#### March 2, 2016





### The Issues

- Observed Data
  - Historical Perspective
  - Northern California Watersheds
- Future Climate Scenarios
  - Interior's Modeling Scenarios
  - Reservoir Management
  - The Bay-Delta
- Adaptation Strategies



# Data





#### Figure 2-3 Changes in Air Temperature Over About the Past 400,000 Years

Explanation: Graph depicts changes in air temperature as evidenced by isotopic analysis of ice cores obtained at the Russian Vostok station in central east Antarctica. For additional explanation visit:

http://cdiac.esd.ornl.gov/trends/temp/vostok/jouz\_tem.htm.

Source: United Nation's Environment Programme Global Resource Information Database - Arendal website at http://www.grida.no/climate/vital/02.htm.



"The Global sea level rose by about 120 m during the several millennia that followed the end of the last ice age (approximately 21,000 years ago), and stabilized between 3,000 and 2,000 years ago." IPCC AR4





Figure 2-27 Graph of Annual Average Relative Sea Level and the 19-Year Running Average Sea Level at the San Francisco Tide Gauge





b) Total Water Year Runoff Volume (October-September)

#### Figure 2-14 Unimpaired Runoff Volume for Four Sacramento Valley Rivers\*

Based on the flows of four rivers in the Sacramento Valley; Sacramento River at Bend Bridge (near Red Bluff), Feather River into Lake Oroville, Yuba River at Smartville, and American River below Folsom Lake. (taf) = thousand acre feet.



#### Sacramento River Runoff April - July Runoff in percent of Water Year Runoff



Source: DWR, 2011



### Blue Canyon, CA - Air Temperature



All August — Linear (All) — Linear (August)



# **Forecasts**



# **USBR Basin Study Modeling Assumptions**







Placer

Cour





#### Annual Folsom Unimpaired Inflow (FUI) (WY1902 - WY2014)





#### Annual Folsom Unimpaired Inflow (FUI) (WY1902 - WY2014)





### USBR Basin Study Results – Sea Level Rise Projections





### Basin Study Results – Delta Salinity Projections





#### Current Brackish Water Zone

Clifton Court Forebay

02010 Google

#### Future Brackish Water

Clifton Court Forebay

Google

Data SIO, NOAA, U.S. Navy, NGA, GEBCO Image Landsat

#### BDCP Results – Folsom Dry in 10% of years with Climate Change





# Adaptations (a.k.a. finally some good news)



# We've Been Here Before





## We Can Adapt

• Preparing for present-day droughts and preparing for a warming climate involve the same adaptations.

Upstream actions:

- More rain and less snow demand more upstream storage.
- Upstream reservoir operations require higher end of year carry-over storage targets, and smarter flood control operations.
- Much broader utilization of conjunctive use of groundwater and surface water.



## We Can Adapt

• Preparing for present-day droughts and preparing for a warming climate involve the same adaptations.

In the Delta:

- A saltier Delta requires modified Delta conveyance to move fresh water around brackish water.
- Compressed winter runoff pattern requires large diversion capacity when water is available in the system.
- Delta requirements must recognize drought and climate reality, or we kill the tributaries trying to keep the Delta fresh.



## We Can Adapt

• Preparing for present-day droughts and preparing for a warming climate involve the same adaptations.

South of the Delta:

- Increased storage south-of-Delta to take advantage of diversions when available.
- Stabilize groundwater levels in the San Joaquin Valley so conjunctive use opportunities are available in dry years for multiple uses.
- Broader utilization of desalination, recycled and groundwater resources, combined with imports to stabilize supplies.





