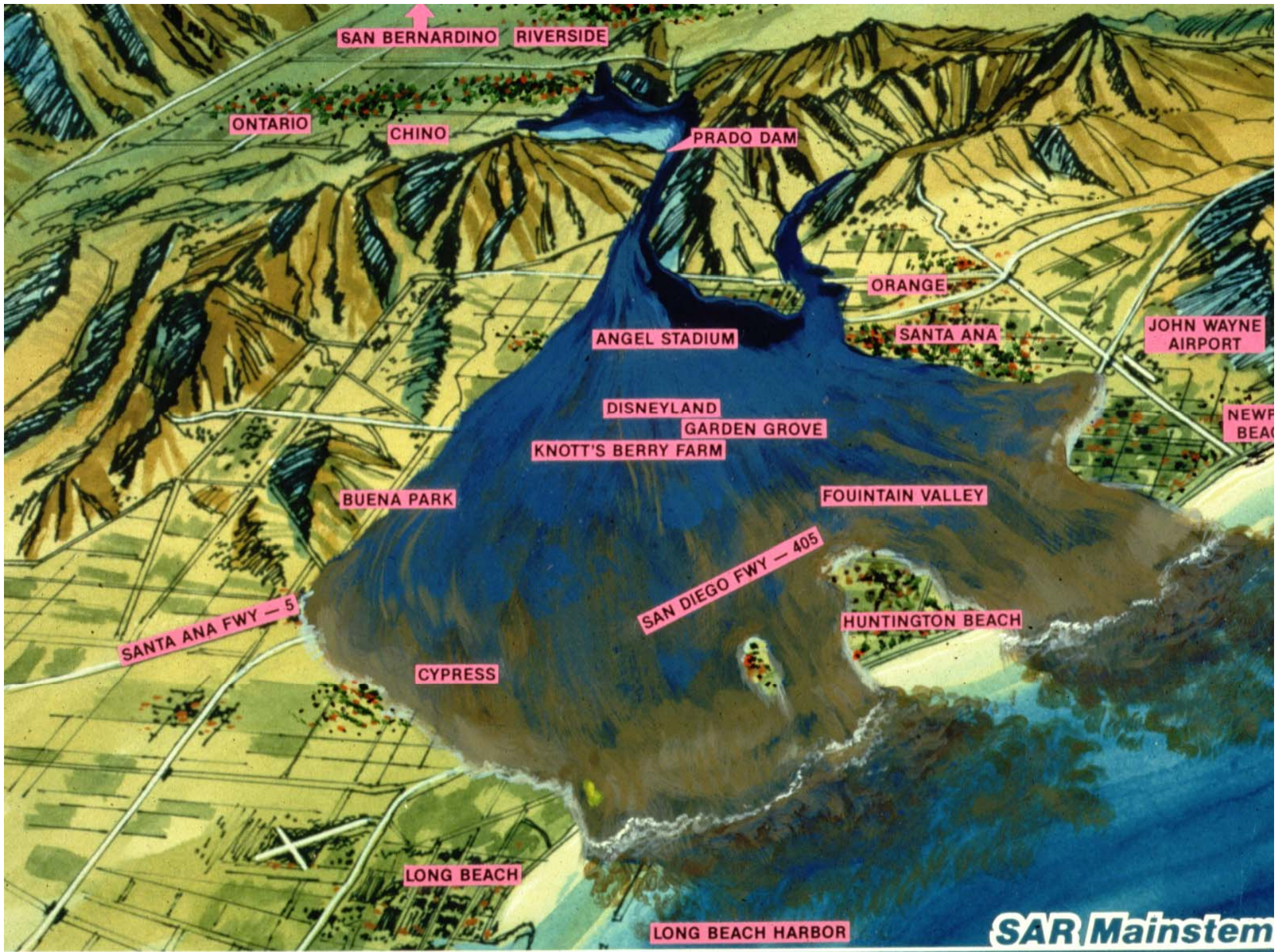




# Local Storm water Capture







SAN BERNARDINO RIVERSIDE

ONTARIO

CHINO

PRADO DAM

ORANGE

ANGEL STADIUM

SANTA ANA

JOHN WAYNE AIRPORT

DISNEYLAND

GARDEN GROVE

KNOTT'S BERRY FARM

NEWPORT BEACH

BUENA PARK

FOUNTAIN VALLEY

SANTA ANA FWY - 5

SAN DIEGO FWY - 405

HUNTINGTON BEACH

CYPRESS

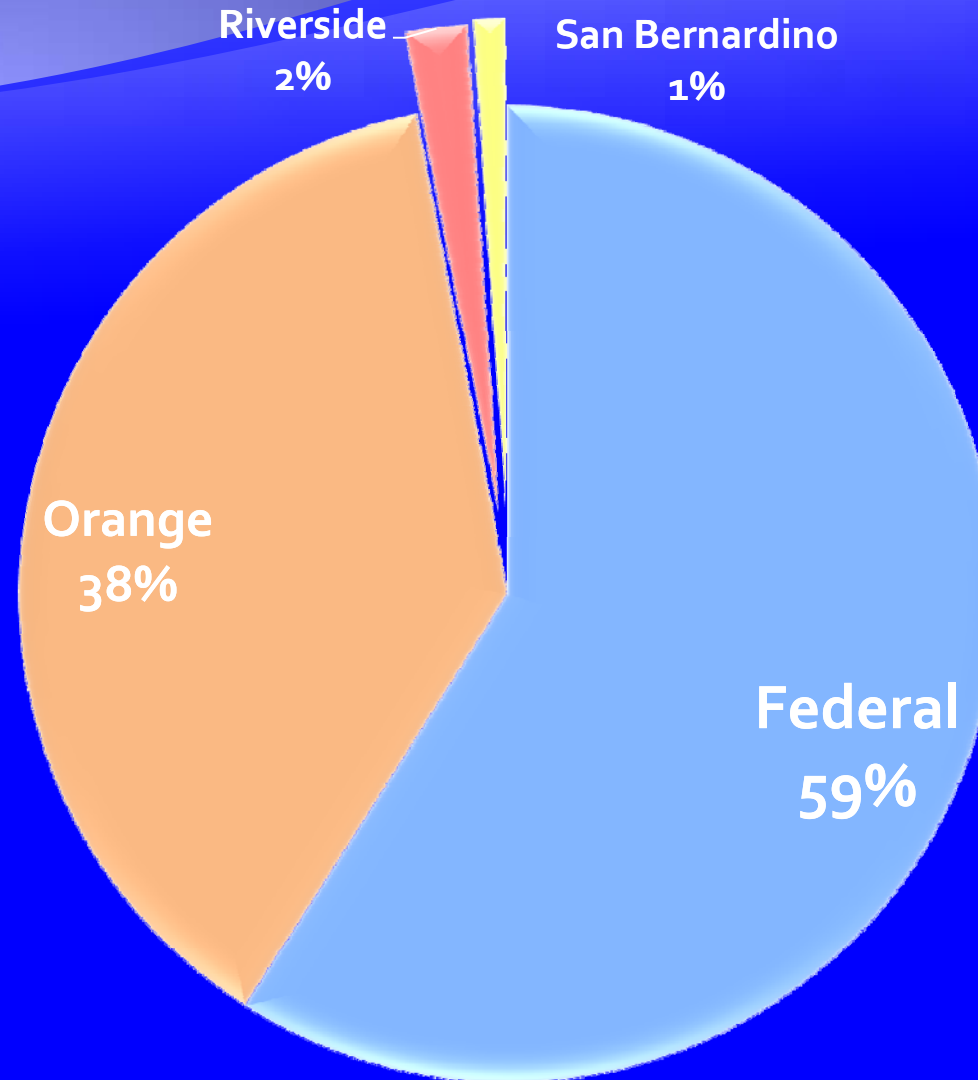
LONG BEACH

LONG BEACH HARBOR

SAR Mainstem



# Who paid for the Dam?



# Investment in SAR Water Right

Date	Description	Cost
1991	SBVMWD submit application to appropriate Santa Ana River water based on construction of Seven Oaks Dam.	
1995	SBVMWD/WMWD submit joint application and petition for reconsideration of "fully appropriated" stream status for Santa Ana River.	
1999	State Water Resources Control Board Hearing on fully appropriated stream status for the Santa Ana River	
2002	Apply for water right on Santa Ana River	\$15 million
2/2007	Seven Oaks Dam Economic Analysis	\$35,000
4/2008	Santa Ana River Groundwater Recharge Optimization Study (SBVMWD/SBVWCD)	\$359,000
8/2009	Complete Seven Oaks Dam Economic Analysis	\$31,039
1/2010	Enhanced Santa Ana River Recharge Environmental and Construction Documents	\$706,200
		<b>Total \$16,131,239</b>



# Water Right Process

Permit  
**June 2010**

Diversion

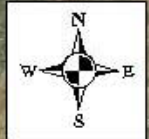
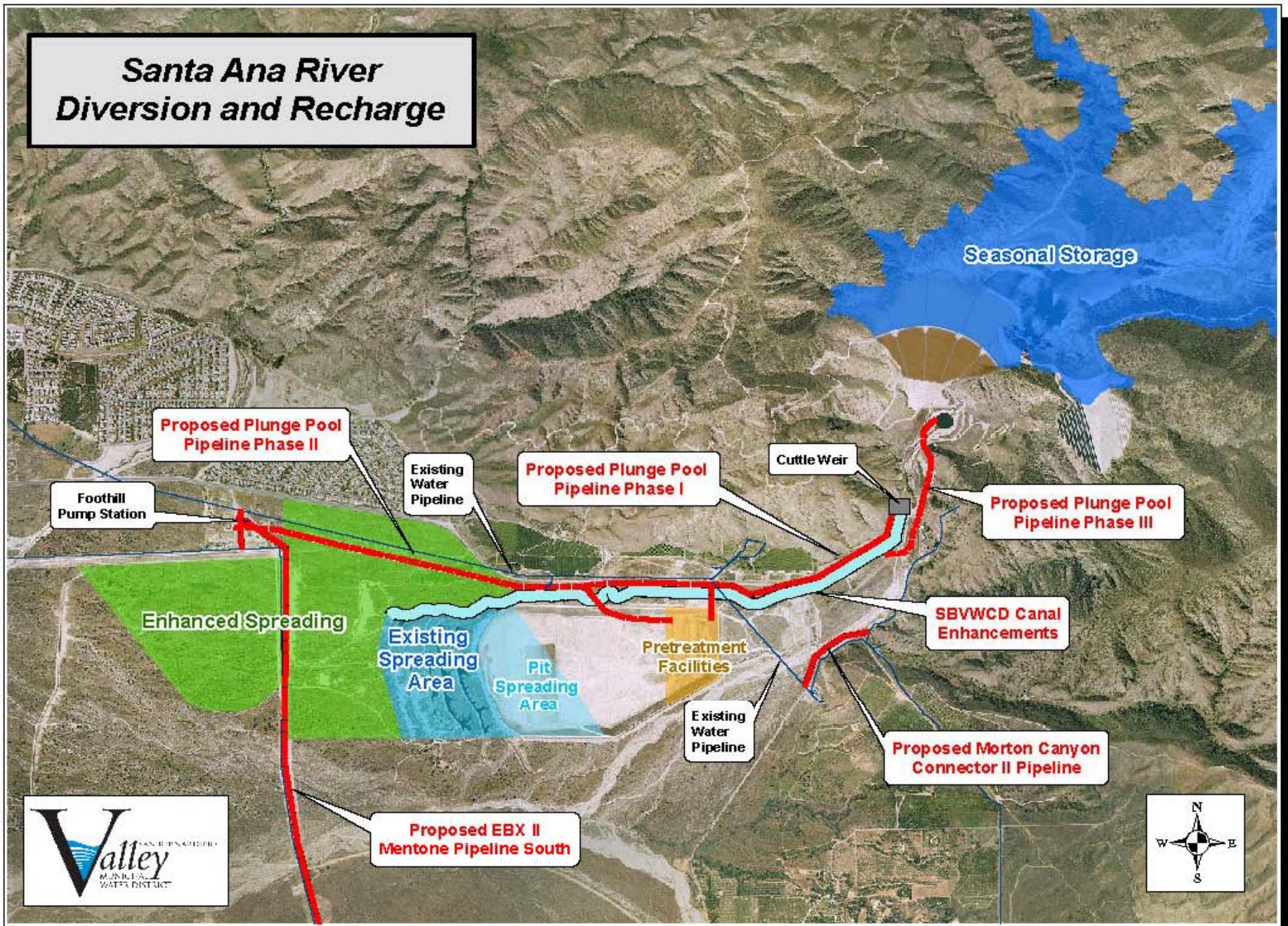
License

# Investment at Seven Oaks

Date	Description	Cost
11/2/93	Seven Oaks Dam Water Conservation Feasibility Study (Completed October 1997)	\$1,023,000
6/11/97	Pay for "blanket drain" improvements to Seven Oaks Dam	\$3.2 million
10/18/06	Participation in Updated Seven Oaks Dam Water Conservation Feasibility Report	
8/3/2007	Payment for updated Seven Oaks Dam Water Conservation Feasibility Study	\$400,000
8/09	Payment for updated Seven Oaks Dam Water Conservation Feasibility Study	\$400,000
	<b>TOTAL</b>	<b>\$5,023,000</b>

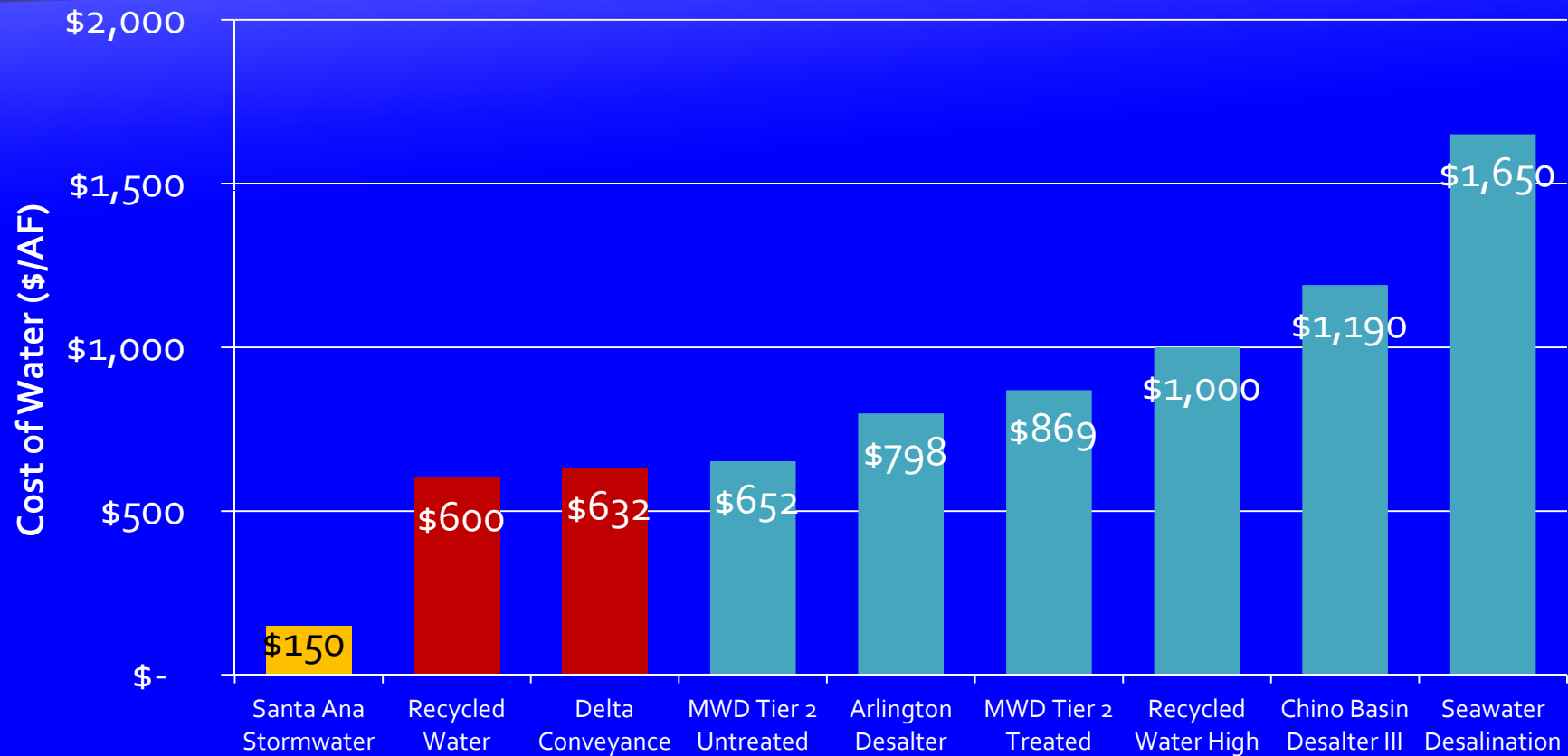


# Santa Ana River Diversion and Recharge





# Cost of New Water Supplies in Southern California



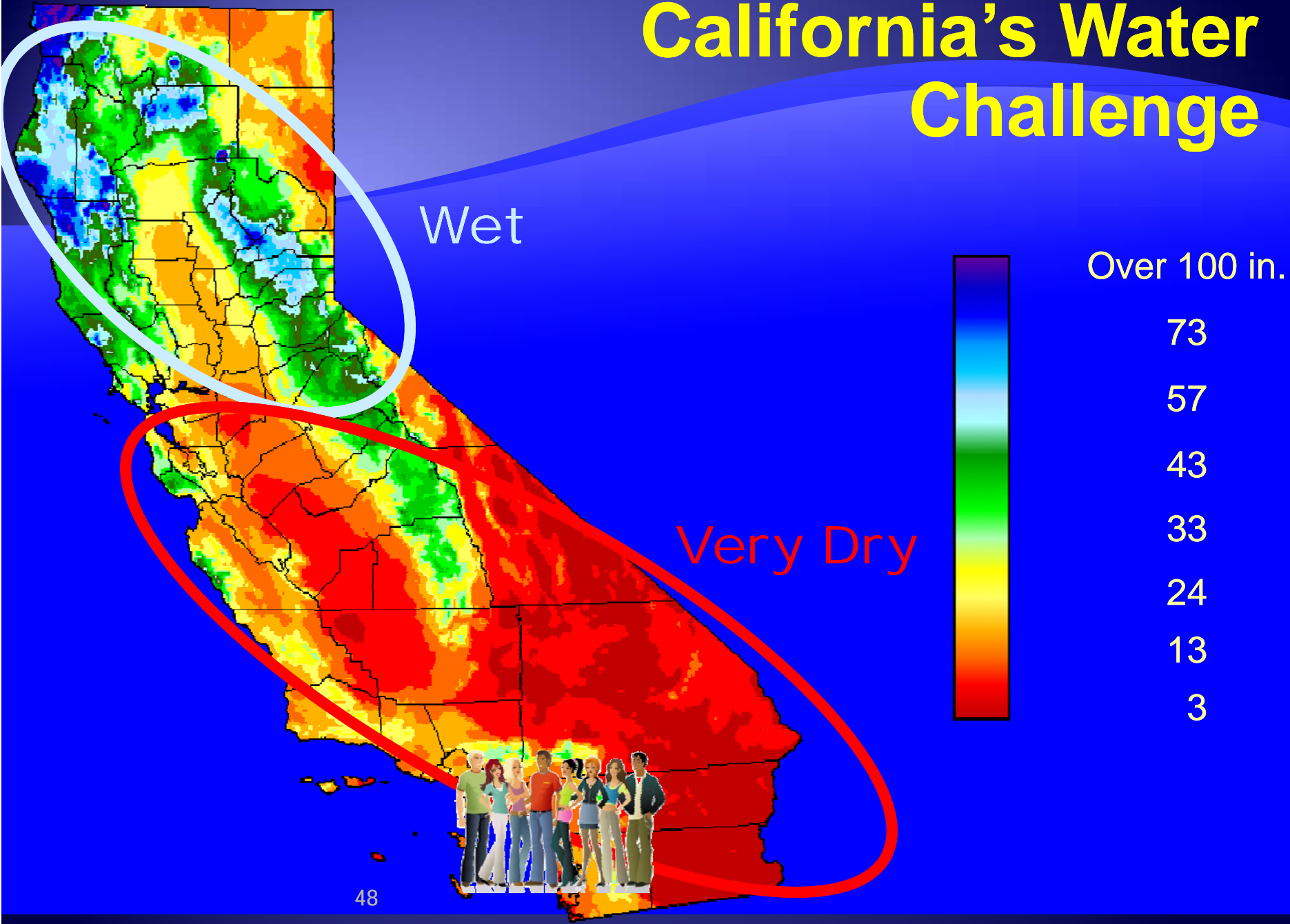




What's next? Storm water Capture  
**Tributaries** of the Santa Ana River



# California's Water Challenge





# Water Projects in CA



- Major Rivers
- State Projects
- Federal Projects
- Local Projects

# State Water Project



The Delta

California  
State Water  
Project



# 29 SWP Contractors

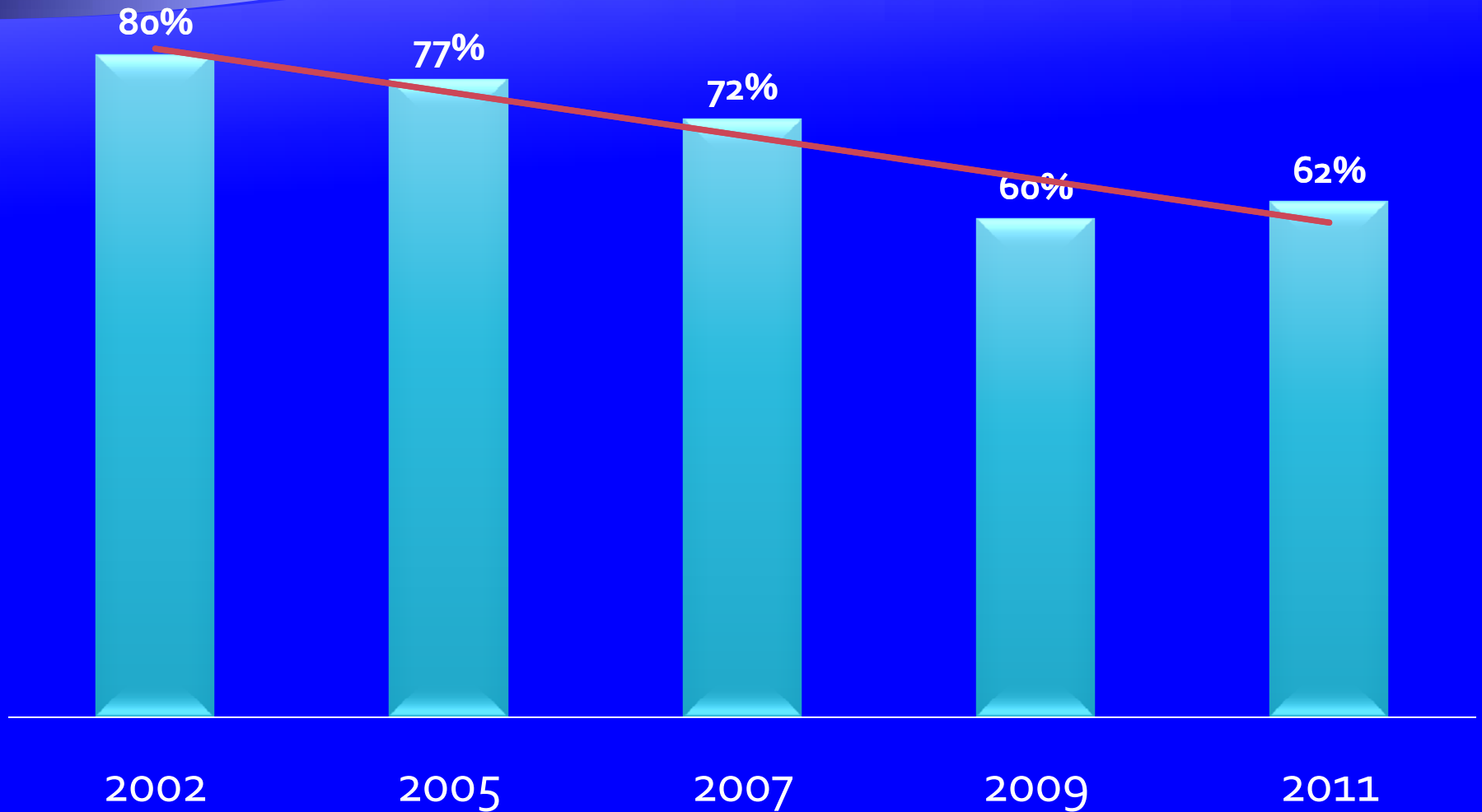


SBVMWD

5<sup>th</sup> Largest State  
Water Contractor

102,600 acre-feet  
per year

# State Water Project Reliability





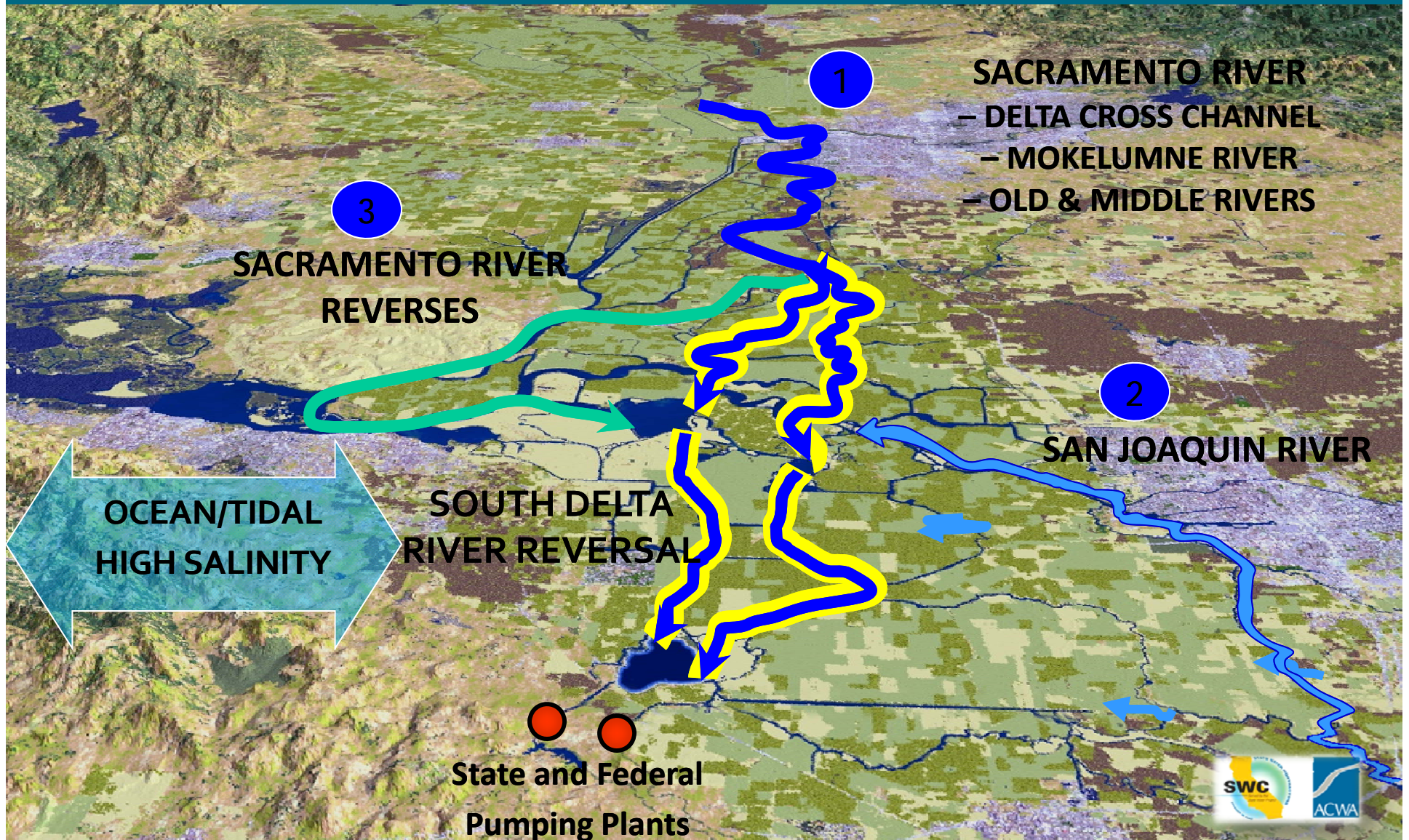
# How Water Flowed Across the Delta Before the SWP and CVP





# How Water Currently Flows Across the Delta

(Delta intended to be temporary conveyance)





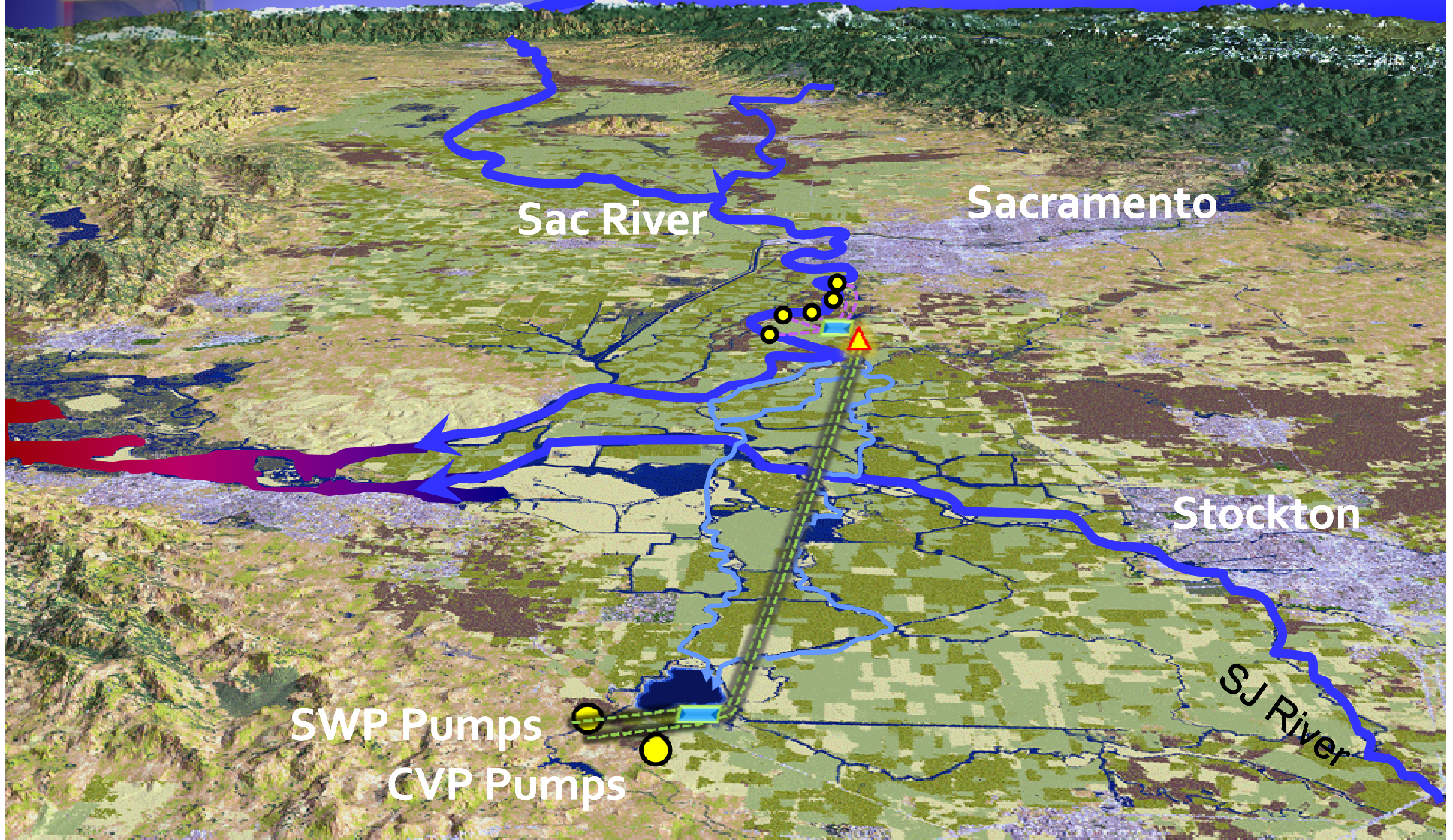
# Solution: “Delta Conveyance” (Peripheral Canal)





# Bay-Delta Conservation Plan

## Dual-Conveyance – Central Tunnel





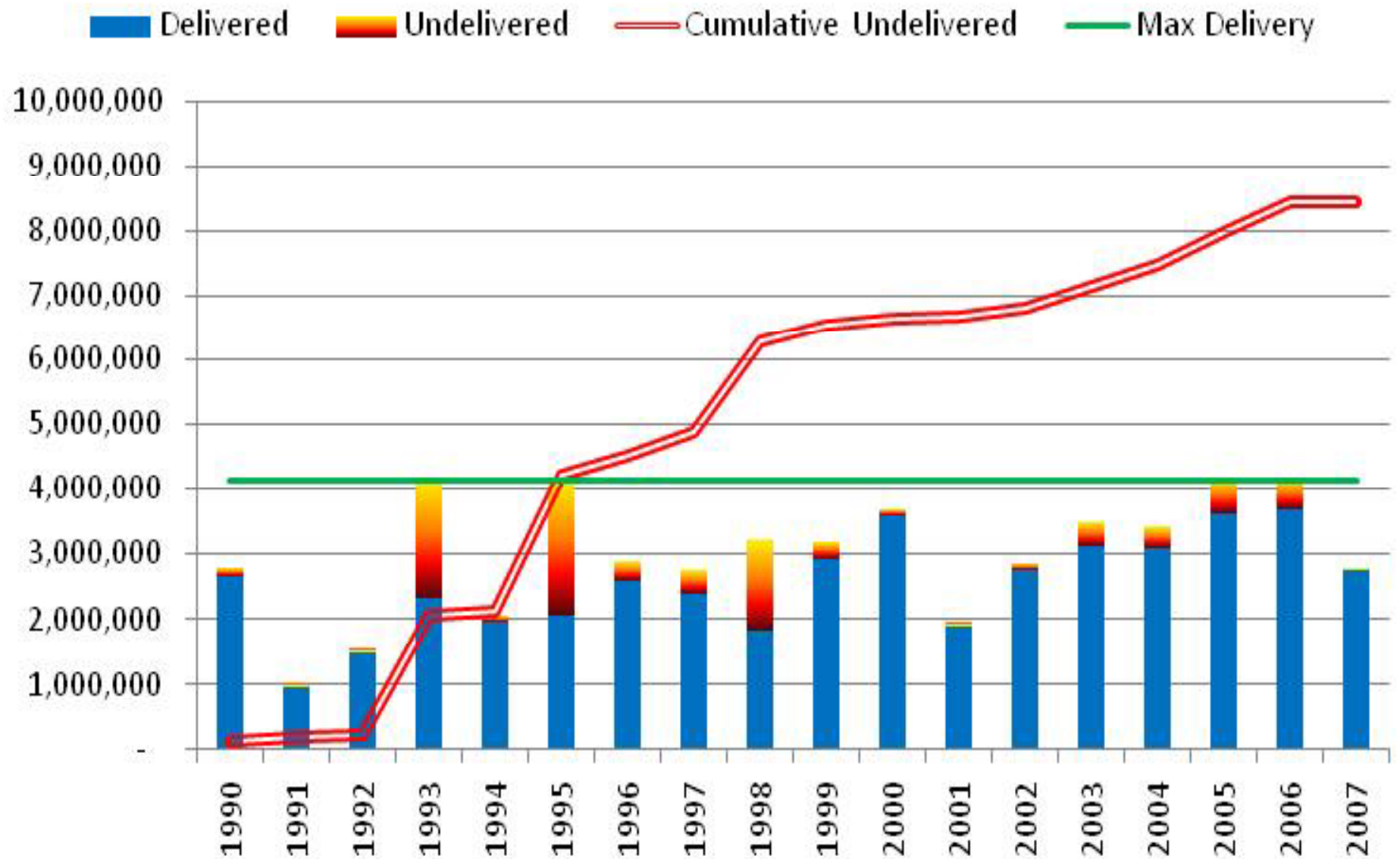
# Optimize Imported Water



- ◆ **Goals**

- ◆ *Paradigm shift:* take more imported water during wet years when it is available.
- ◆ Increase utilization.
- ◆ Increase storage for dry years.
- ◆ **Not a new concept.**

# Undelivered State Water Project Water Since 1990



Source: Department of Water Resources



# Previous Utilization: “\$hort Term”

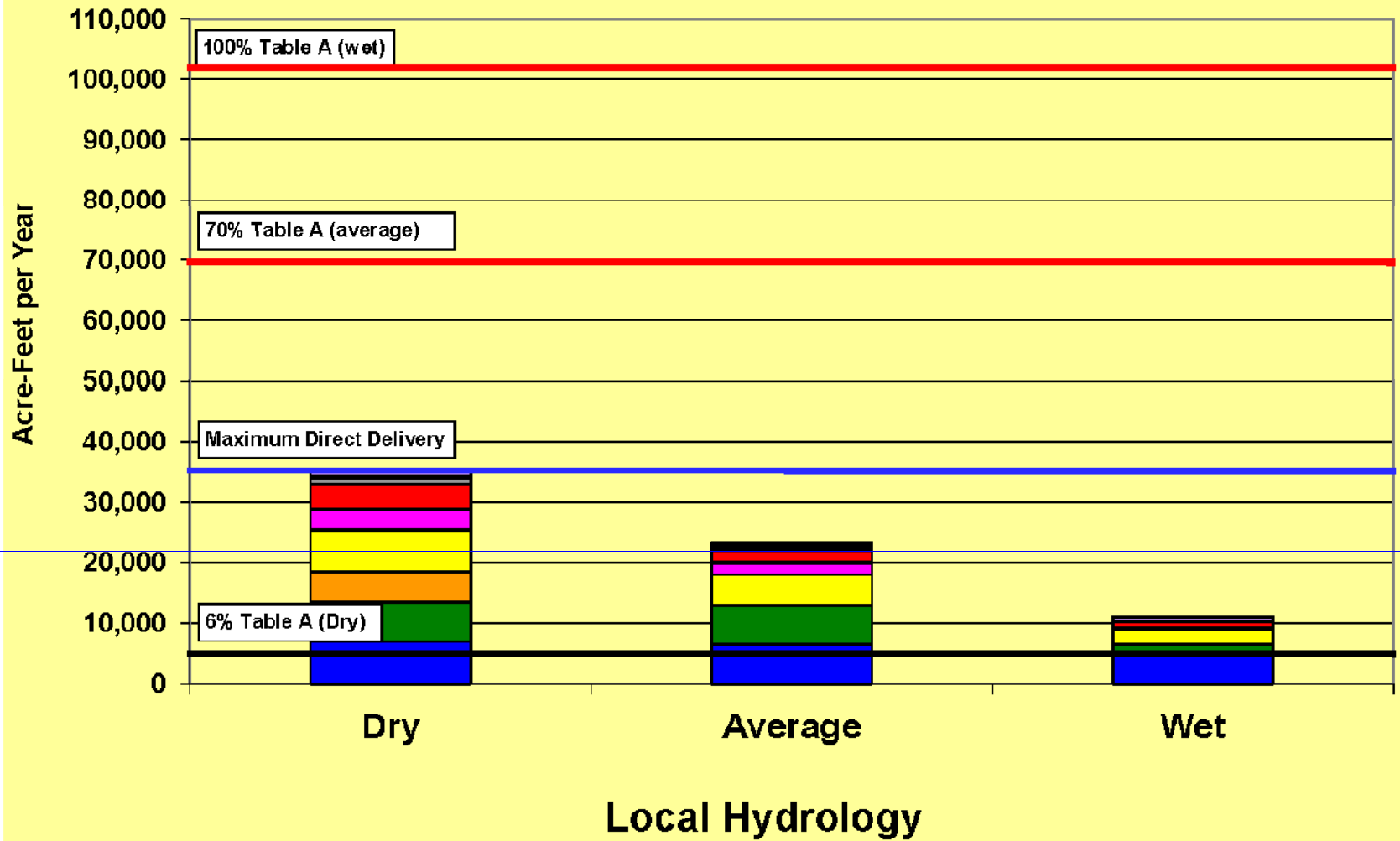


**Dry Year**  
(spot market)



**Wet Year**  
(minimal delivery)

# Current SWP Delivery Trend





# Proposed Utilization: Long Term

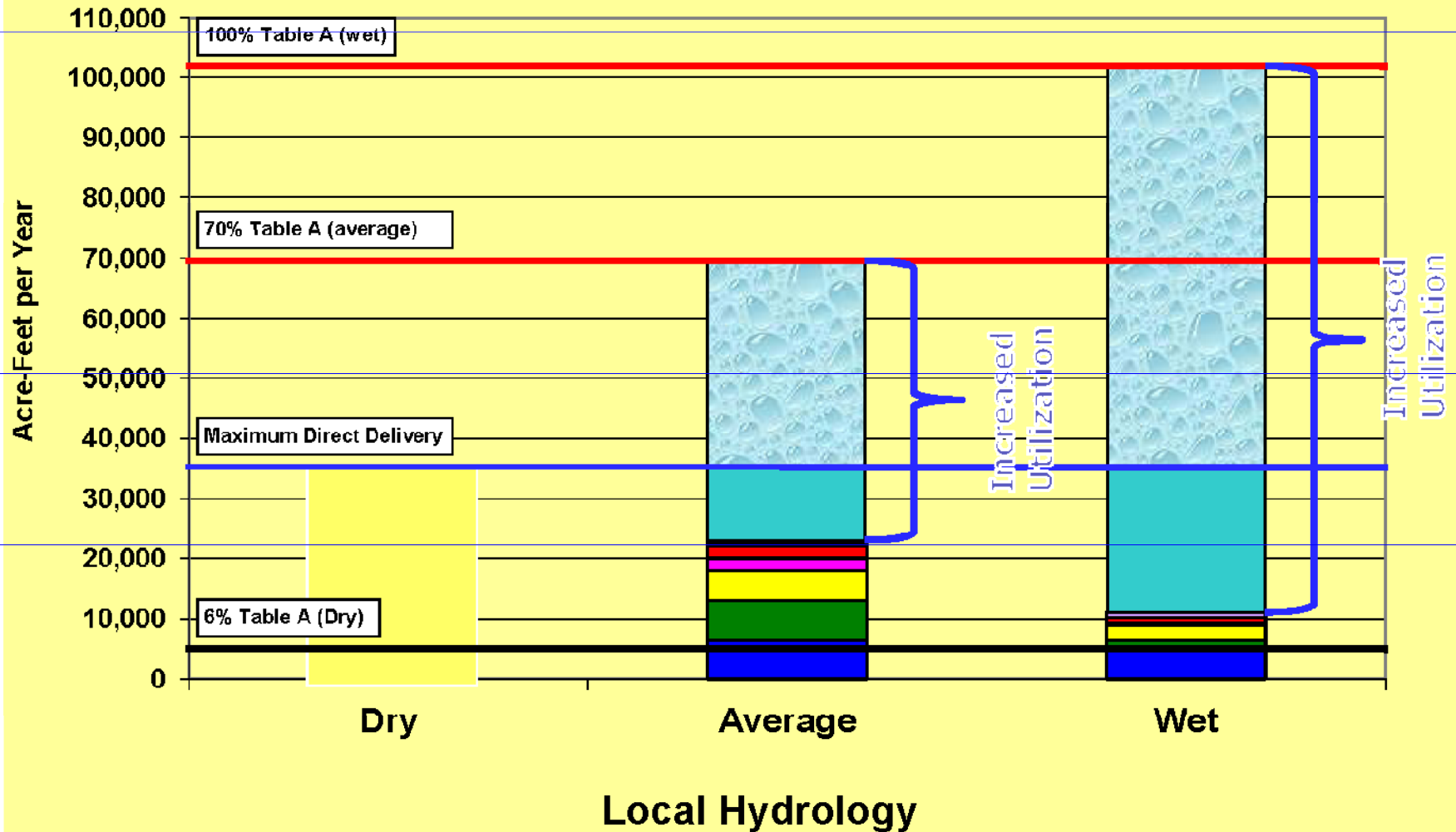


**Wet Year**  
(Store water)



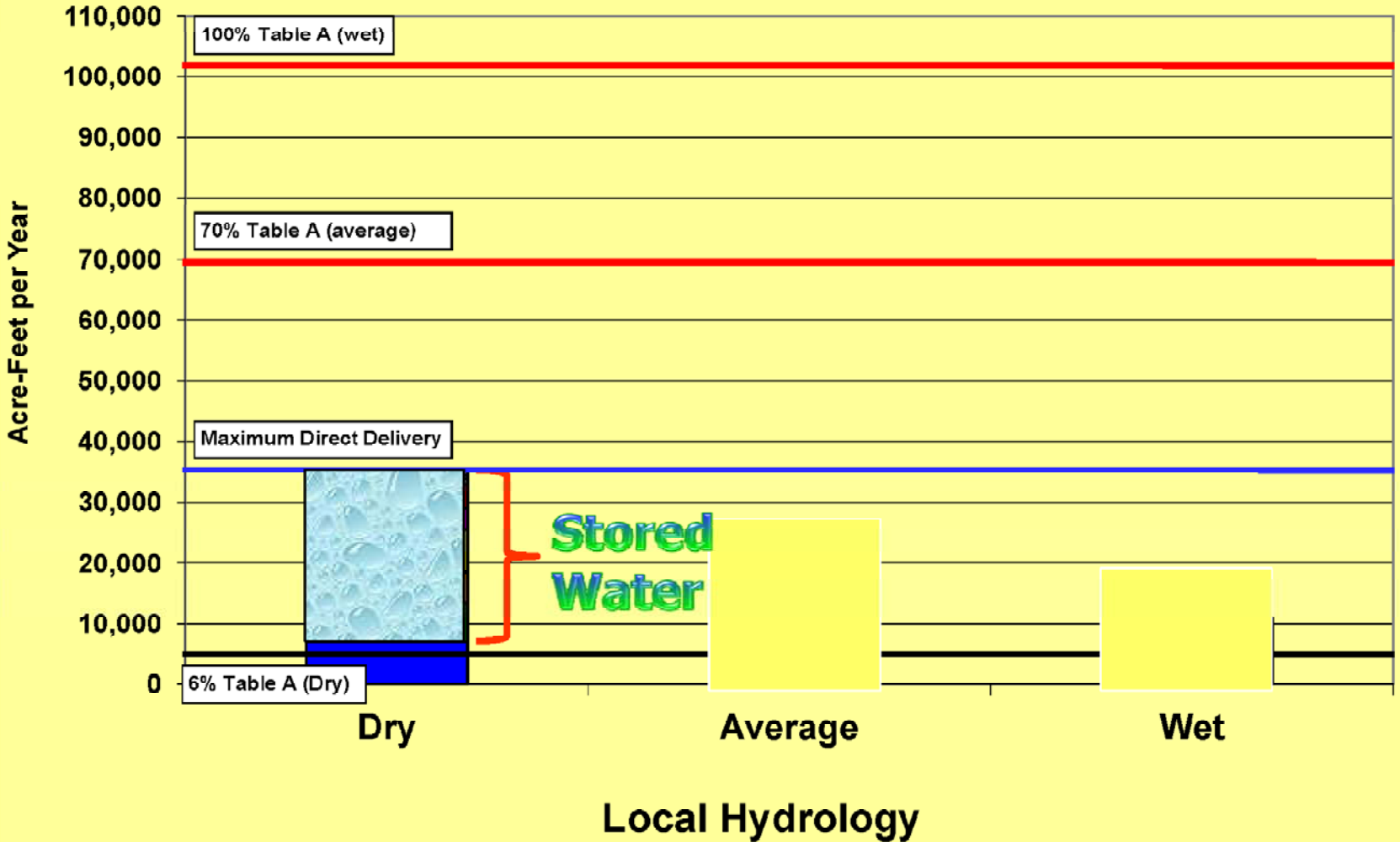
**Dry Year**  
(Use stored water)

# Optimization Delivery Trend





# Dry Year Optimization



# Emergency Measures

Normal

Threatened

Emergency



# Projections

**IRWMP**

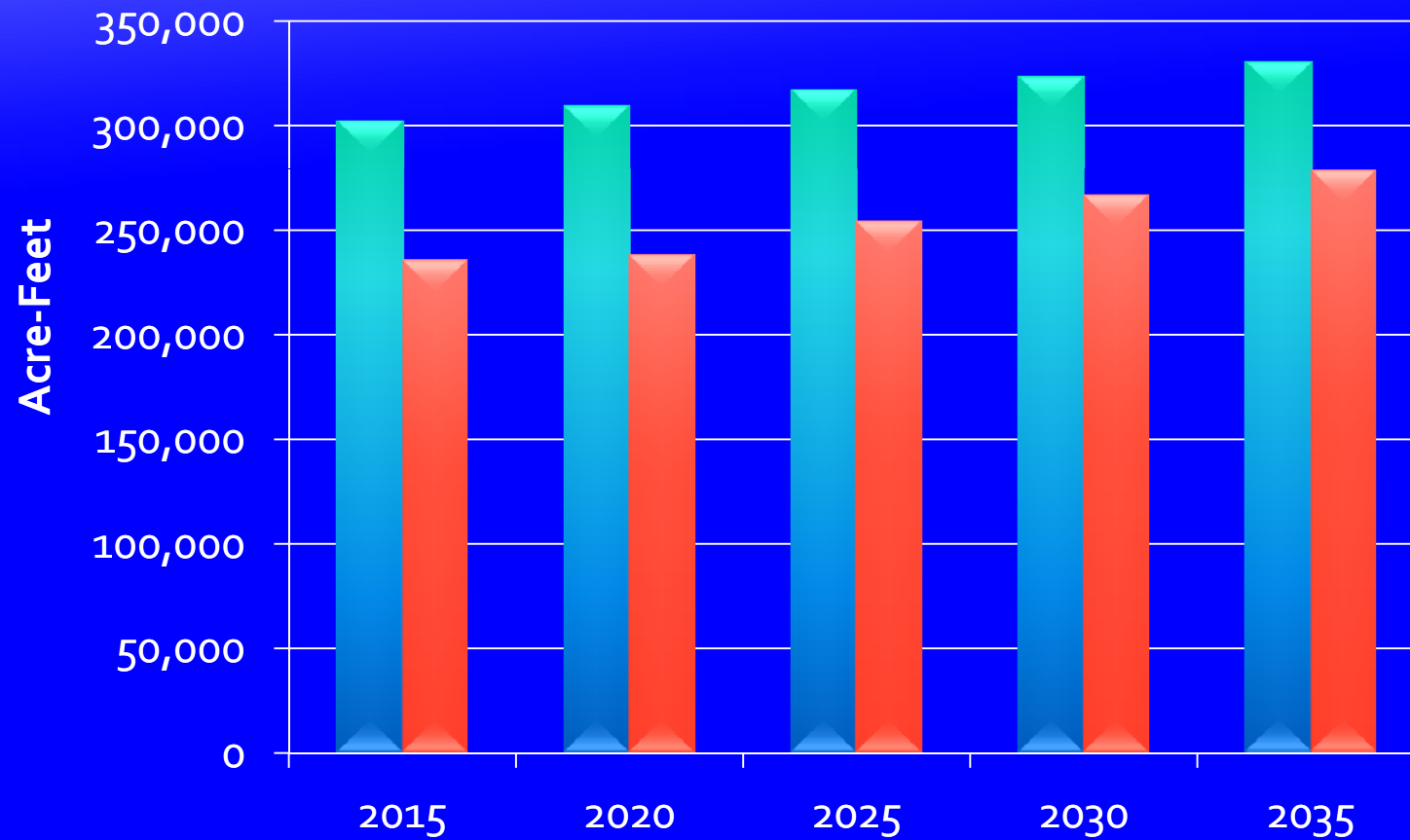
(Multiple Discipline)

**RUWMP**

(Water)

# Normal Year

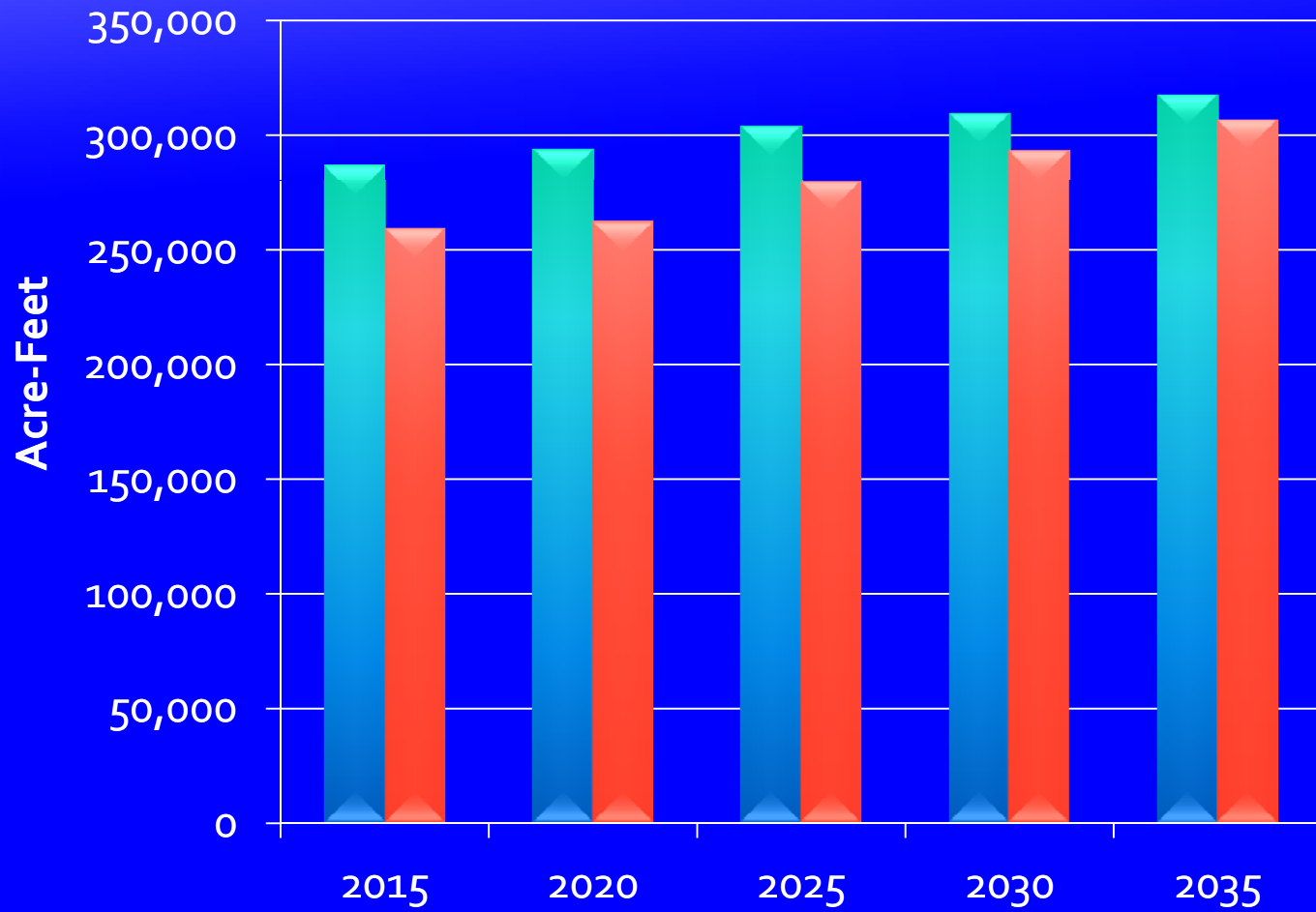
■ Total Supplies ■ Total Demands



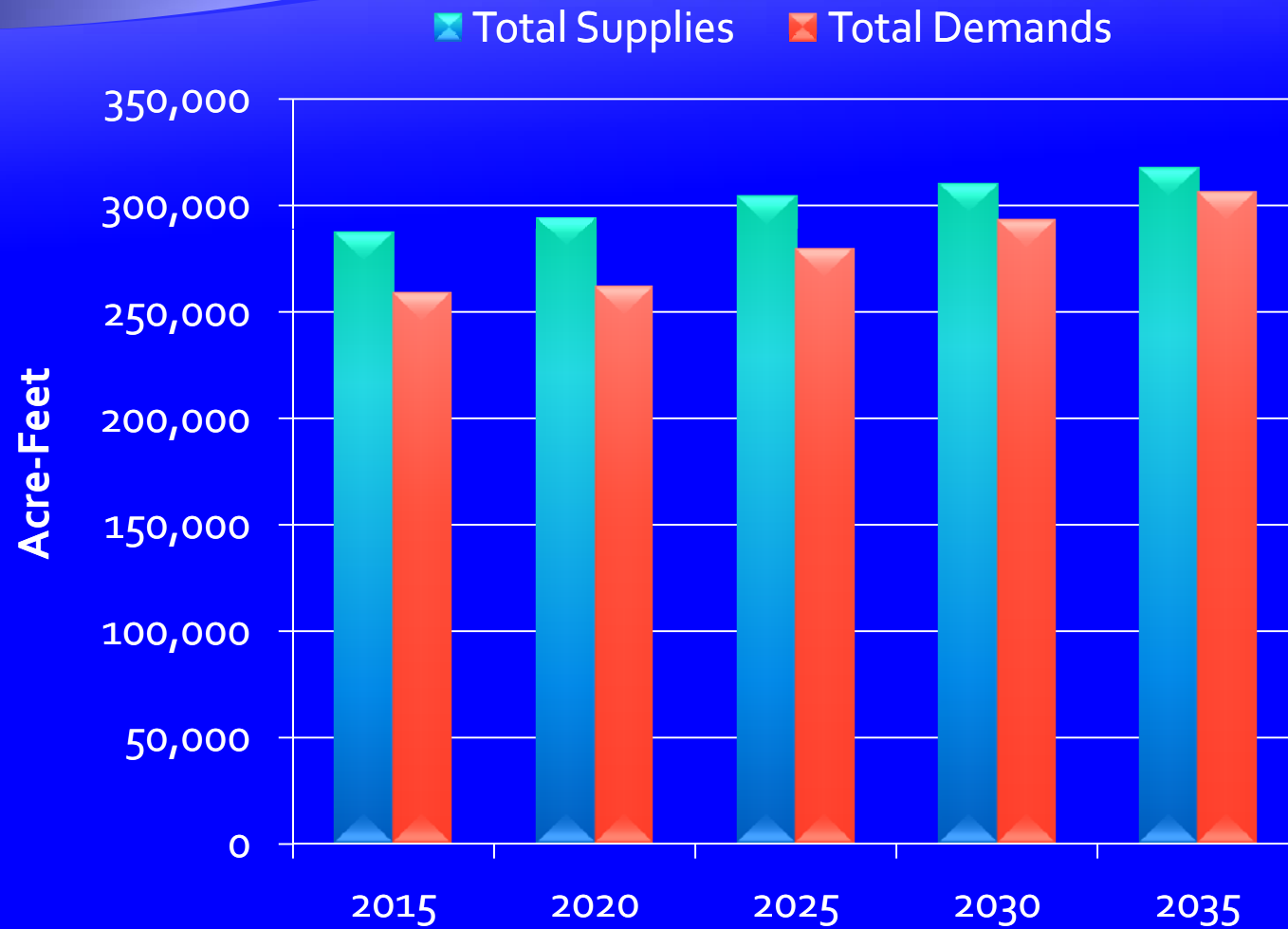


# Single Dry Year

◆ Total Supplies    ◆ Total Demands

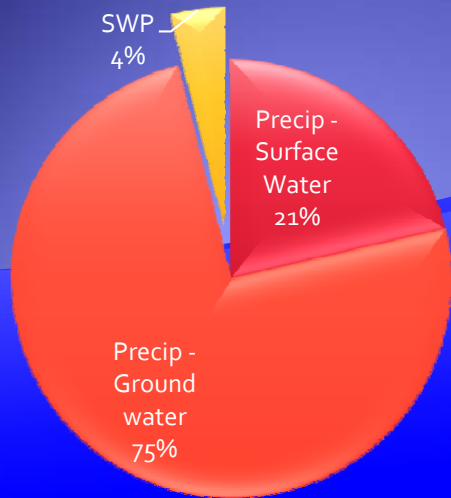


# Multiple Dry Years (4)

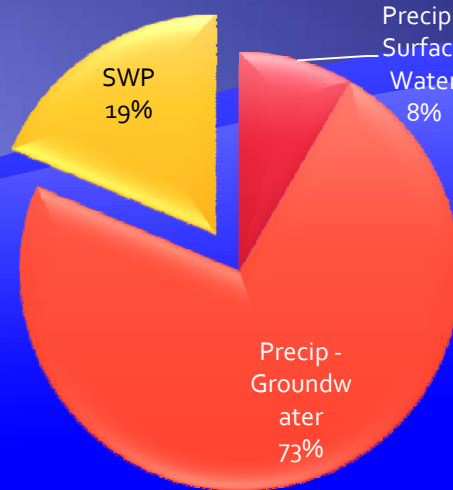




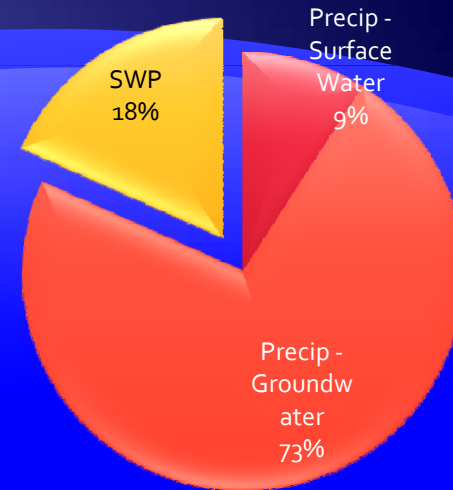
2015



Average

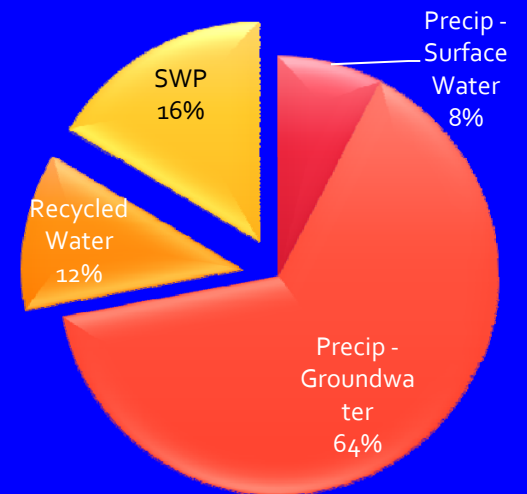
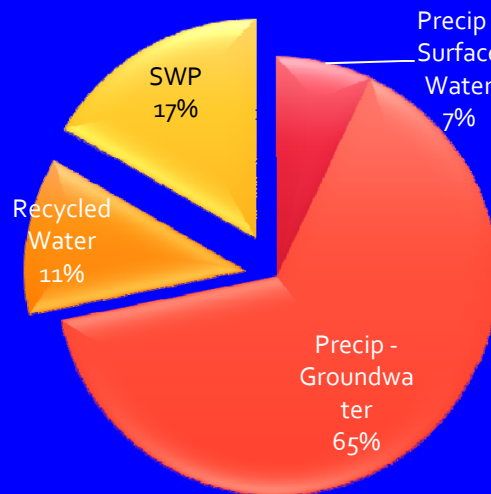
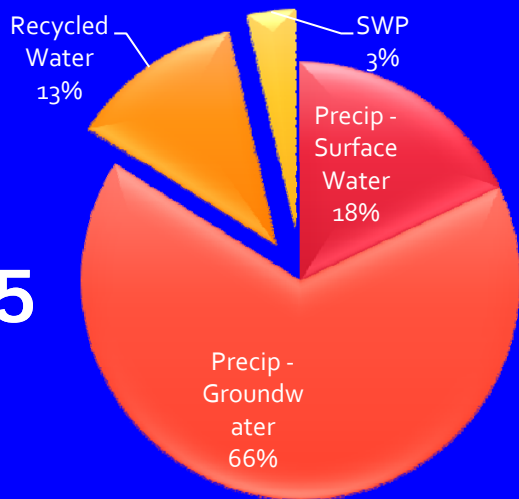


Single-year drought



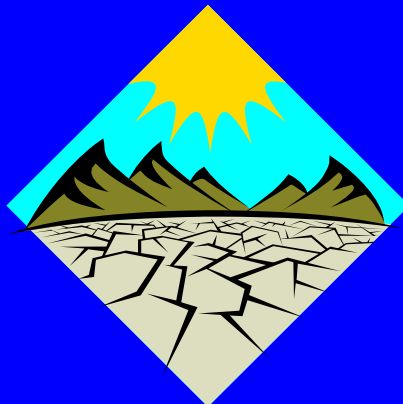
Multi-year drought

2035

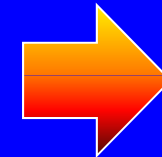
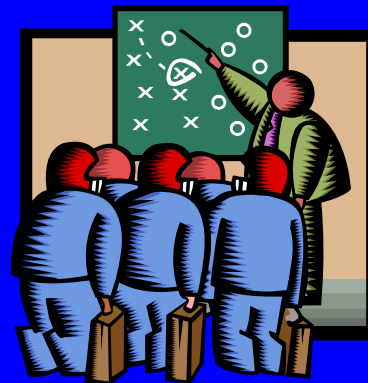


# Uncertainties are Certain

# Managing Uncertainty



## Management Strategies







# Questions?

## Contact Information

Bob Tincher

909/387-9215, direct

909/226-2812, cell

[bobt@sbvmwd.com](mailto:bobt@sbvmwd.com)

03/01/2011



# Solution: State Water Project



California  
State Water  
Project

The Delta





Bay-Delta  
Conservation Plan

# New Delta Conveyance Water Supply Benefit Analysis

**Without** Improved Conveyance

**62%** – average SWP Table A deliveries

**With** Improved Conveyance

**80%** – average SWP Table A deliveries

**Restored Water Supply for SoCal**

**Almost 1 million af**

# San Bernardino Valley Municipal Water District

- ◆ Table A Entitlement: 102,600 acre-ft.
- ◆ 2009 Reliability Report Average Delivery
  - ◆ Current (2009) = 68,700 acre-ft
  - ◆ Future (2029) = 64,600



# The weak link: the Delta



## Unique Environment

- Confluence of CA's two biggest watersheds
- 750 plant and animal species
- More than 40 threatened and endangered species



## Economy and infrastructure

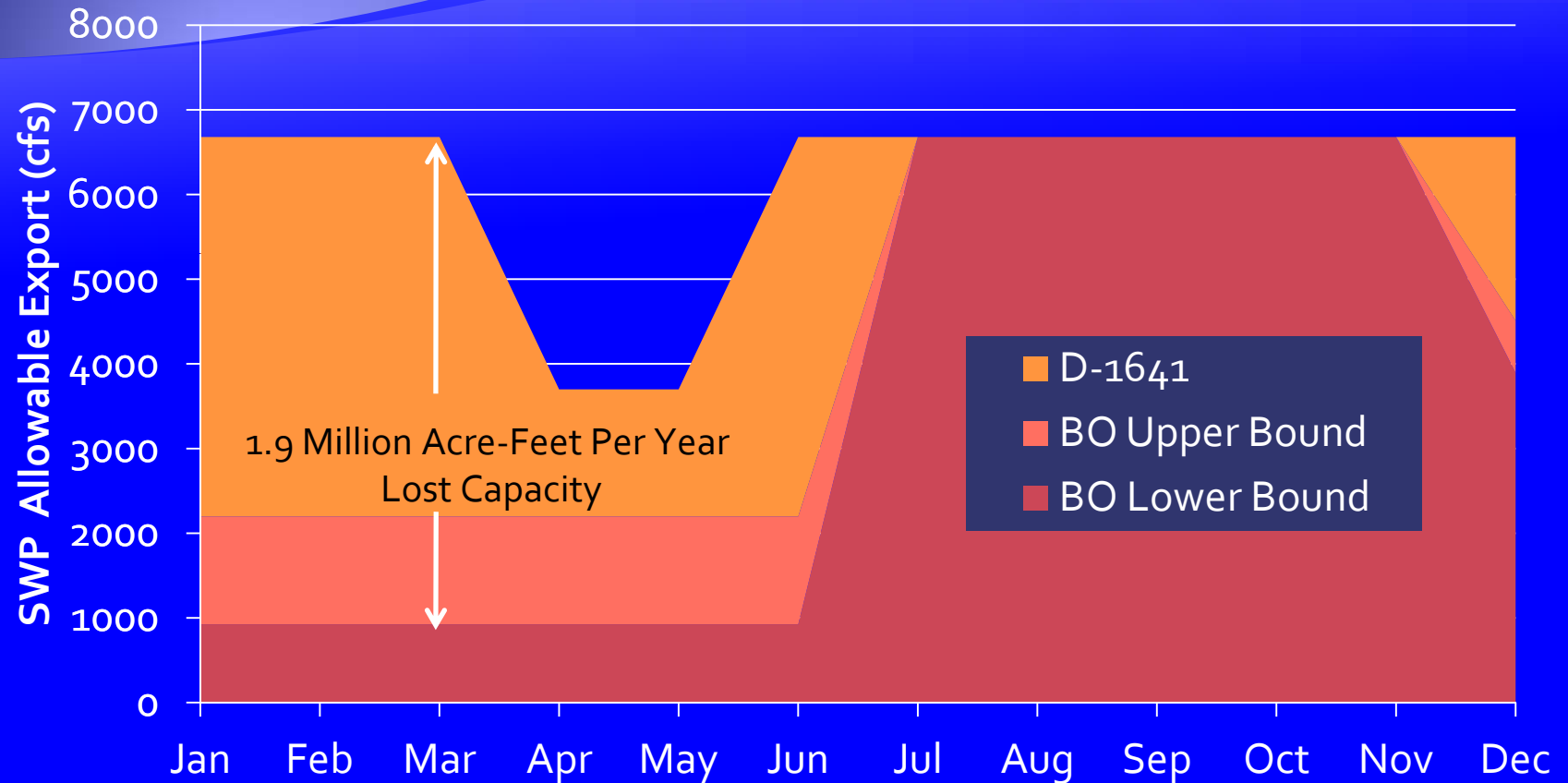
- Agriculture, recreation, transportation, energy reserves, flood protection



## Water conveyance

- Drinking water for 25 million people
- Irrigation for ~3 million acres of farmland

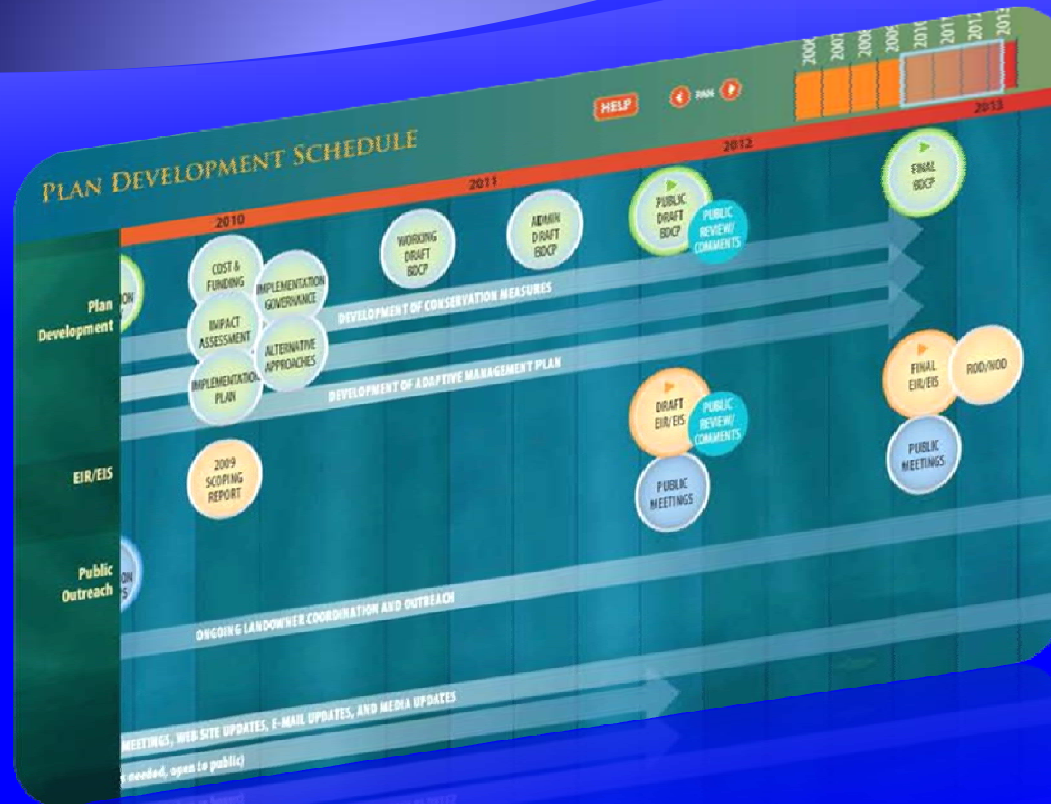
# South Delta Export Limitations with 2008 Smelt Biological Opinion



*(Assumes San Joaquin River Flow of 1,000 cfs)*



# Schedule



End of 2011

Draft Conservation Plan

Draft EIR/S

End of 2012

Final EIR/S

Permits

2022

Construction complete

*Preliminary Subject to Revision*



• Bay-Delta Conservation Plan

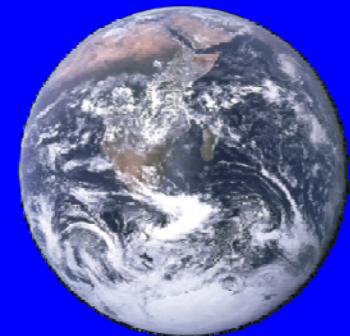
# New Delta Conveyance Cost per Acre-Feet

	Total SWP-CVP Water Supply	Cost per Acre-ft
<b>East</b>	6.27 million AF	~ \$82/AF
<b>West</b>	6.27 million AF	~ \$100/AF
<b>Tunnel</b>	6.27 million AF	~ \$119/AF



# New Delta Conveyance Tunnel Facts

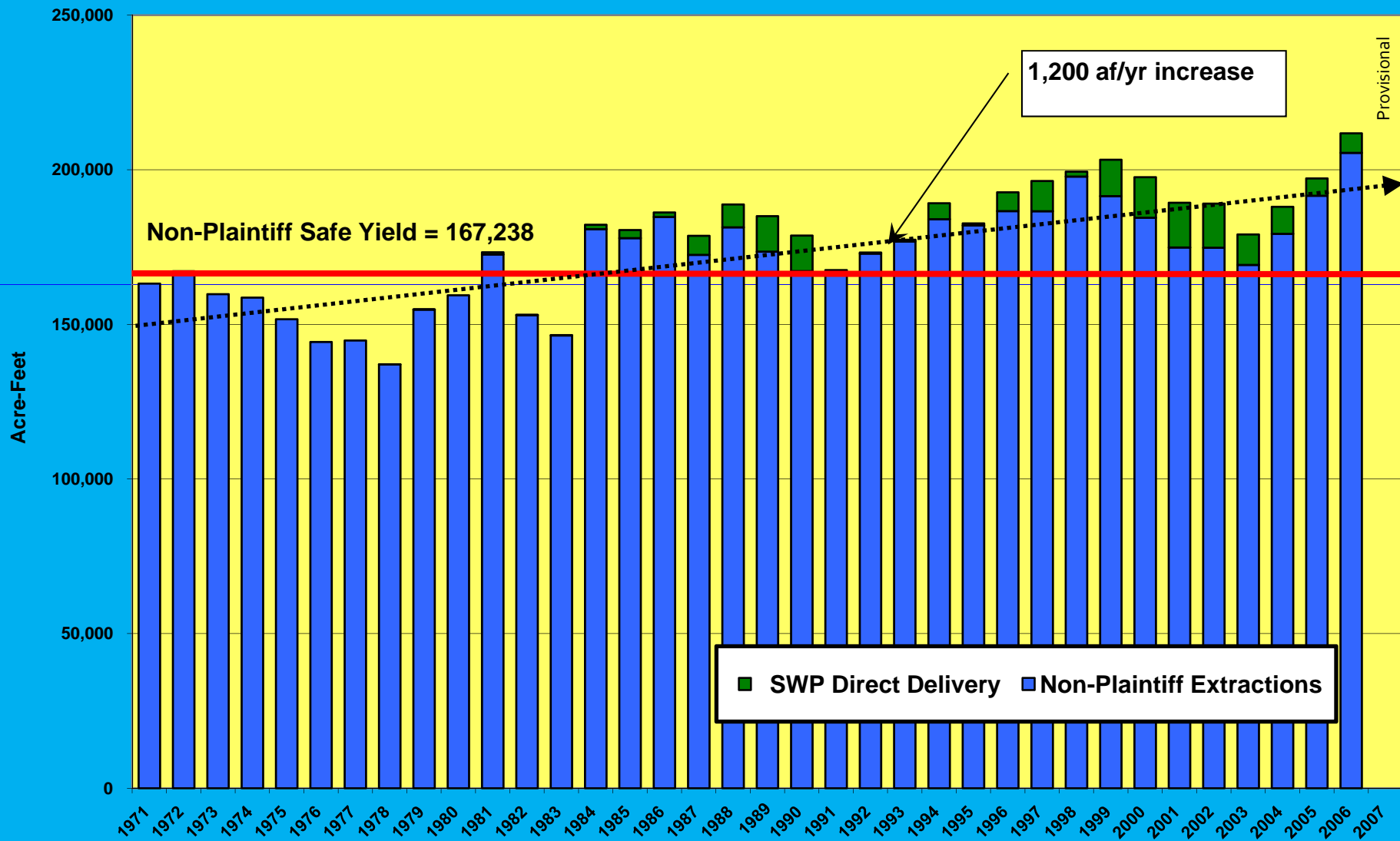
- ◆ 3.4 million cubic yards of concrete
  - ◆ Hoover Dam 3.25 million cy
- ◆ 15 million cubic yards of tunnel muck
  - ◆ 1000 story football field
  - ◆ 3.8 million muck car trips
- ◆ 260 million feet of reinforcing steel
  - ◆ 2 times around the world



# Total SBBA Production

## San Bernardino County

### Non-Plaintiffs



# 1961 Court Decision

- ◆ Groundwater production limits set to begin 1964
  - ◆ SB – 15,000 af (1960 usage 22,000 af)
  - ◆ Riverside – 10,000 af
  - ◆ Redlands – 14,000 af
  - ◆ Colton – 4,000 af
- ◆ Cities then go out to find supplemental supplies
- ◆ OCWD not happy about efforts to thwart the decision



# Why not Metropolitan?

- ◆ Loss of local control
- ◆ Big Cities Rule!
- ◆ San Bernardino and Colton charter members of MWDSC in 1928 (Both cities withdrew in 1931.)
- ◆ Must pay all back taxes and interest - \$20.1 mil in 1957

# Valley District History

