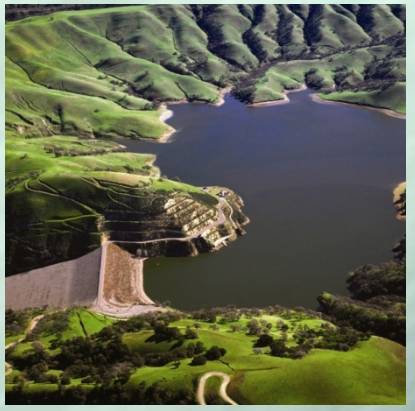

Quantifying Resource Management Strategy Benefits and Robustness

Rich Juricich,
California Department of Water Resources

Update 2013
California Water Plan

Presentation Overview

- Application of scenarios from Update 2009
- Enhancements for Update 2013
- Water Plan climate data requirements

Acknowledgements
- Dr. Mohammad Rayej, DWR
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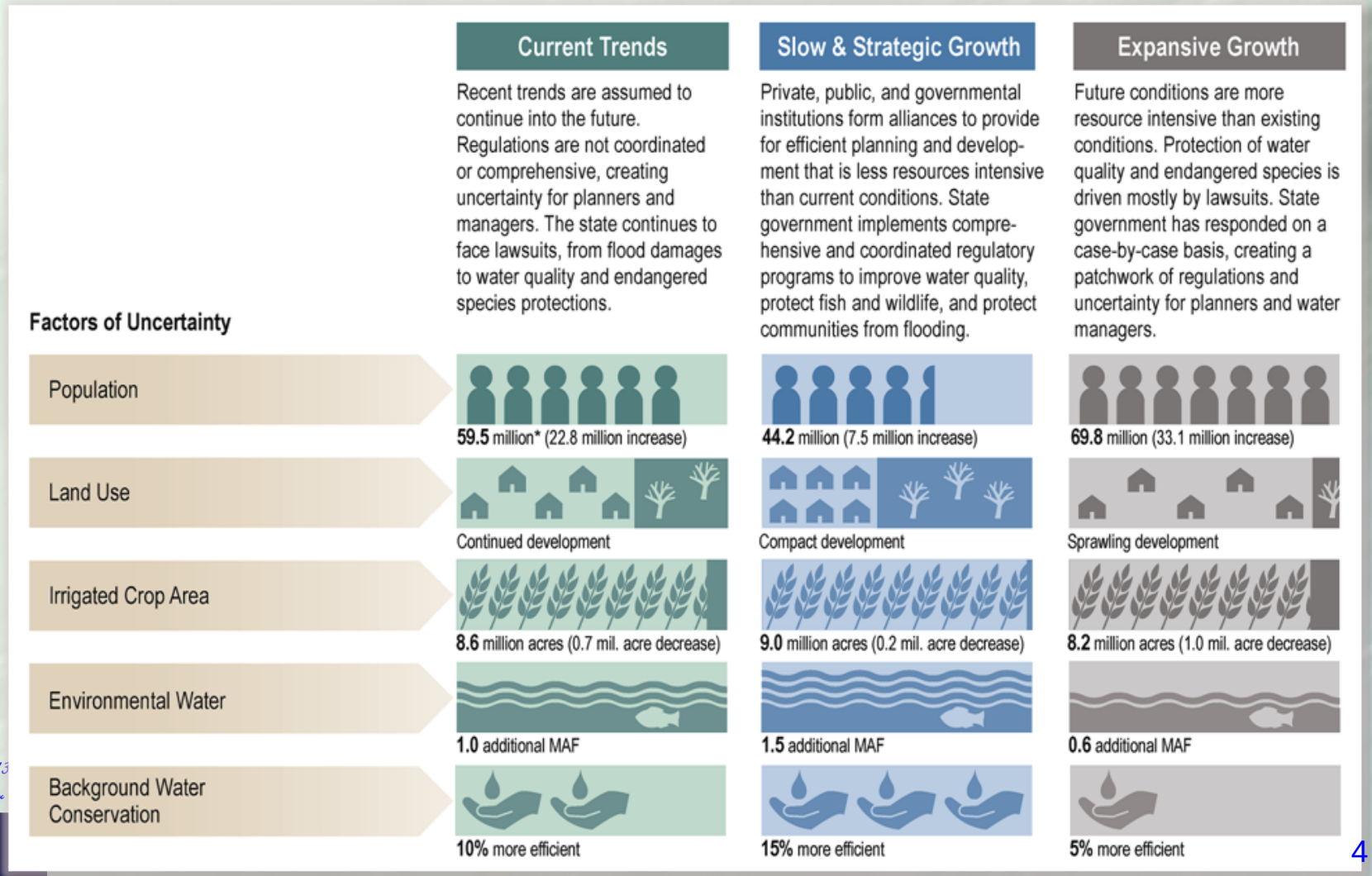
- Dr. David Yates, National Center for Atmospheric Research
- Dr. Hal Cardwell, USACE, Institute for Water Resources

Managing an Uncertain Future

Risk, Uncertainty, and Sustainability

Update 2009 Scenarios



Analysis Considers Possible Climate Change Impacts

- **Global circulation models produce numerous projections of fut**
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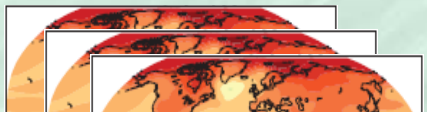
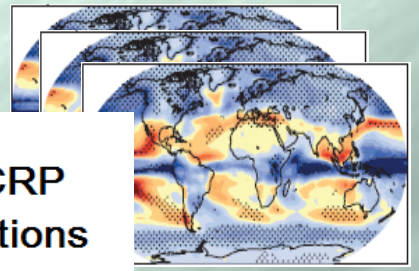
Future Temperature Projections



Future Precipitation Projections



RECLAMATION USGS

Santa Clara University CLIMATE CENTRAL

SCRIPPS INSTITUTION OF OCEANOGRAPHY

Bias Corrected and Downscaled WCRP CMIP3 Climate and Hydrology Projections

This site is best viewed with Chrome (recommended) or Firefox. Some features are unavailable when using Internet Explorer. Requires JavaScript to be enabled.

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Summary

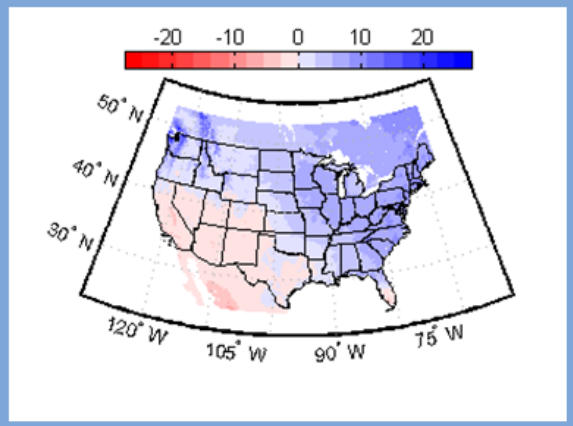
This archive contains fine spatial-resolution translations of:

- climate projections over the contiguous United States (U.S.) developed using two downscaling techniques (monthly BCSD Figure 1, and daily BCCA Figure 2), and
- hydrologic projections over the western U.S. (roughly the western U.S. Figure 3) corresponding to the monthly BCSD climate projections.

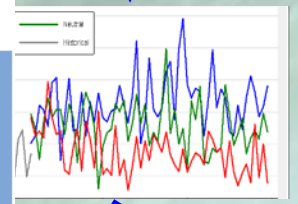
Archive content is based on global climate projections from the World Climate Research Programme's (WCRP's) Coupled Model Intercomparison Project phase 3 (CMIP3) multi-model dataset, which was referenced in the Intergovernmental Panel on Climate Change Fourth Assessment Report. Please see the "About" page for information on projection development, including the methodology to perform climate model bias-correction and spatial downscaling.

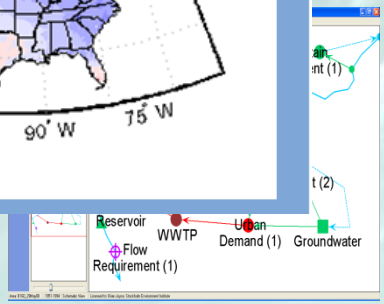
Purpose

Figure 1: BCSD CMIP3 Monthly Climate Analysis example - Median projected change in average-annual precipitation (cm/year), 2041-70 versus 1971-2000.



weather

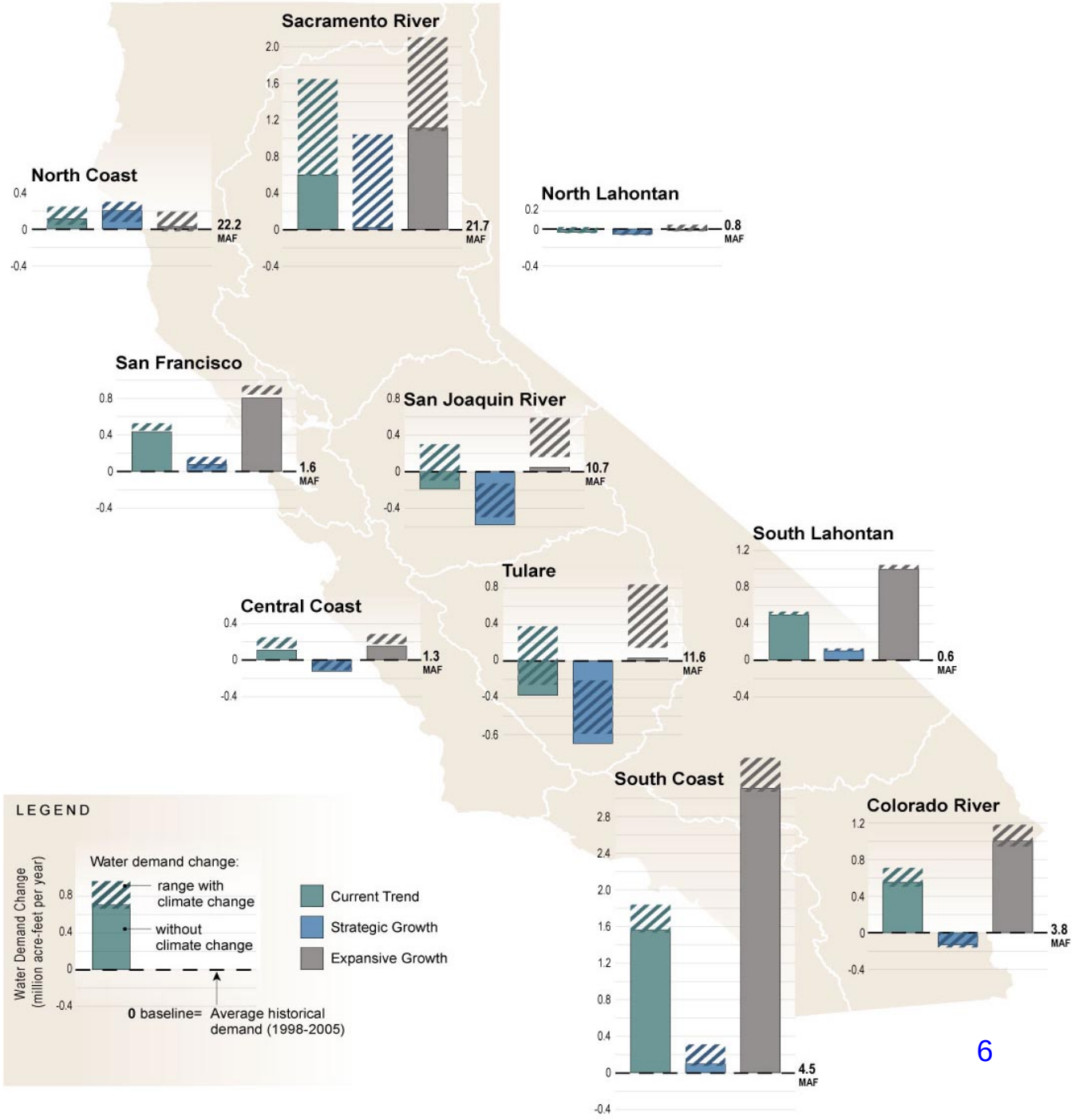




Hydrologic Model

*** Using the World Climate Research Programme's (WCRP's) Coupled Model Intercomparison Project phase 3 (CMIP3) multi-model dataset**

Update 2009 Regional Water Demand Changes By Scenario



Resource Management Strategies (Update 2009)
A Range of Choices

Reduce Water Demand
- Agricultural Water Use Efficiency
- Urban Water Use Efficiency

Improve Operational Efficiency & Transfers
- Conveyance – Delta
- Conveyance – Regional / Local
- System Reoperation
- Water Transfers

Increase Water Supply
- Conjunctive Management & Groundwater Storage
- Desalination –Brackish & Seawater
- Precipitation Enhancement
- Recycled Municipal Water
- Surface Storage – CALFED
- Surface Storage – Regional / Local

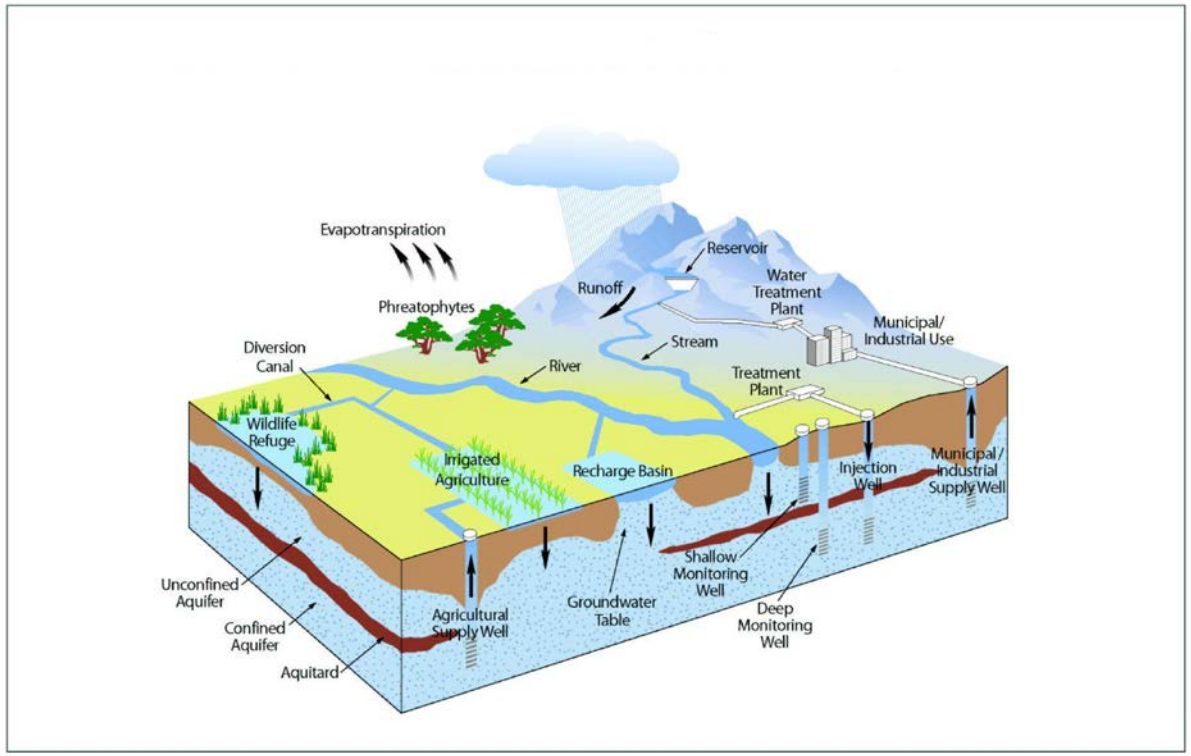
Improve Flood Management
- Flood Risk Management

Improve Water Quality
- Drinking Water Treatment & Distribution
- Groundwater / Aquifer Remediation
- Matching Quality to Use
- Pollution Prevention
- Salt & Salinity Management
- Urban Runoff Management

Practice Resource Stewardship
- Agricultural Lands Stewardship
- Economic Incentives (Loans, Grants & Water Pricing)
- Ecosystem Restoration
- Forest Management
- Land Use Planning & Management
- Recharge Areas Protection
- Water-Dependent Recreation
- Watershed Management

Other-- Crop idling, dew vaporization, fog collection, irrigated land retirement, rainfed agriculture, waterbag transport

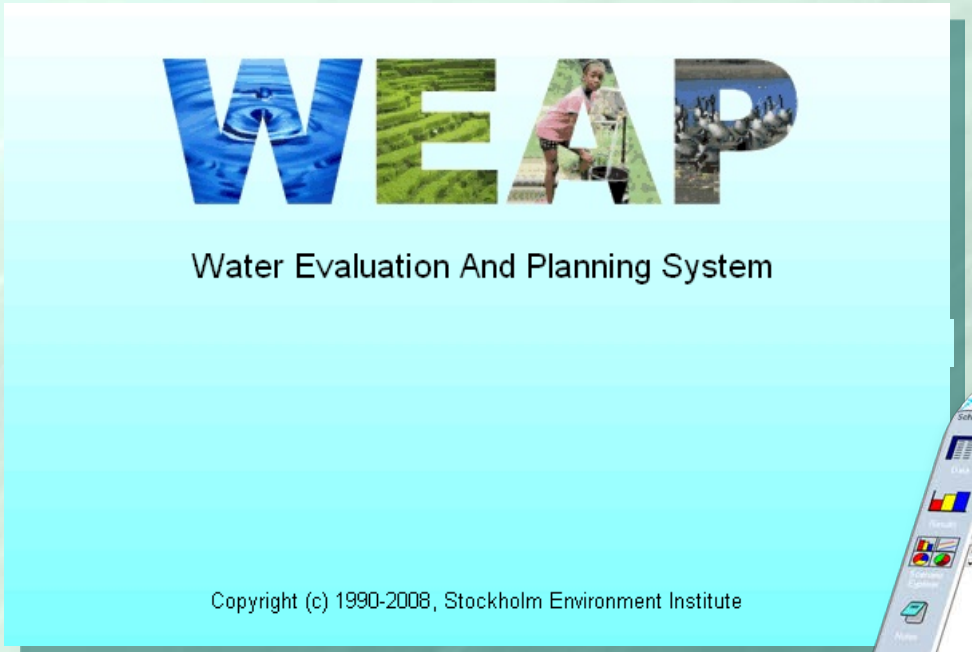
Improvements to analytical tools allow fo more comprehensive evaluation



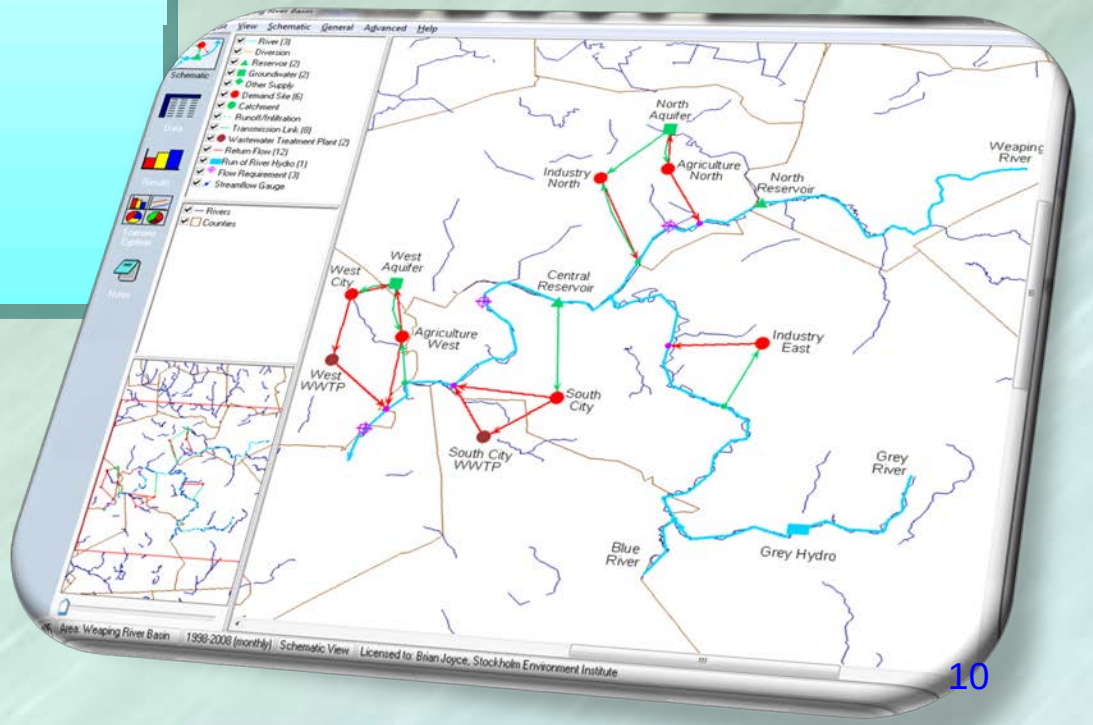
Summary of Water Plan Scenario Analysis

Scenario Factors	Resource Management Strategies
•Demographics •Urban and agricultural footprint •Climate conditions •Costs of resource management strategies	•Urban water use efficiency •Agricultural water use efficiency •Recycled municipal water •Conjunctive management and groundwater storage •Surface storage •System reoperation •Meet new instream flow objectives •Groundwater overdraft recovery
Analytical Tools	**Performance Metrics**
Water Evaluation And Planning system (WEAP) Central Valley Model UPlan urban growth model Statewide Agricultural Production model (SWAP) Demographic analysis Costs and economic impact tools	•Urban supply reliability •Agricultural supply reliability •Instream flow reliability •Groundwater levels •Combined SWP/CVP Delta exports •Cost of implementing response packages •Economic impacts of unmet water demand

Water Evaluation And Planning System

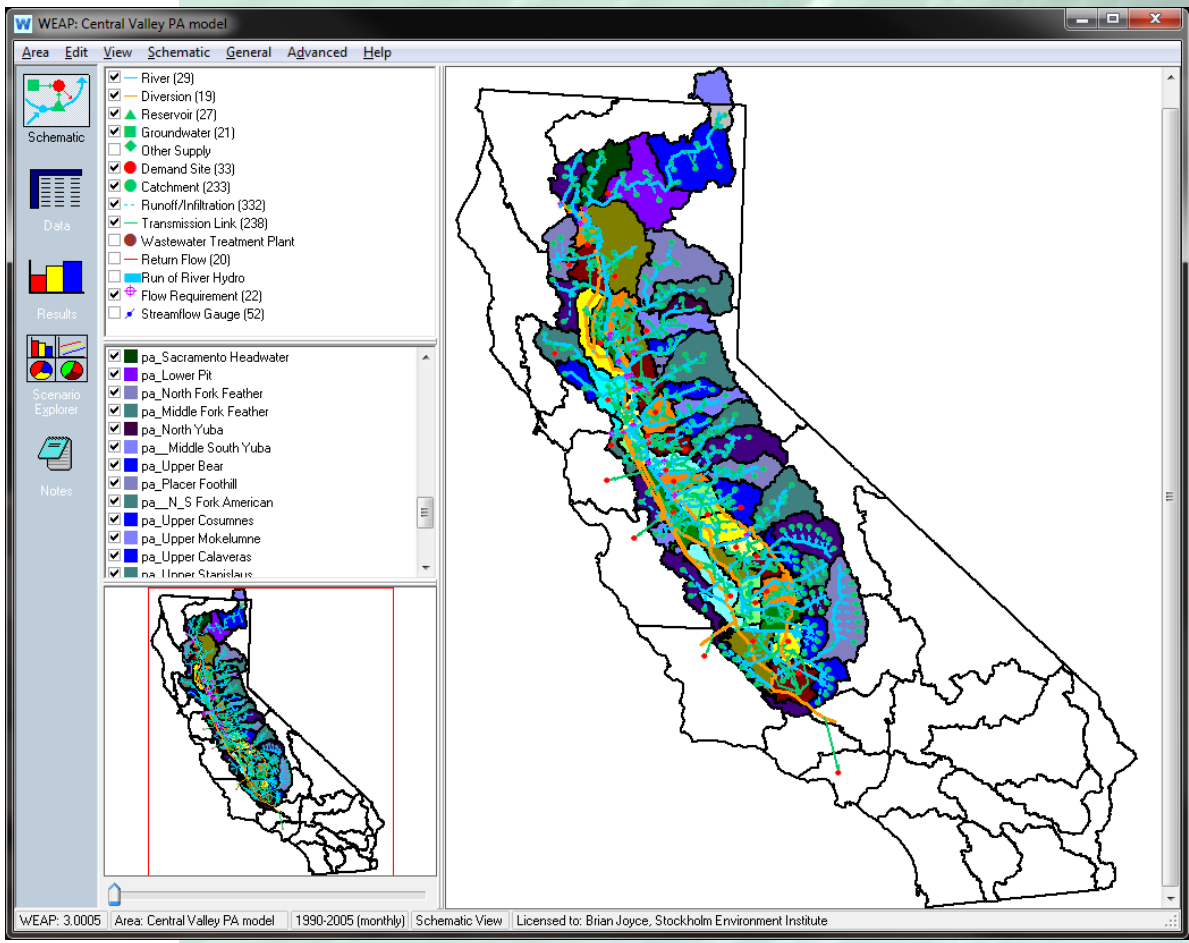


Generic, object-oriented, programmable, integrated water resources management modeling platform



Update 2013
California Water Plan

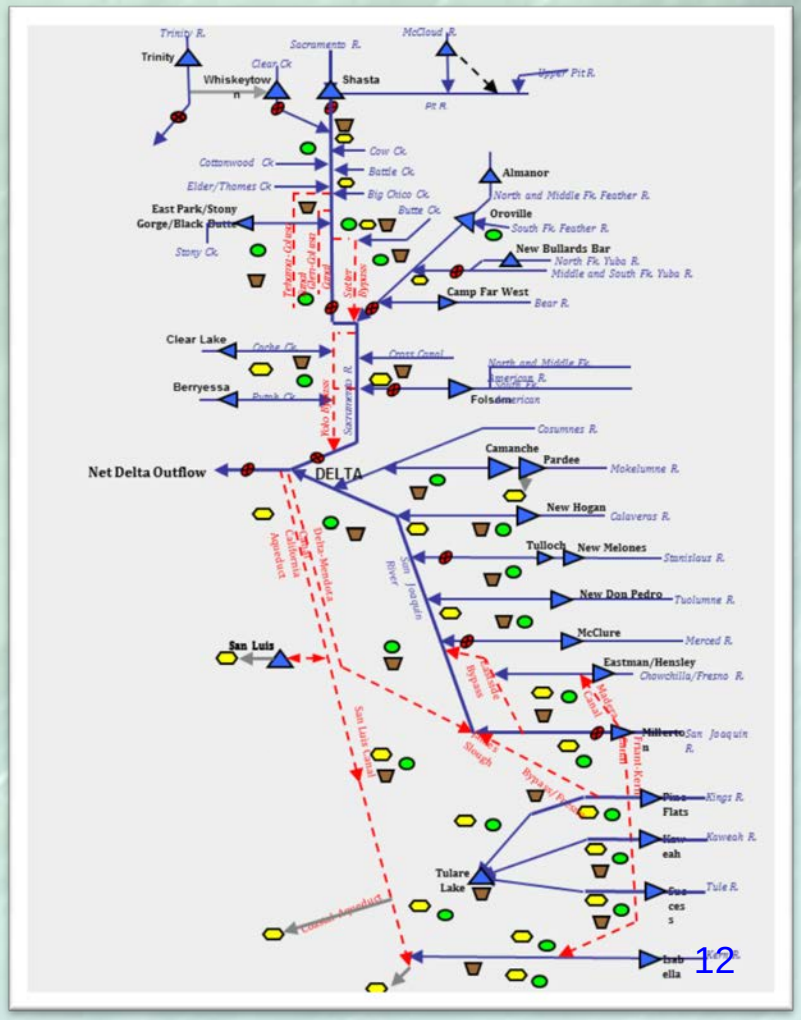
Central Valley WEAP Model



Water Evaluation And Planning (WEAP) Model*

Integrates Hydrology and Water Management

- Monthly temperature and precip. drive rainfall/runoff model
- Indoor demands:
  - Households / employees
- Irrigation demands:
  - monthly climate
  - land use patterns
- Network of rivers, reservoirs, conveyance, groundwater basins
- Linear program routes supplies to demand nodes according to supply preferences and priorities



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*http://www.weap21.org/

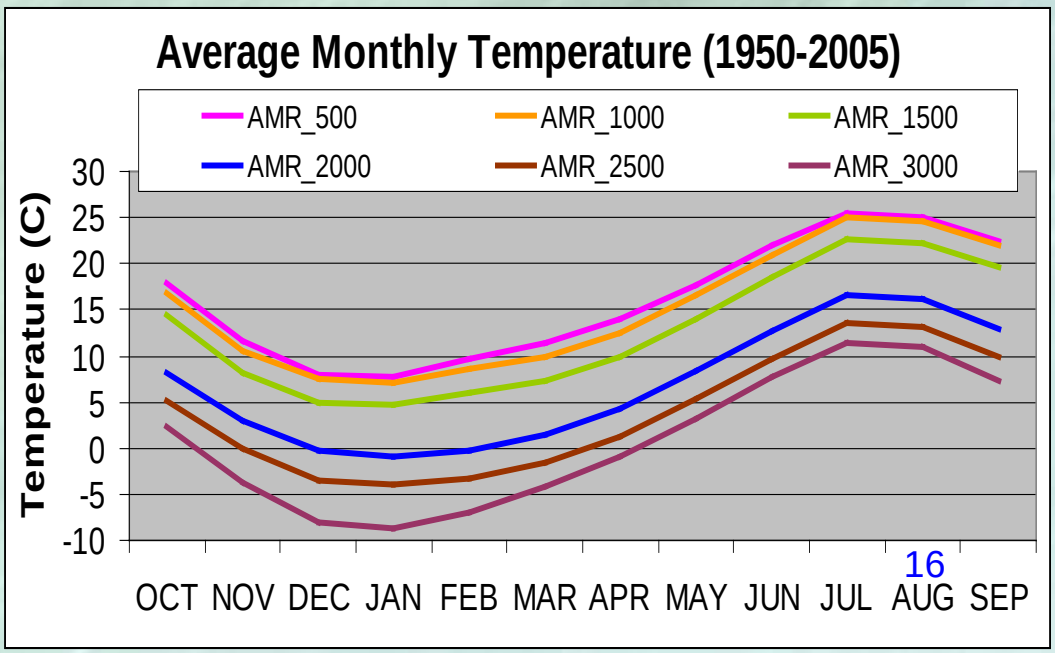
Gridded Climate Data

- 2,905 California grid points for climate data
- Central Valley WEAP PA model uses 233 representative points from 1,045 points covering source watershed and demand areas

Elevation Banding of Source Watersheds

Ex. American River:

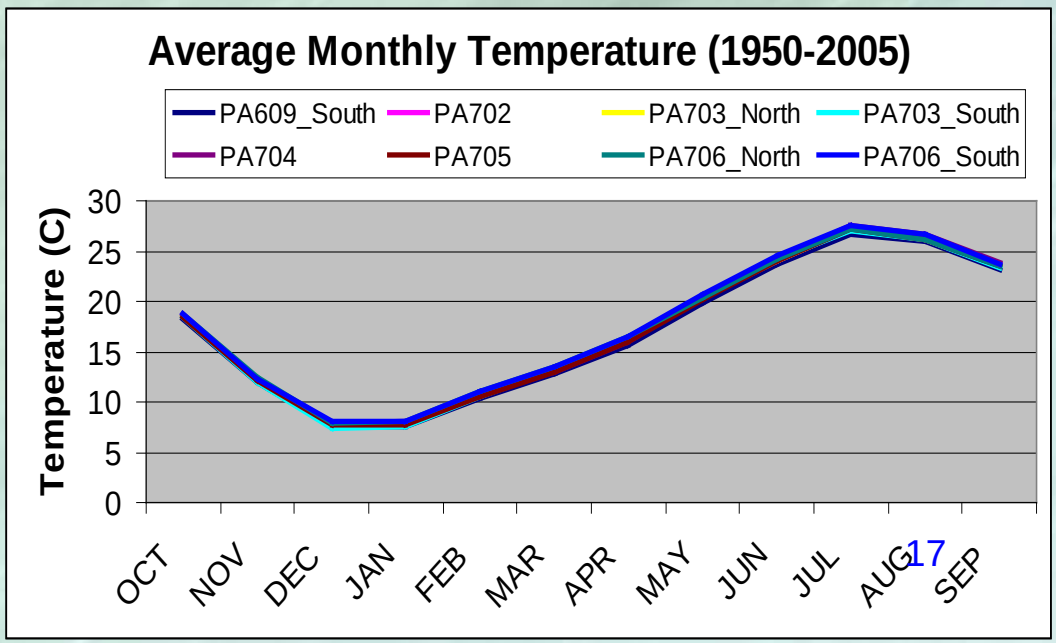
- Six 500-meter elevation bands
- 6 points selected from 33 grid points



Valley Floor Demand Areas

Ex. Southern San Joaquin Valley (PA's 609, 702, 703, 704, 705, 706):

- 8 points selected from 104 grid points



Areas Outside of Sacramento River, San Joaquin River and Tulare Lake Regions

- Apply simpler Hydrologic Region model developed for Update 2009
- Quantify regional water demand
  - Update 3 growth scenarios
  - Update 12 climate scenarios
- Ability to include some demand management strategies

Water Plan Climate Data Requirements

- 2005-2050 monthly time series of future projections of precipitation, average temperature, average relative humidity, and average wind speed
- 12km gridded climate data for California
  - spatially averaged at the Water Plan Planning Areas for the Central Valley floor areas
  - spatially averaged across 500 meter elevation bands in the foothills and Sierra Nevada Mountains
  - spatially averaged across the hydrologic regions for areas outside of the Central Valley

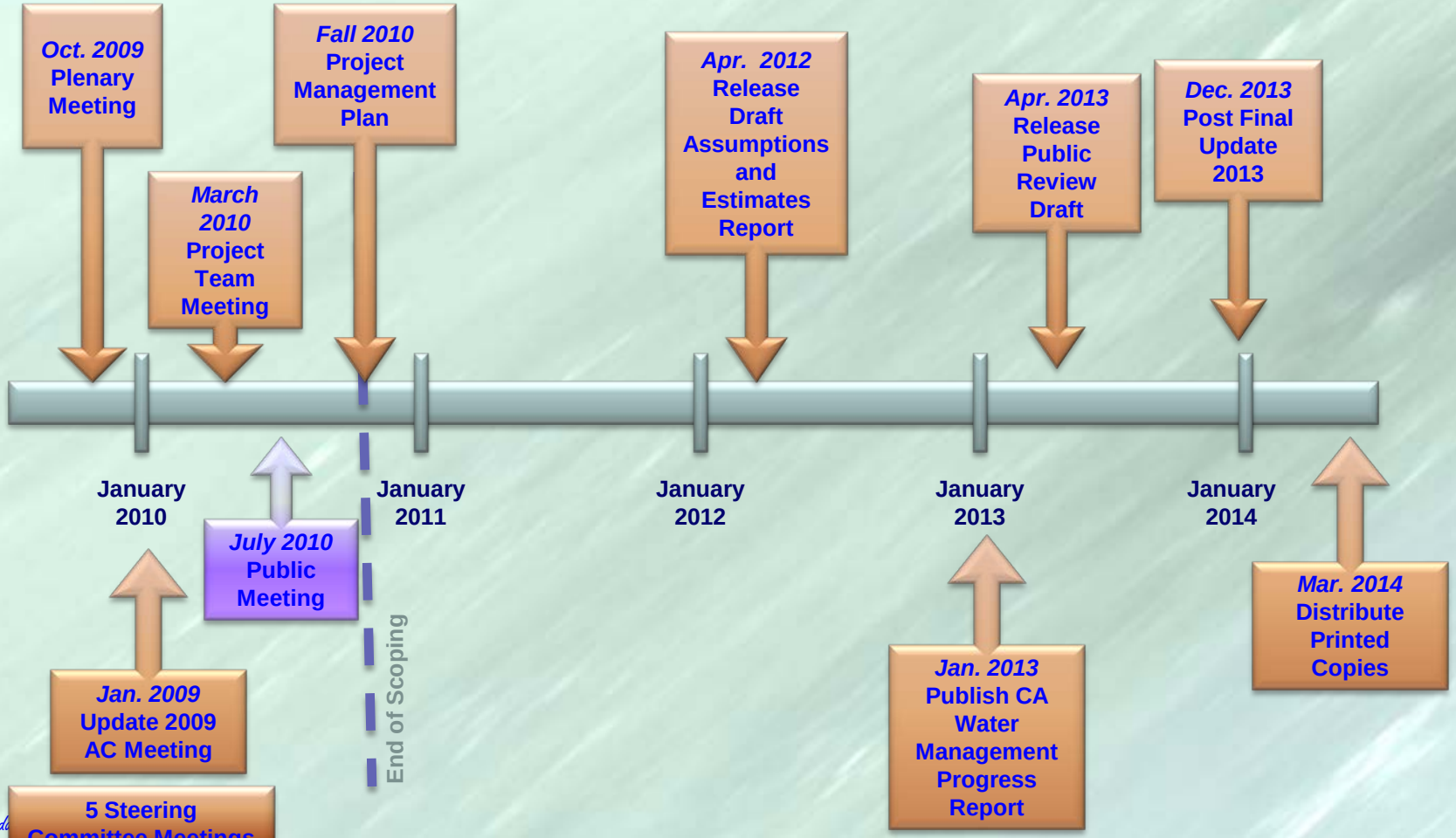
Schedule for Water Plan Scenarios

- JAN-JUN 2012 – Data development
- JUL-SEP 2012 – Initial scenario runs
- OCT-DEC 2012 – Initial public vetting of scenarios
- JAN-MAR 2013 – Refinement of scenario runs and documentation
- APR 2013 – Public Review Draft Update 2013

What the Water Plan needs from the CCTAG

- By May 2012, **provide a high level assessment** of the strengths and weaknesses of the 12 CAT climate scenarios and the 5 ensemble informed scenarios used by BDCP, and other existing and available projections or ensembles of projections for sampling the distribution of future climate projections.
- By May 2012, **provide recommendations for climate scenarios** (selecting from existing and available projections or ensembles of projections) that are appropriate for representing a reasonable variation of future climate conditions for use in Update 2013 of the Water Plan.

Water Plan Update 2013
Timeline and Major Deliverables



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