Benefits of Improved Long Range Weather Outlooks to the Salt River Project

Improving Sub-Seasonal and Seasonal Precipitation Forecasting for Drought Preparedness

San Diego, CA

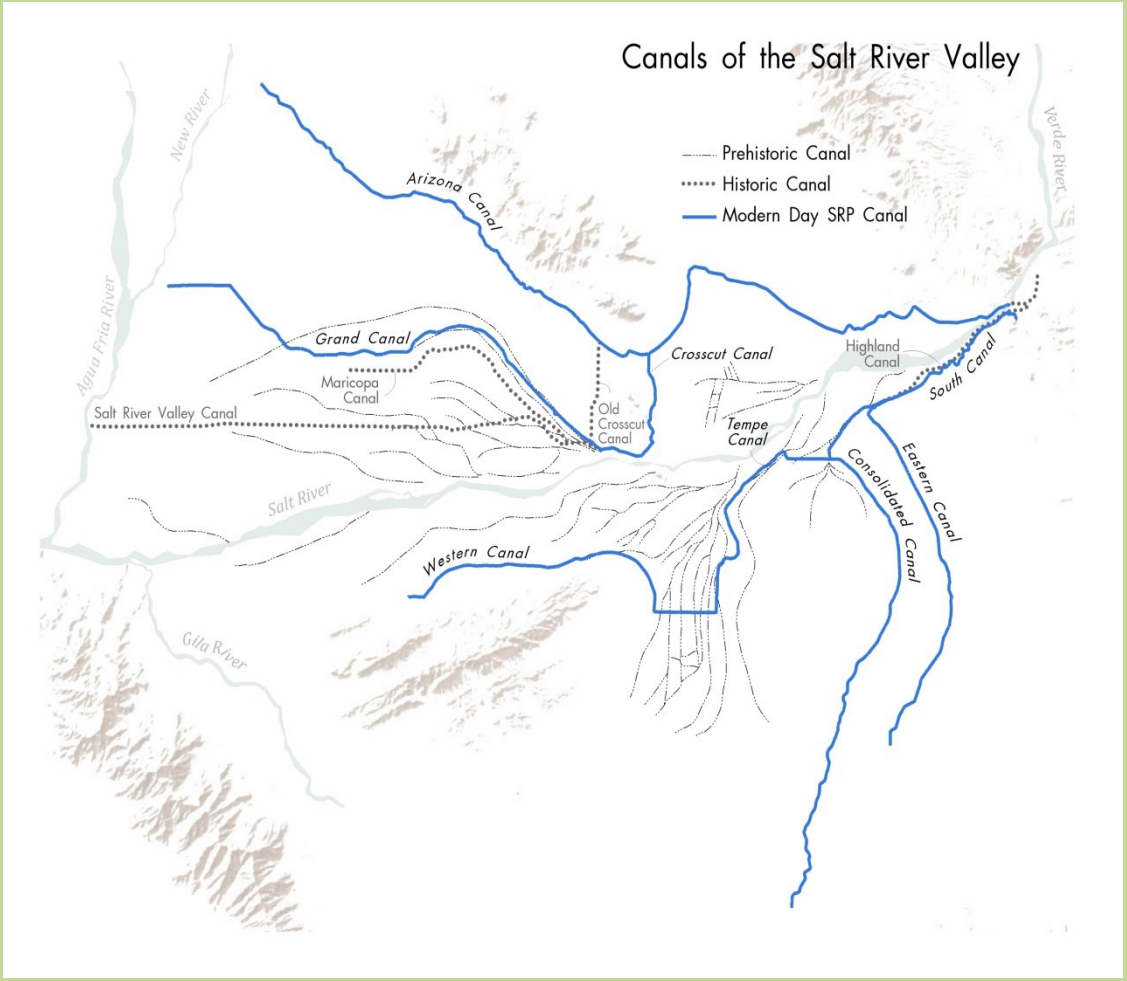
May 27-29, 2015

Charlie Ester

Manager, Water Resource Operations

Hohokam Civilization, c.1000 A.D.

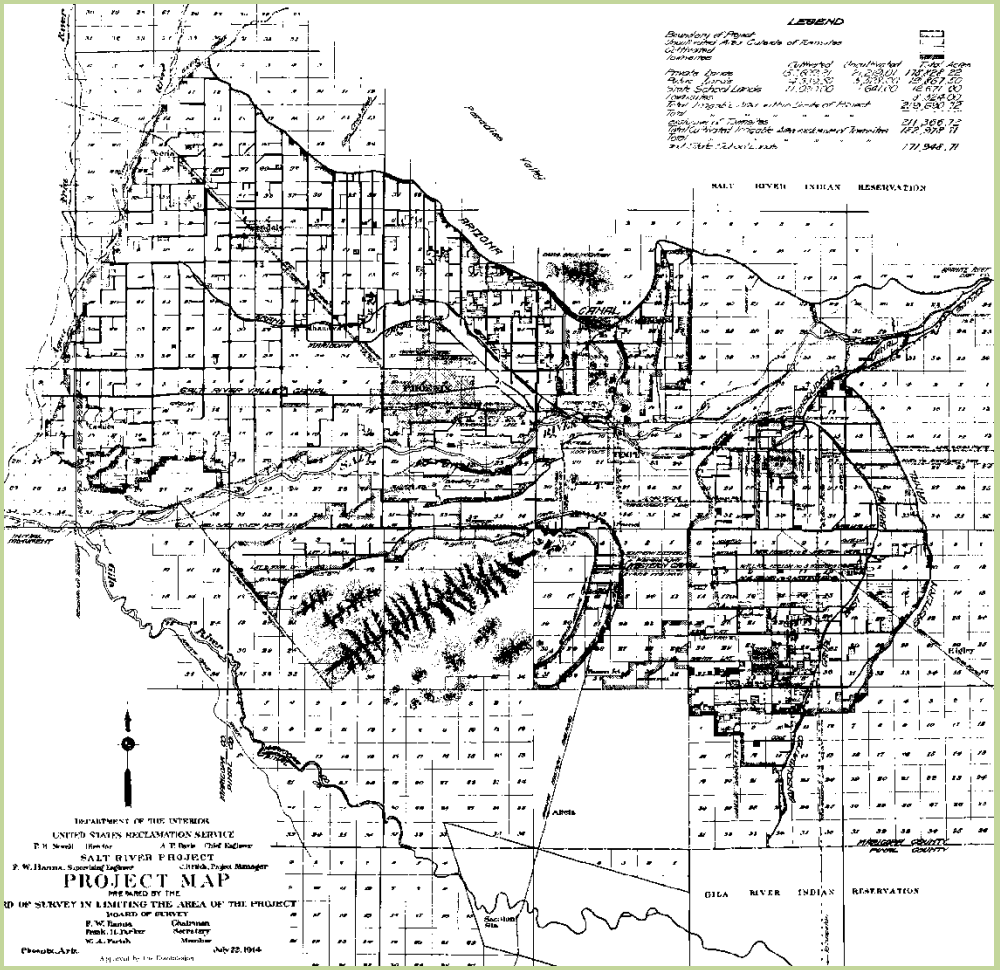
Bridge over Grand Canal, 1909



Early Canals: Pre-1880s

@10,000 @ 700 0 0

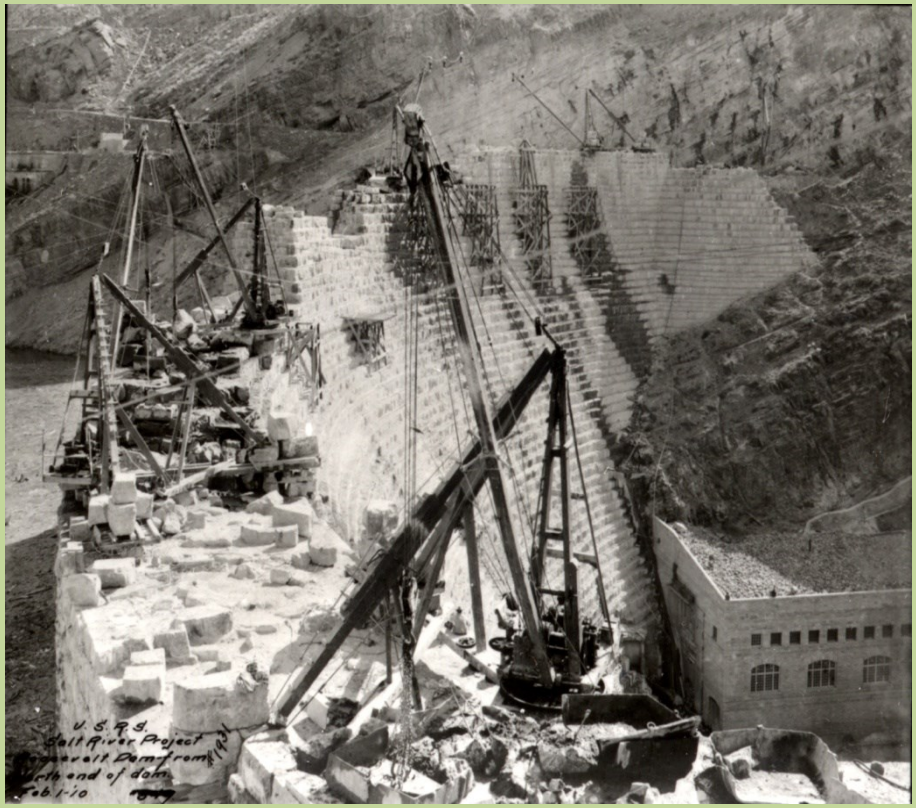
President Theodore Roosevelt



Board of Survey Map, 1914

Reclamation Act and the Association: 1902/03

@90,000 20,457 0 0



Roosevelt Dam construction, stiff legged derrick, 1910


CONSERVATION

Conservation looks to the planned, orderly, and complete development of a greater Nation, a happier people, in a Continent saved from Waste.—*Gifford Pinchot.*

SCIENTIFIC AMERICAN

THE ROOSEVELT DAM

Vol. CV. No. 7
August 12, 1911

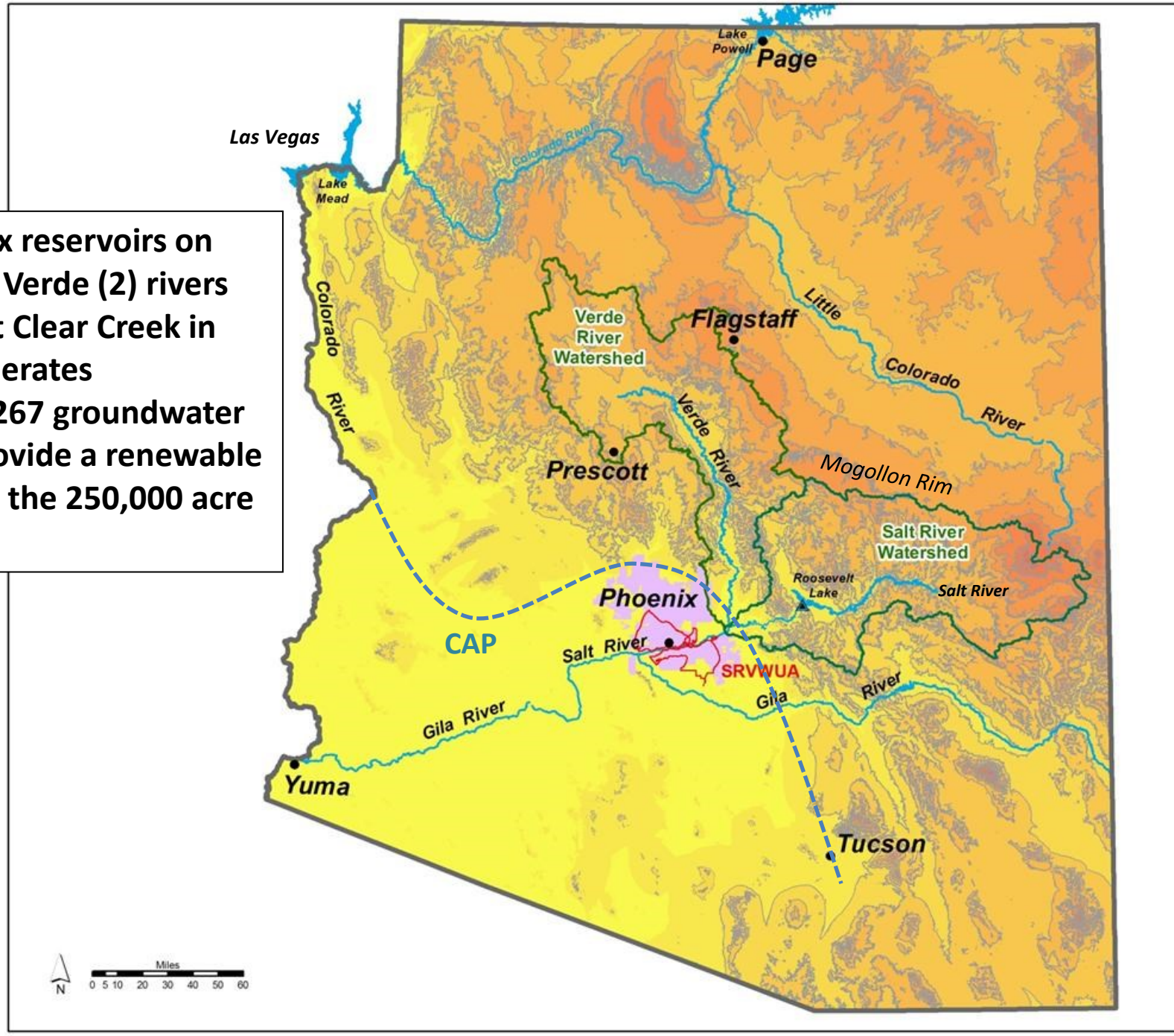
Munn & Co., Inc., Publishers
New York, N. Y.

Price
10 Cents

Theodore Roosevelt Dam: 1906–1911

131,364 34,488 1,284,205 4

SRP manages six reservoirs on the Salt (4) and Verde (2) rivers and one on East Clear Creek in Arizona, and operates approximately 267 groundwater wells, which provide a renewable water supply to the 250,000 acre service area.



SRP Watershed

Roosevelt Dam

Construction from 1903-1911

Modified from 1989-1996

Lower Salt Reservoirs

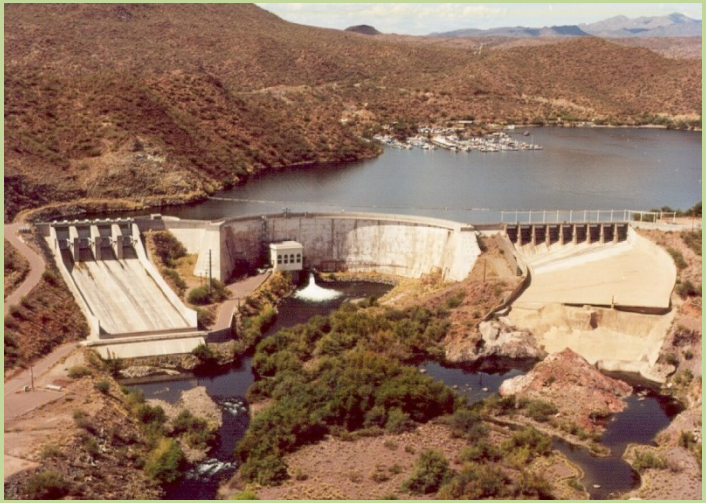
Horse Mesa Dam

Construction from
1924-1927

Mormon Flat Dam

Construction from
1923-1926

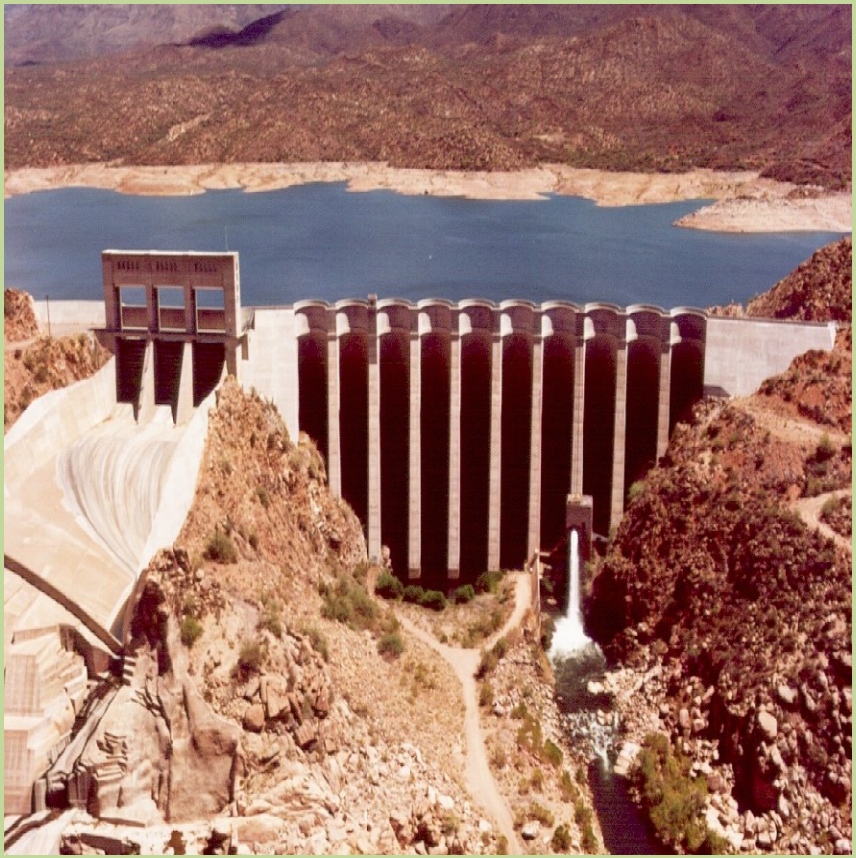
Stewart Mountain Dam



Construction from
1928-1930

Verde Reservoirs

Bartlett Dam

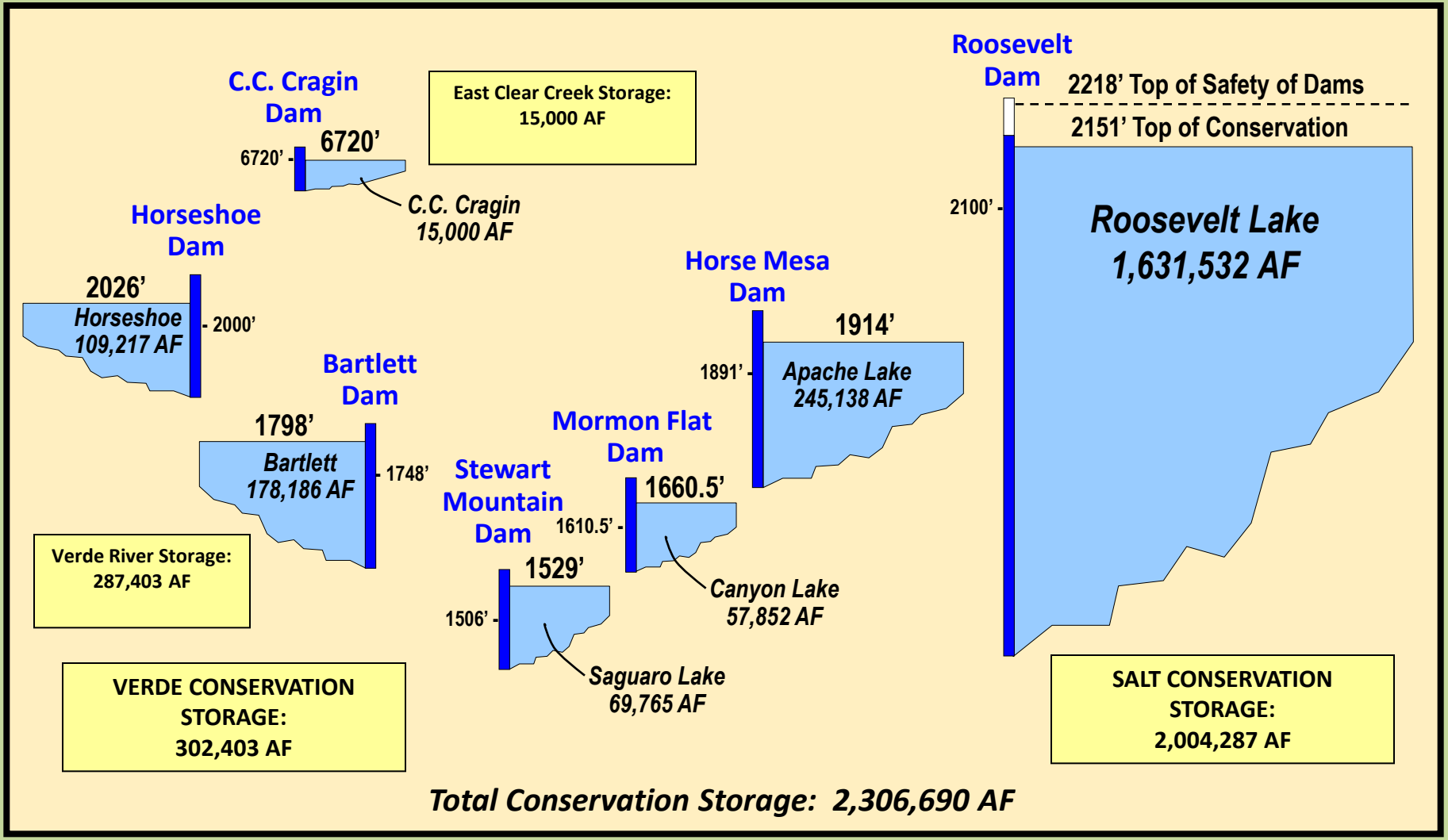


Construction from 1936-1939

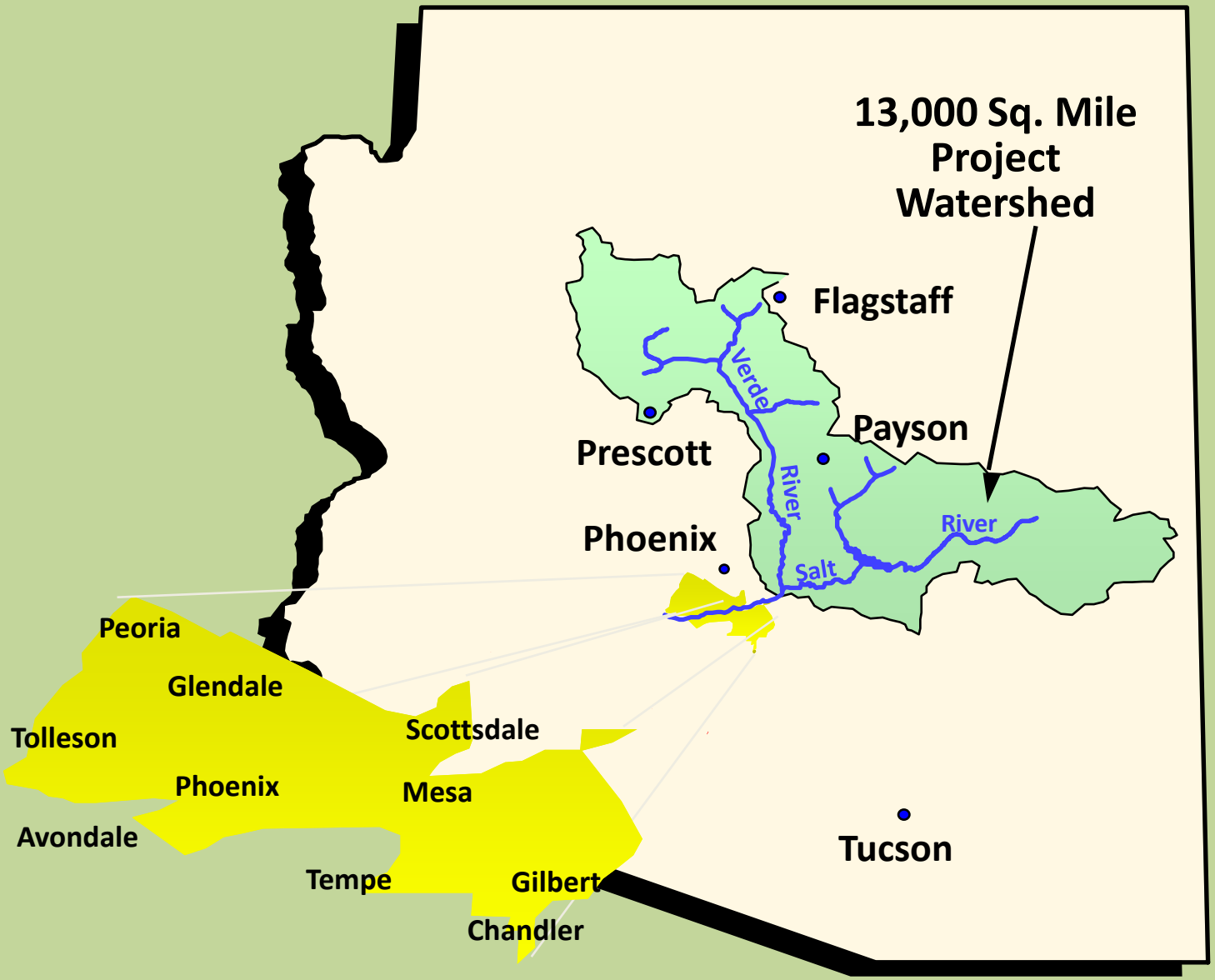
Horseshoe Dam

Construction from 1944-1946

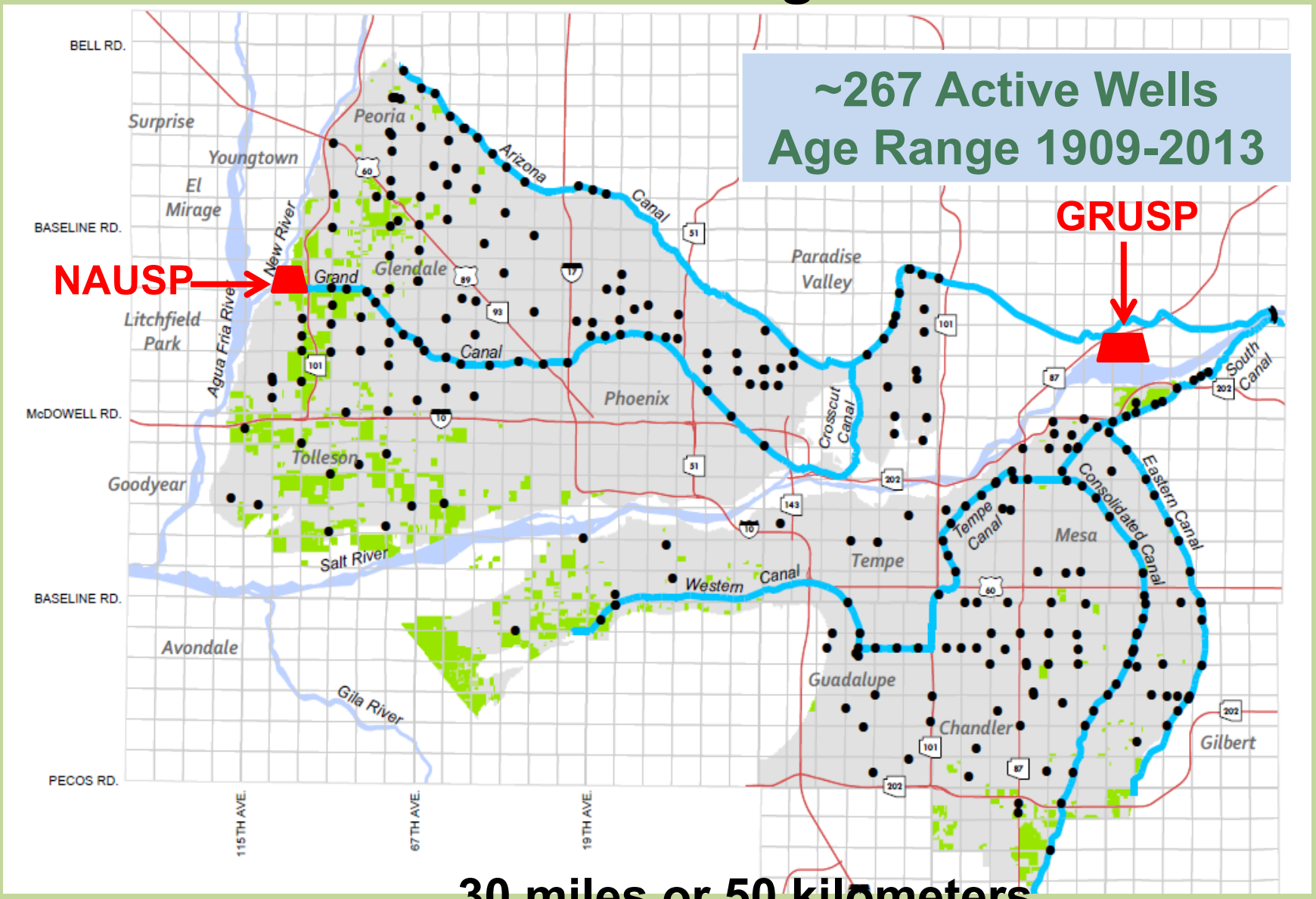
Salt River Project Reservoir System



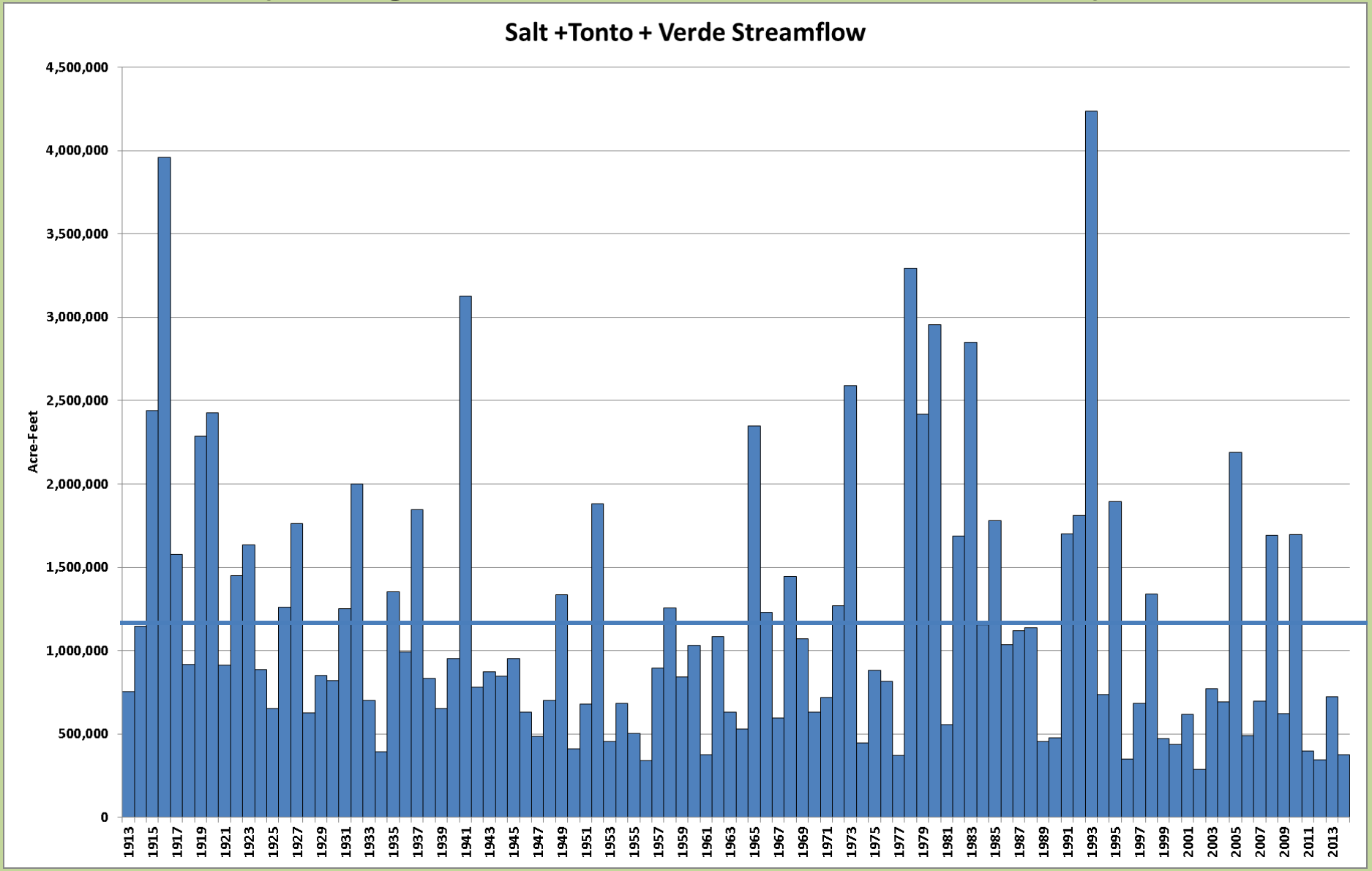
SRP Water Service Area



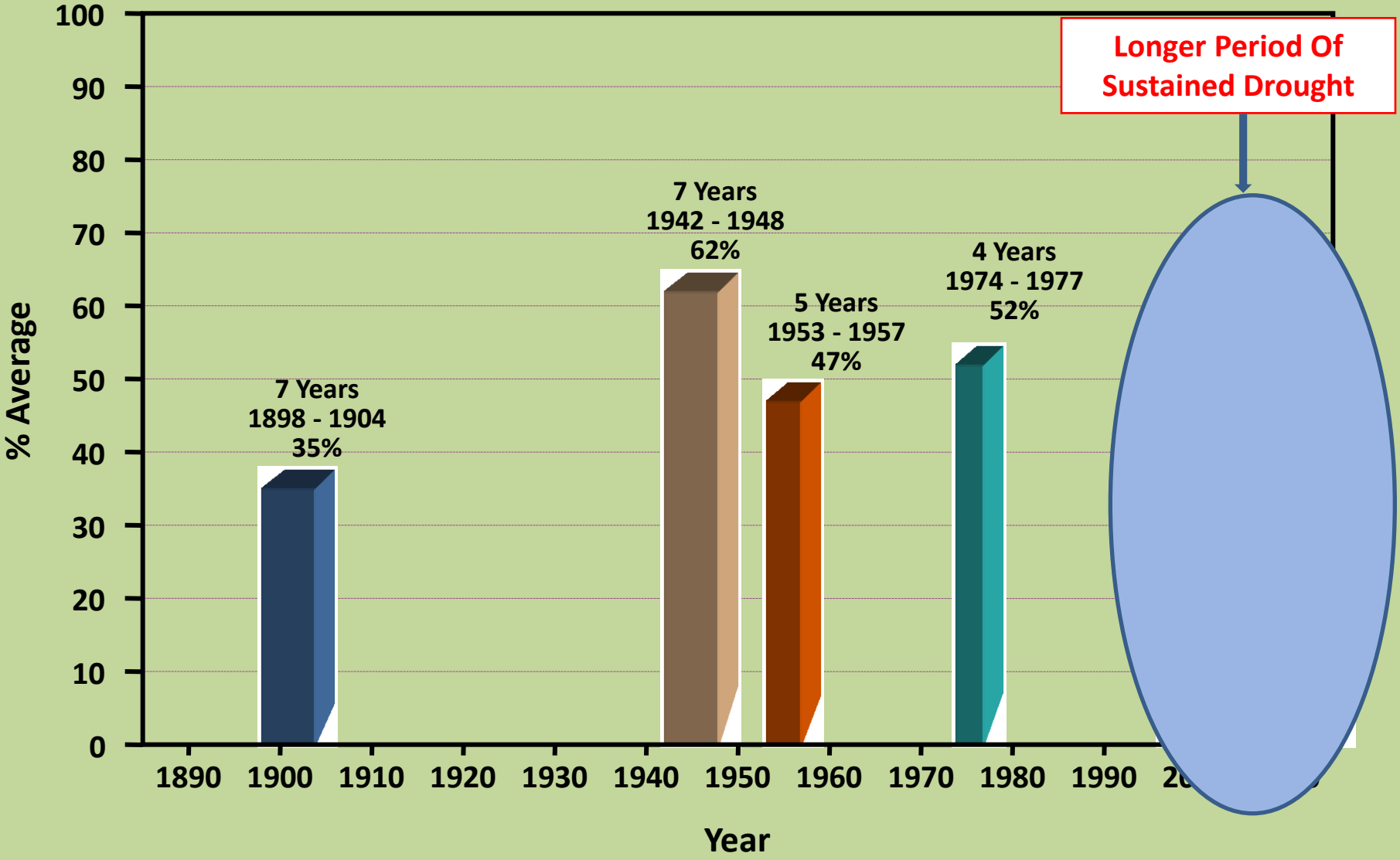
Water Wells & Recharge Facilities



Salt River, Tonto Creek and Verde River Streamflow (Average Runoff 1913–2014 = 1,169,526 AF)

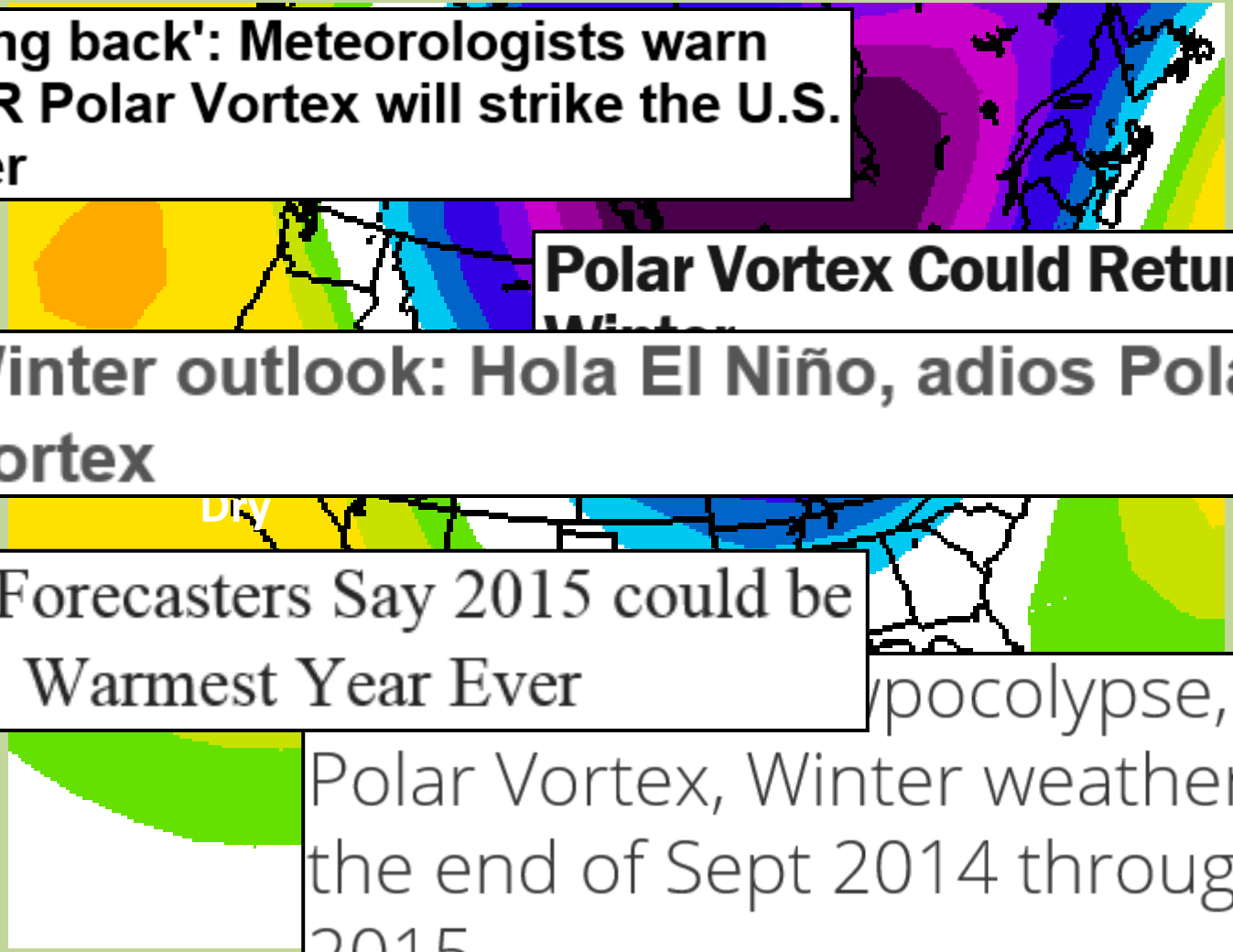


Salt River Project Historic Drought Periods
(Average Runoff 1996–2014 = 783,262 AF)



Winter Outlook 14-15

Dec 2013 - Mar 2014



'It's coming back': Meteorologists warn ANOTHER Polar Vortex will strike the U.S. this winter

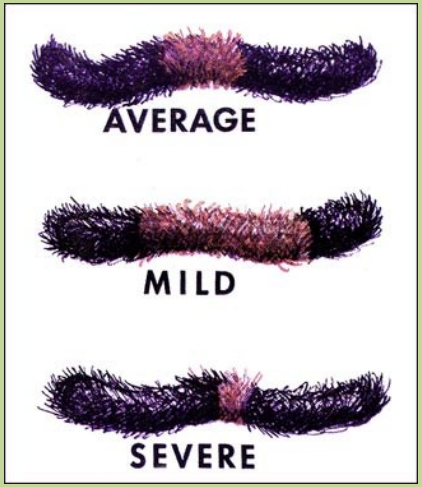
Polar Vortex Could Return This

Winter outlook: Hola El Niño, adios Polar Vortex

Climate Forecasters Say 2015 could be Warmest Year Ever

ypocolypse, not Polar Vortex, Winter weather by the end of Sept 2014 through June 2015

Weather Forecast “Tools”



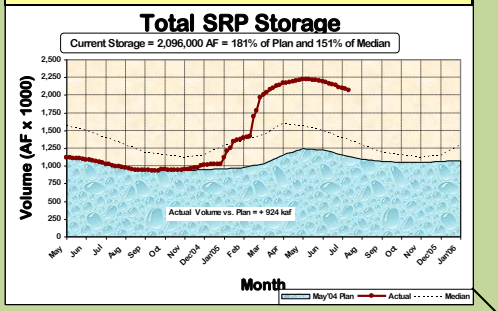
Winter Outlook 2014-2015

NATURE – Wet Winter

- Lots of acorns
- Pine cones gathered on the top of the tree
- Frequent rings around the sun
- Large spider webs
- Woolly worms with thin brown stripe
- Bees become secluded
- Woodpeckers sharing trees
- Raccoons with thick tails
- Mice overeating
- Wildlife putting on early and thick winter coats
- Squirrels gathering nuts
- Spleen of big game animals

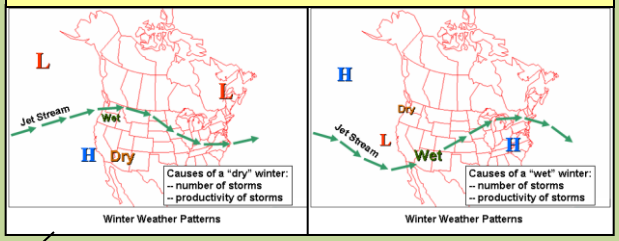
WINTER OUTLOOK – (Early and Thick Winter Coat)

Reservoir Storage

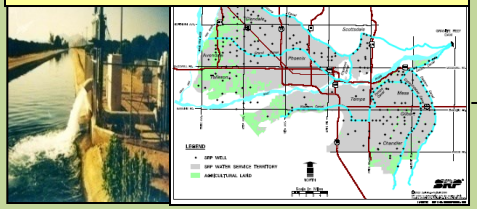


Water Demand

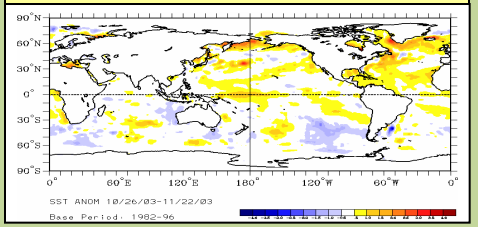
Synoptic Scale Patterns



Groundwater

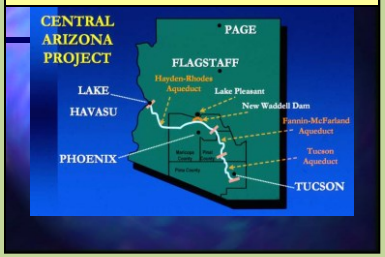


Teleconnections

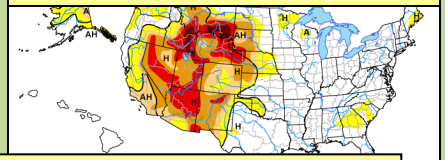


Project Reservoir Operation Plan

Other Sources

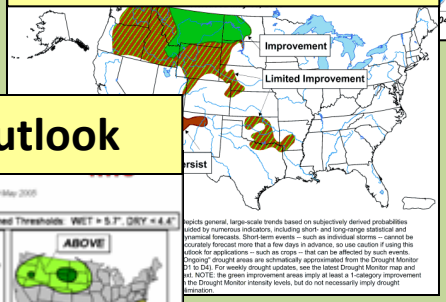


Drought Monitor

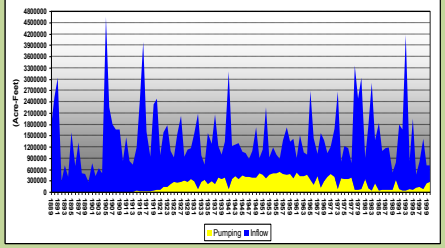


Allocation

Drought Outlook

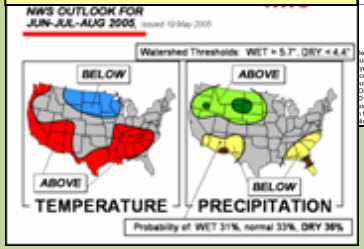


Historical Runoff



Water Mix

NWS Outlook



Project Reservoir Operation Plan (Seasonal)

Objective: Provide an adequate and reliable water supply to our ***shareholders***.

Water Demand: The quantity of water needed to satisfy shareholder demand and contract obligations for Agricultural, Municipal, Industrial, Domestic, Recreational, and Wildlife uses.

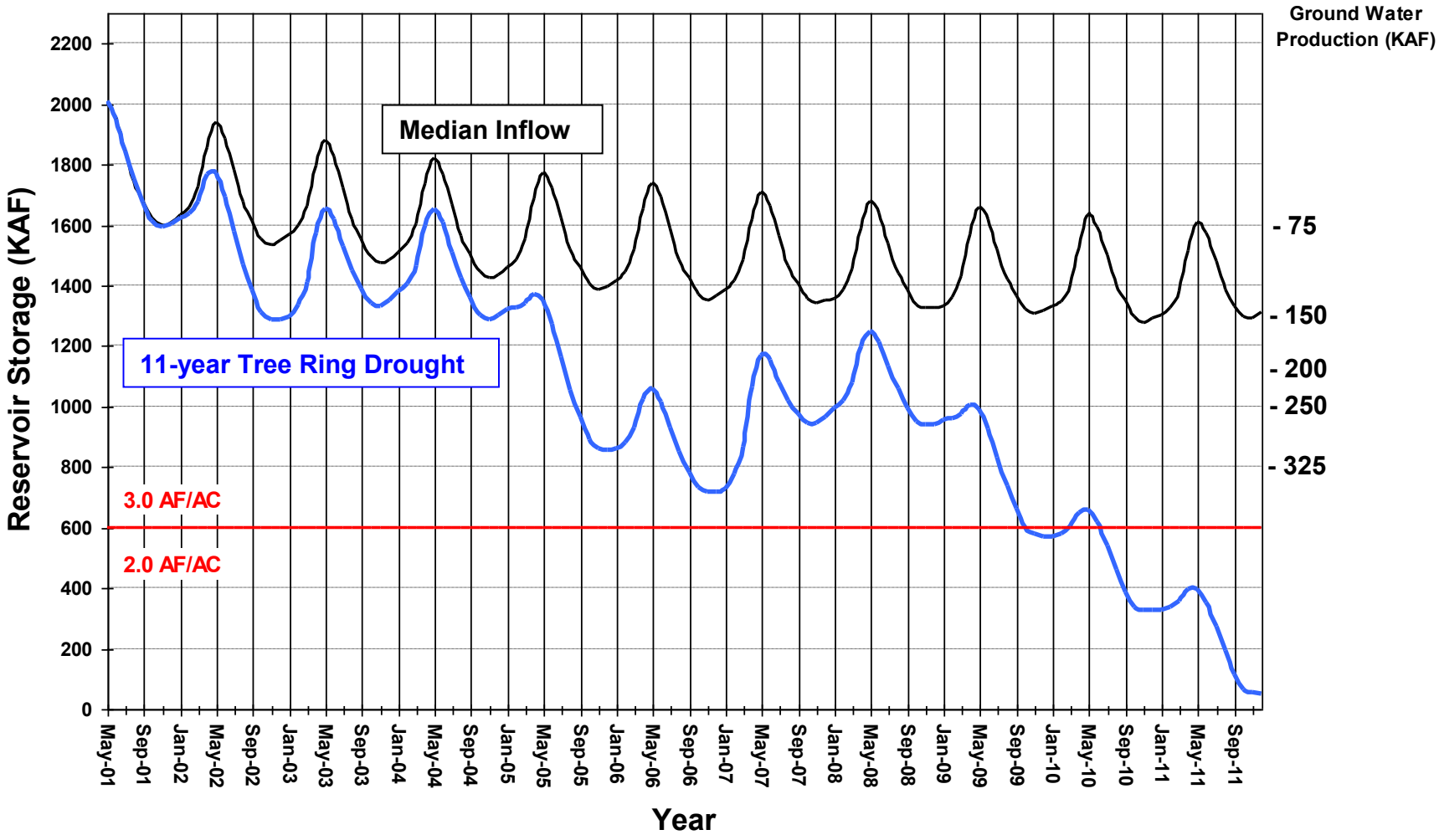
Management Philosophy:

- Ensure carry-over storage to manage the worst drought on record.
- Reduce the probability of having to cut the allocation of water to 2.0 AF/AC to less than one percent.

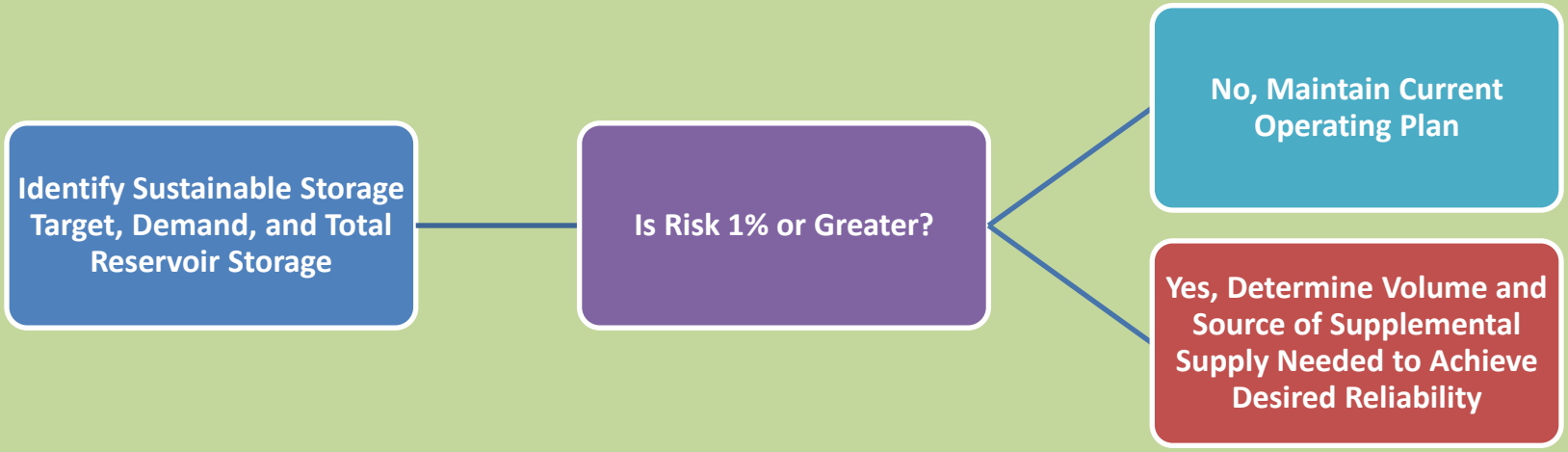
Methodology:

- The end of every wet runoff season is the start of the next severe sustained drought period.

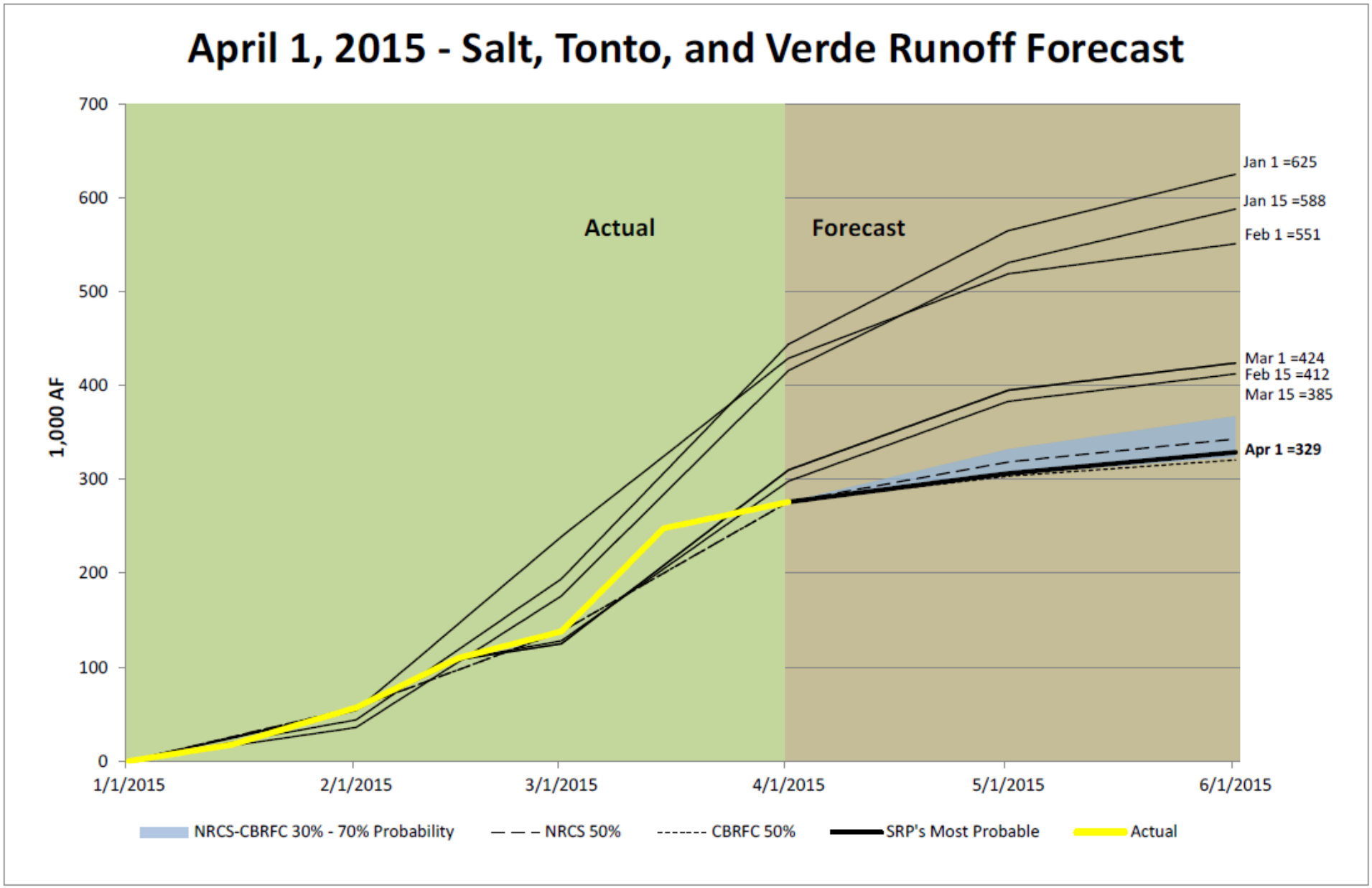
SRP Storage, Pumping & Water Allotment Planning



Methodology Process



Winter Season Runoff !



Planning Process

- **Planning Goals**
  - **Minimize Risk of Reducing Allocation**
  - **Minimize Risk of Spill**

- **Planning Horizons**
  - **Seasonal (3 months to Years)**
  - **Sub-seasonal (2 weeks to 3 Months)**
  - **Event Driven (0-15 Days)**

Possible Beneficial Scenarios

Alter Surface/Ground water mix of Allocation

- **reliable "wet" forecast could prompt a decrease in groundwater usage that is offset by increased surface water usage**
- **reliable "dry" forecast could prompt an increase in groundwater usage that is offset by decreased surface water usage**
  - **Preserve carry-over storage**
  - **Use of current delivery capacity**
  - **Reduces the use of augmentation sources**
  - **Initiate drought management plans**

Alter Groundwater Recharge Goals

- **reliable "wet" forecast could prompt greater recharge efforts**

Make Decisions of Least Regrets: Avoid Unrecoverable Actions

Save Money—Everyone's Favorite

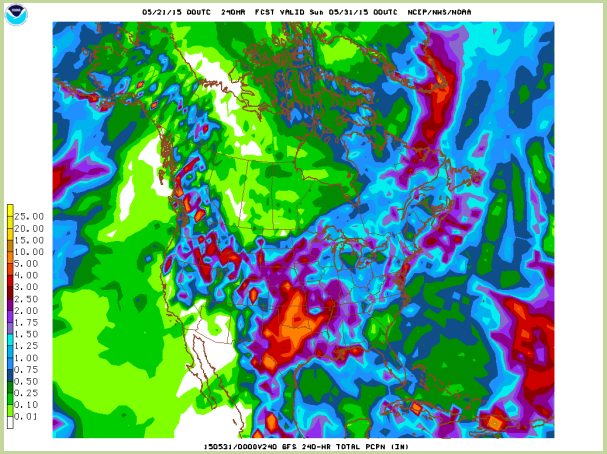
Weather Forecast Tools (Event Driven)

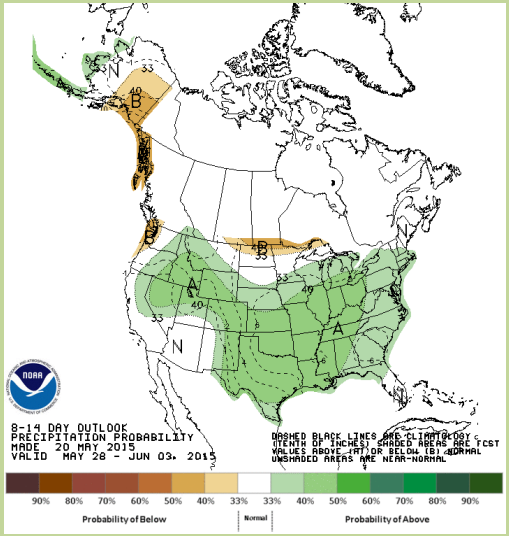
0-15 Days

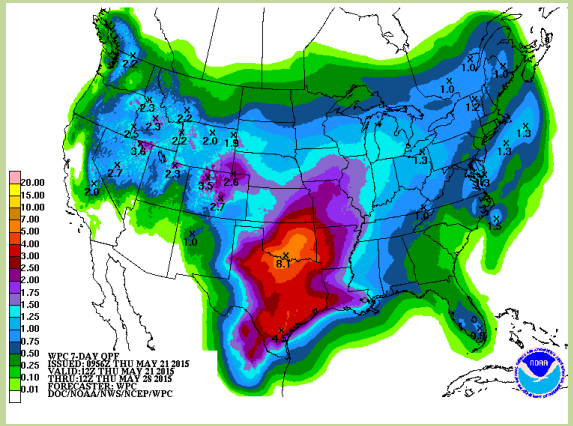
Dynamic Weather Forecast Models
(GFS, NAM, WRF, ECMWF & etc.,)

Model Output Statistics (MOS)

Expert Guidance
(CPC 6-10 day/8-14 day & WPC QPFs)







Weather Forecast Tools (Seasonal)

0-15 Days

Dynamic Weather Forecast Models
(GFS, NAM, WRF, ECMWF & etc.,)

Expert Guidance
(CPC 6-10 day/8-14 day & WPC QPFs)

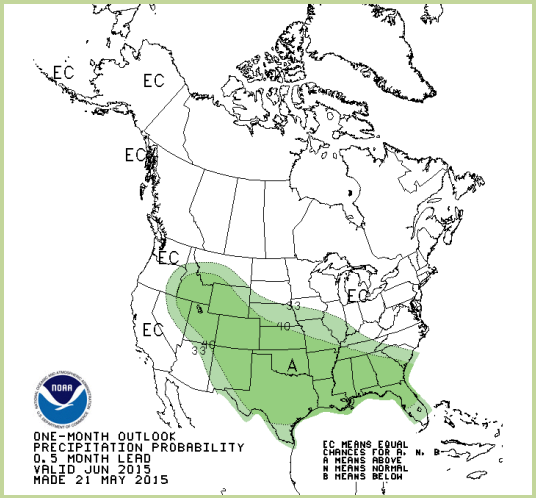
Model Output Statistics (MOS)

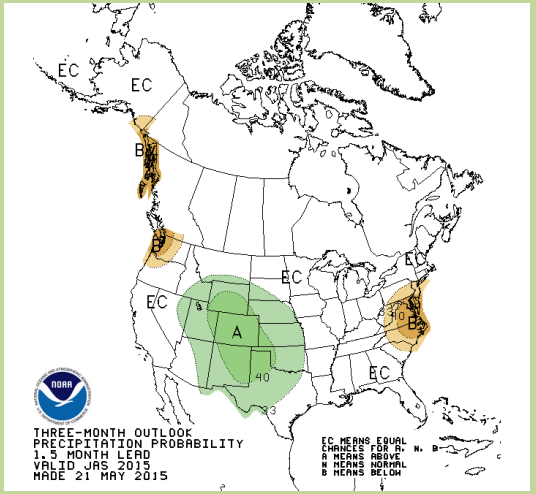
3 Month – Years

Expert Guidance
(CPC Monthly and Seasonal Outlooks)

Statistical Tools

Dynamic Models
(CFS)





Water Necessary to Recover

Historical Drought		Recovery Water (KAF)											
	Reduction	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Total
1212-1218	20%					132	114	298					544
1576-1586	15%			169				143	285	316			913
1665-1671	20%			29	190	40		256					515
1817-1824	20%			337	140	261		19	112				869
1895-2005	20%							298	180	38			516
1998-2004	20%			19	242		283						544

“The Gap”
Weather Forecast Tools (Sub-seasonal)

0-15 Days

Dynamic Weather Forecast Models
(GFS, NAM, WRF, ECMWF & etc.,)

Expert Guidance
(CPC 6-10 day/8-14 day & WPC QPFs)

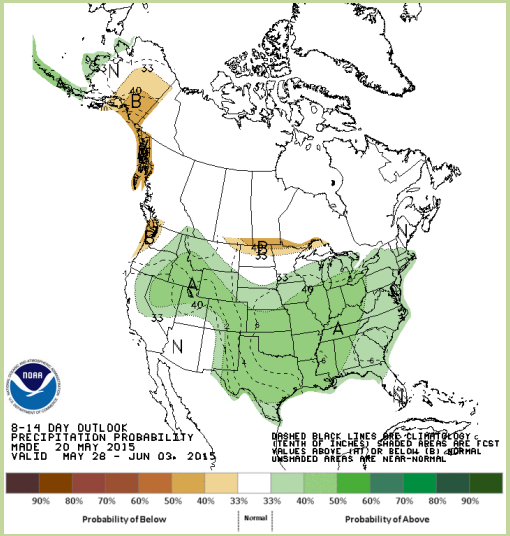
Model Output Statistics (MOS)

3 Months – Years

Expert Guidance
(CPC Monthly and Seasonal Outlooks)

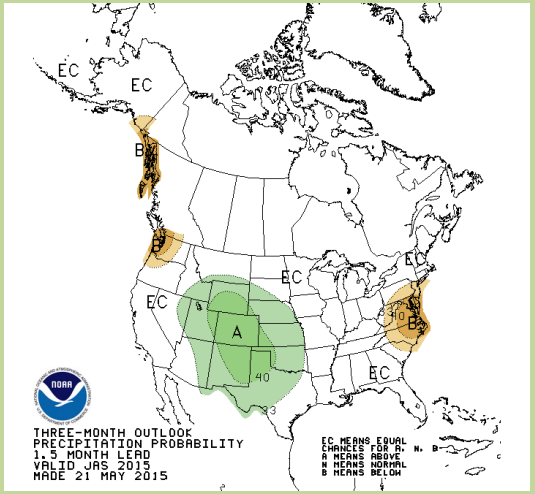
Statistical Tools

Dynamic Models
(CFS)



2 Weeks to 3 Months

Dynamic Models?
Statistical Tools?



Possibilities to fill “The Gap”

QPF/Precipitation Guidance

Categorical

Probability of Above/Near/Below Median

2 or 4 Week Time Frames

e.g., CPC Seasonal Outlooks

Probability Based

Threshold Exceedence

Ranges

Weekly/Multi-weekly Time Frames

e.g., NCEP Ensemble PQPF

Extended QPFs

Ranges

Multi-Day & Multi-Week Time Frames

e.g., WPC QPFs

Summary of Gap Filling Needs

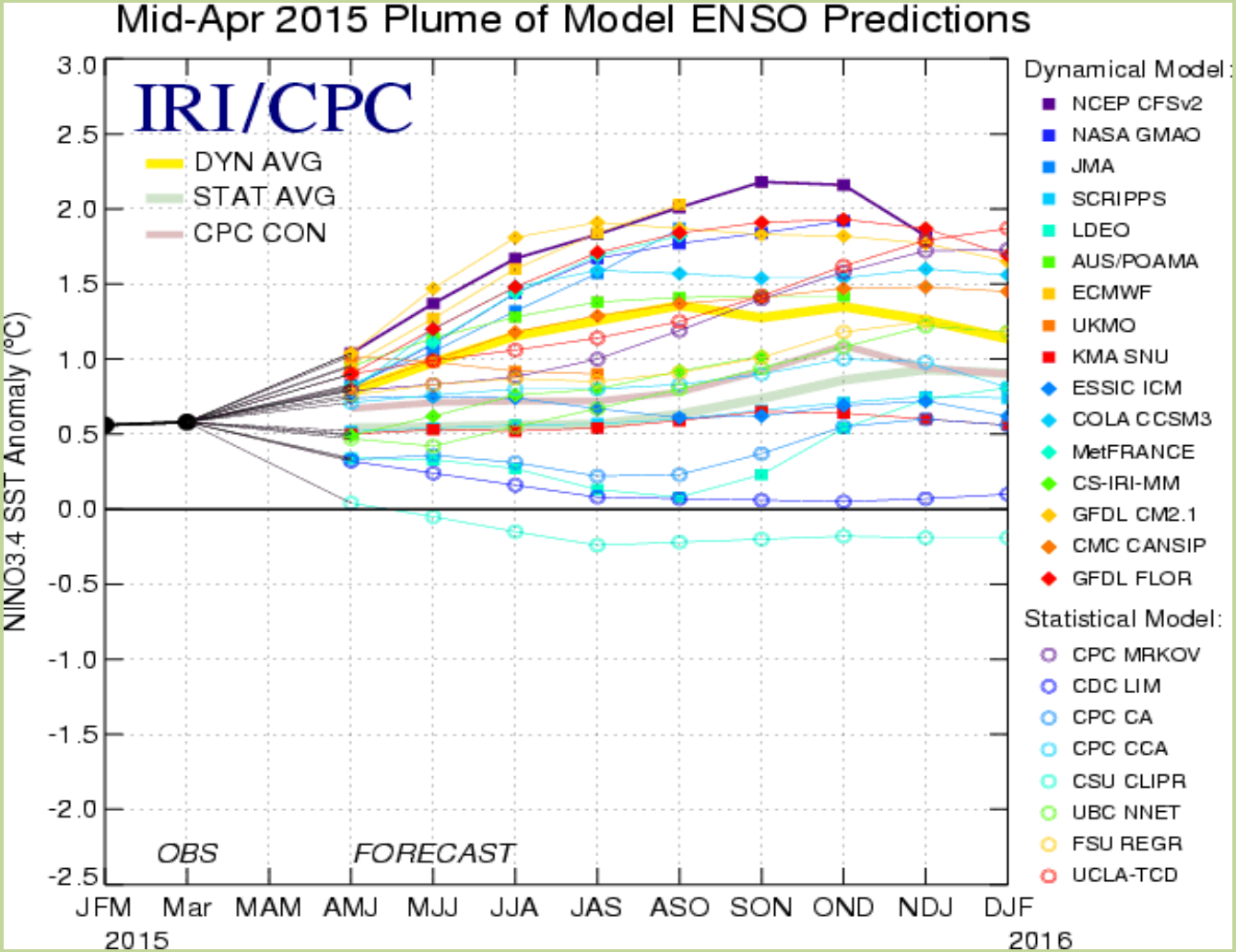
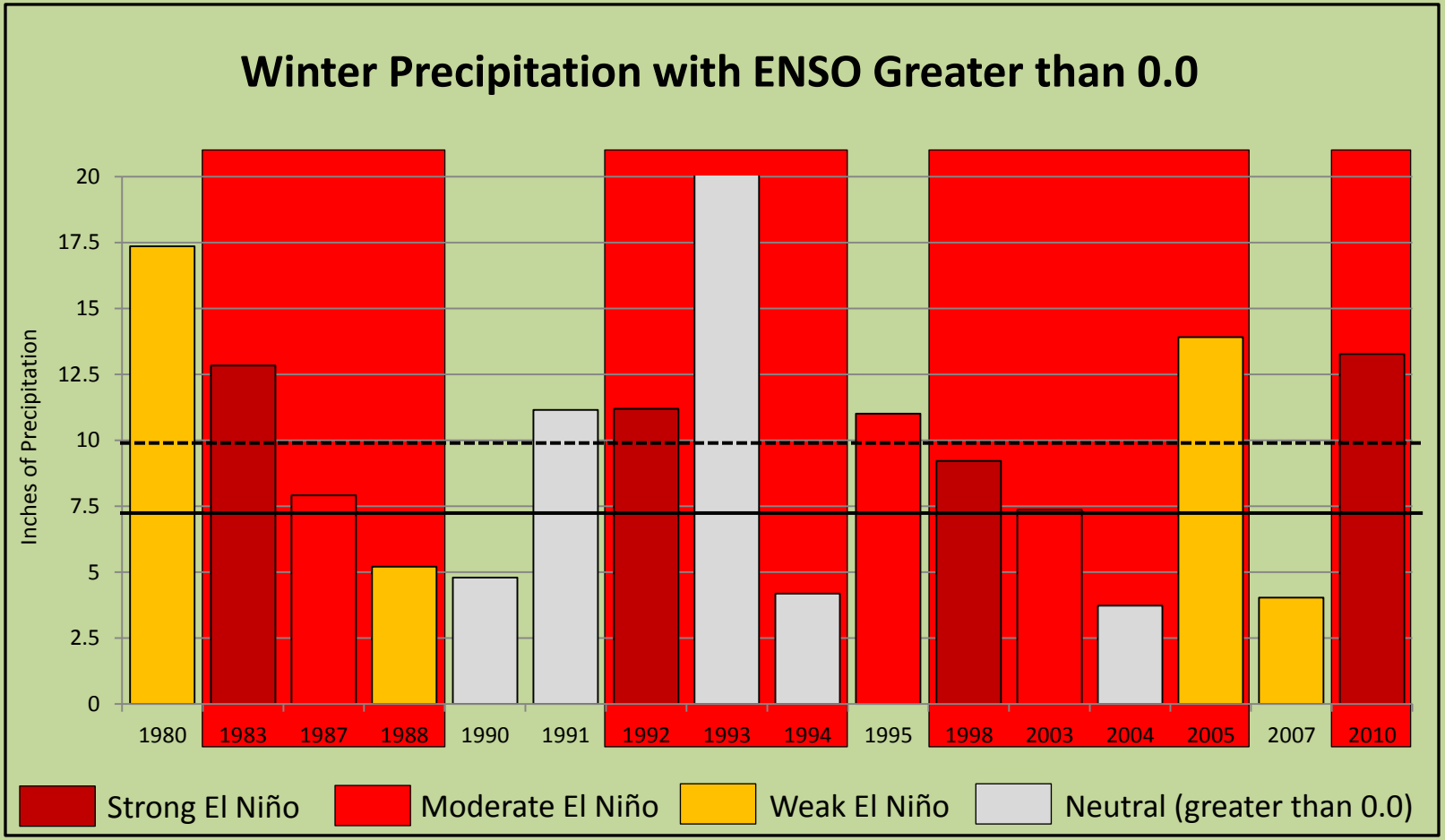


Figure provided by the International Research Institute (IRI) for Climate and Society (updated 14 April 2015).

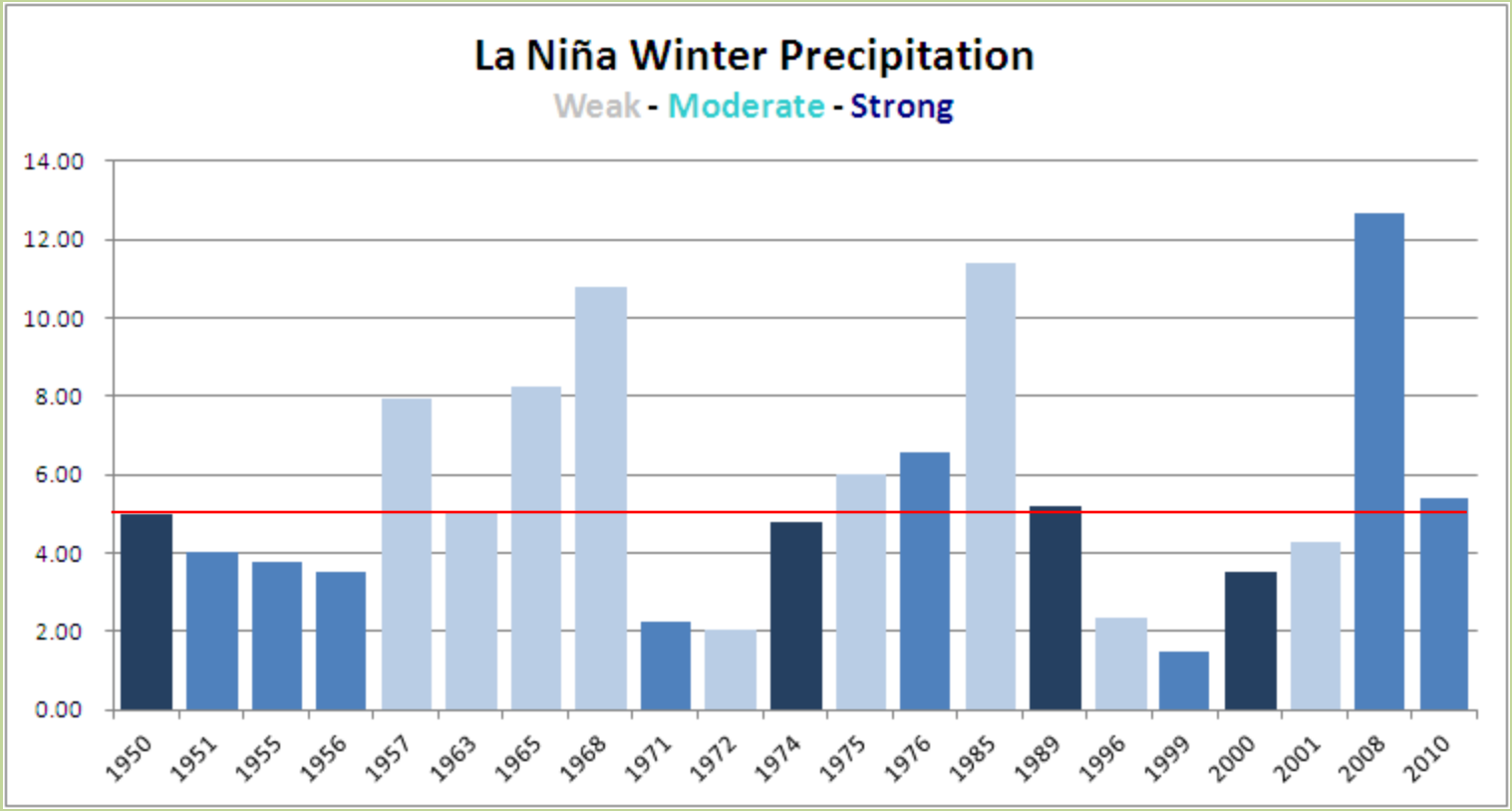
As a water supply manager, what should you do?

Winter Outlook

Analog Years—Huh?



Precipitation Uncertainties For the Watershed



	La Niña	Weak	Moderate	Strong
n	21	9	8	4
Max	12.67”	11.41”	12.67”	5.21”
Median	4.98”	6.02”	5.22”	4.89”
Min	1.49”	2.05”	1.49”	3.53”

Filling “The Gap”
Weather Forecast Tools (Sub-seasonal)

Mid-season updates with more specifics that:

- **Identify trends that narrow the range of forecast possibilities**
- **Identify thresholds offering greater confidence in a forecast outcome**
- **Identify and incorporate “season changing” events**
- **Need more communication and collaboration between the forecaster and the water resource manager.**
- **?**


Questions?