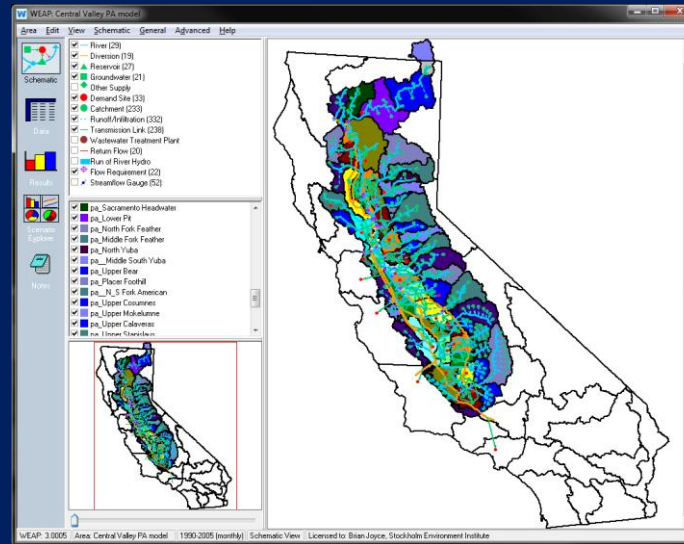


The Central Valley WEAP Model



**Workshop 3: Analytical Tools for Evaluating Water Supply,
Hydrodynamic, and Hydropower Effects**
Tuesday, November 13, 2012

David Purkey, Ph.D.

US Water Group Leader, Stockholm Environment Institute

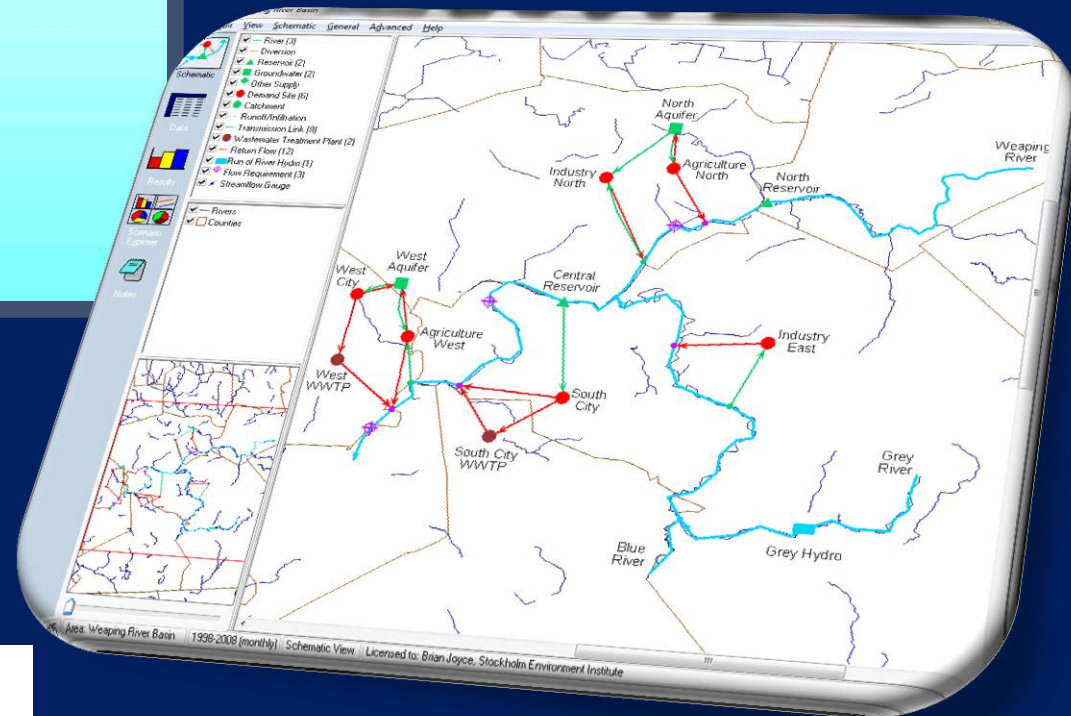
Water Evaluation and Planning System



Water Evaluation And Planning System

Copyright (c) 1990-2008, Stockholm Environment Institute

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



Why WEAP?

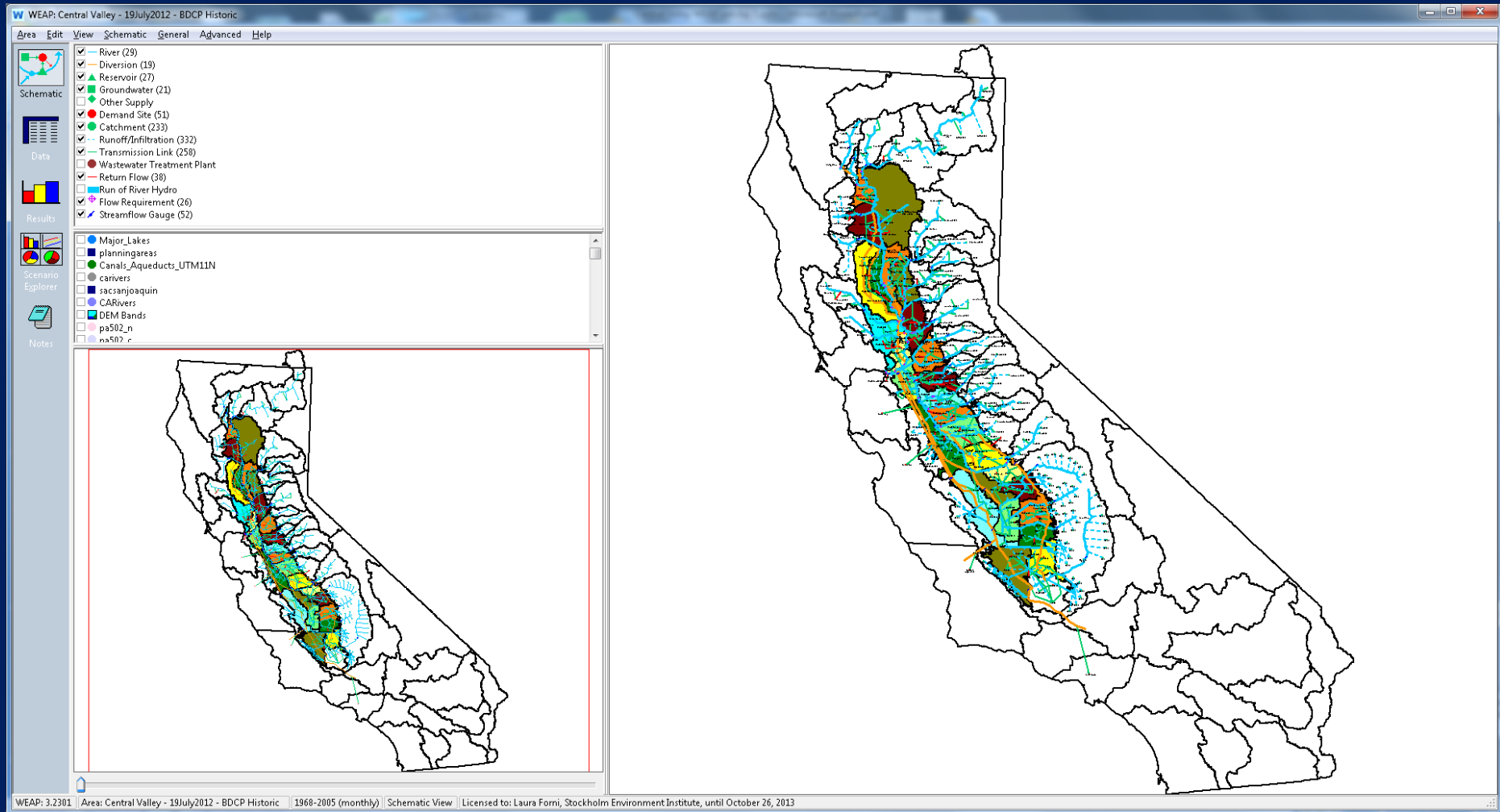
- **WEAP** is modern modeling software.
- **WEAP** has a global user community.
- **WEAP** is continuously upgraded by software engineers.
- **WEAP** is free for California government.
- **WEAP** includes NO dependencies on historical time series.
- **WEAP** integrates issues of concern in a consistent analytical platform.
- **WEAP** has been constructed for scenario analysis.
- **WEAP** is used for major system level planning exercises:
 - DWR State Water Plan Update;
 - USBR Sacramento-San Joaquin Basin Study.

Pertinent WEAP Functionality

- **Snow accumulation/melt**
- **Rainfall/runoff processes**
- **Evapotranspiration from both natural and cropped landscapes**
- **Soil moisture storage**
- **Groundwater dynamics, including stream aquifer interactions**
- **Hydraulic system operations, including hydropower**
- **Urban water demand**
- **Water allocation priorities, including environmental flows**
- **Surface water quality**
- **Financial accounting of costs and benefits.**

N.B.: from comment letter submitted by SEI

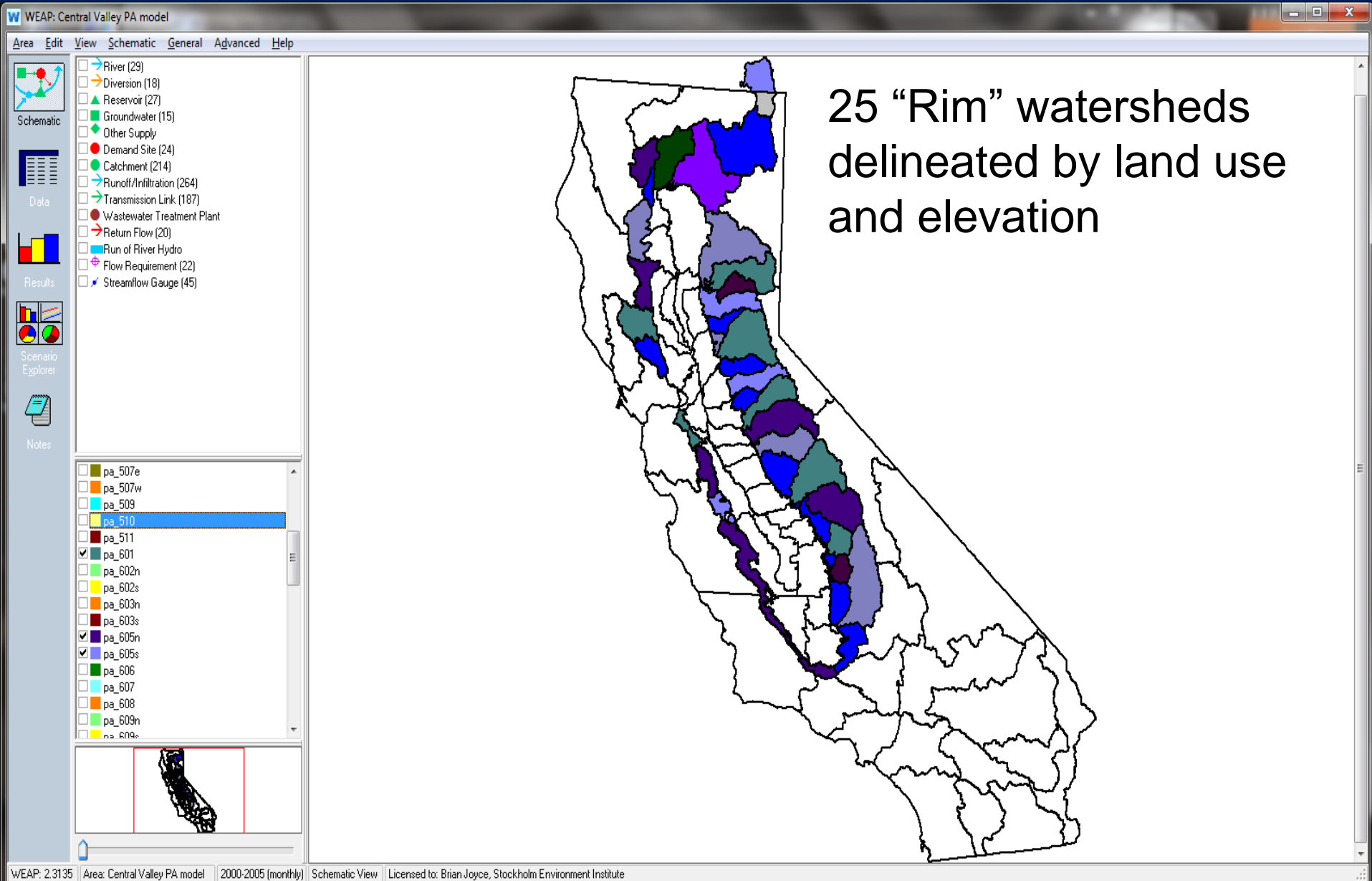
Central Valley WEAP



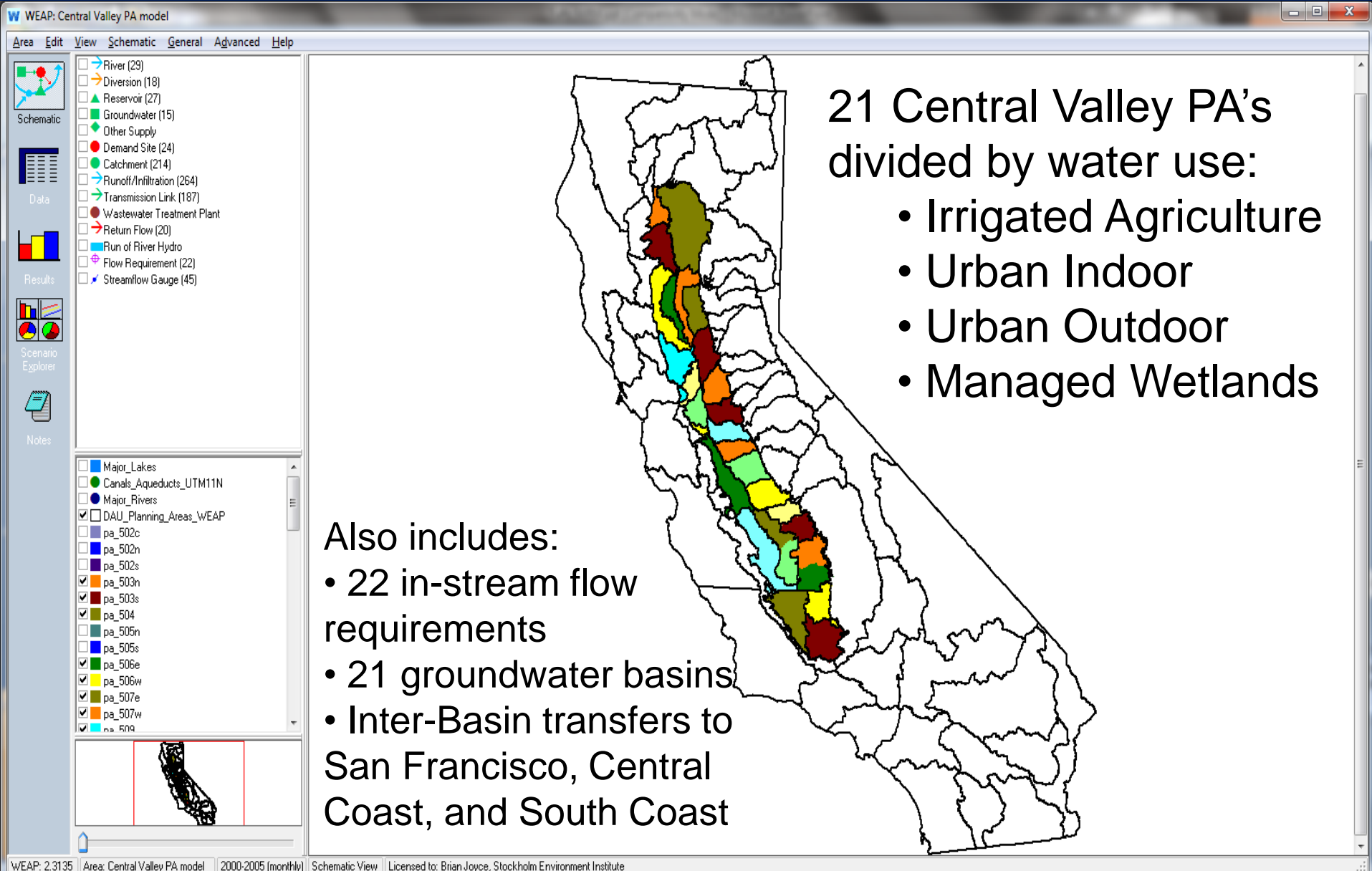
Central Valley WEAP Model Evolution

- **Sacramento Valley**
 - **EPA funded: finished in 2005**
- **Westside San Joaquin Valley**
 - **CEC funded: finished in 2006**
- **Entire San Joaquin Valley**
 - **DWR funded: finished in 2009**
- **Tulare Lake Basin**
 - **USBR funded: finished in 2011**

Upper Watersheds



Central Valley



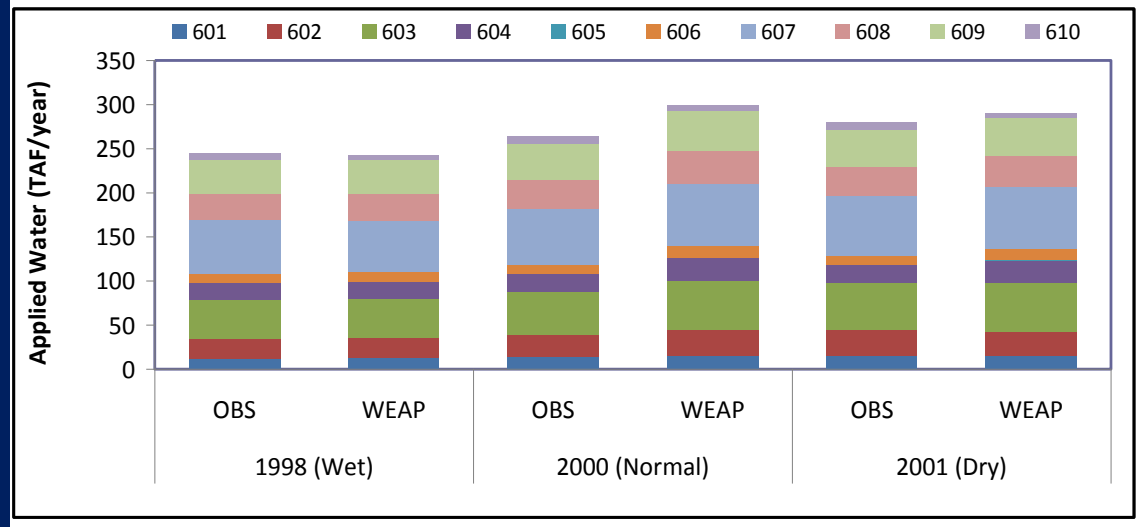
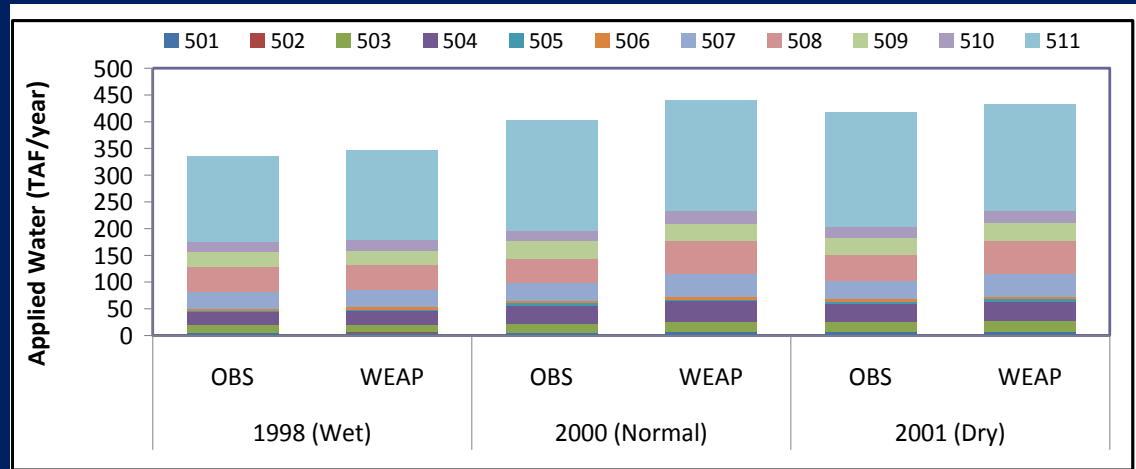
Model Calibration

Calibrated to:

- Monthly inflows to major reservoirs (1970 – 2005)
- Agricultural, urban (indoor and outdoor), and managed wetland water use (1998-2005)
- Reservoir storage (1990-2005)
- Groundwater use and groundwater elevations (1970-2005)
- Delta inflows, outflows and exports (1990-2005)

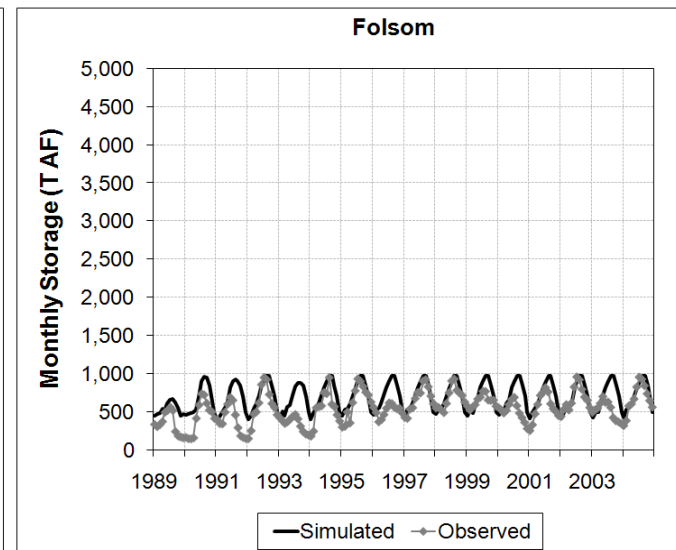
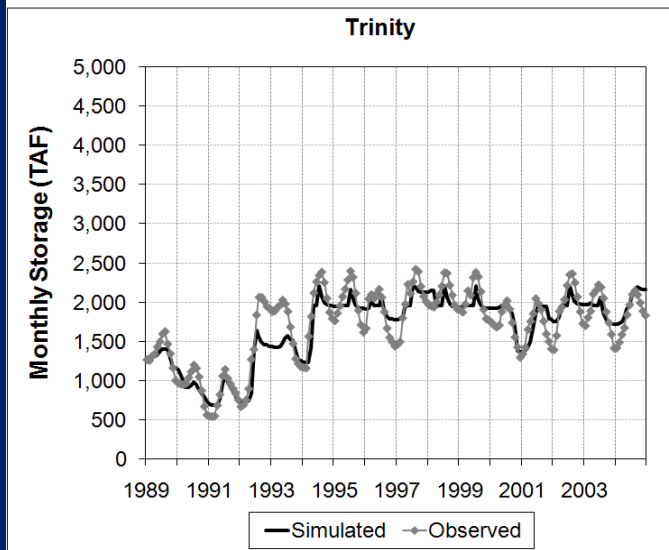
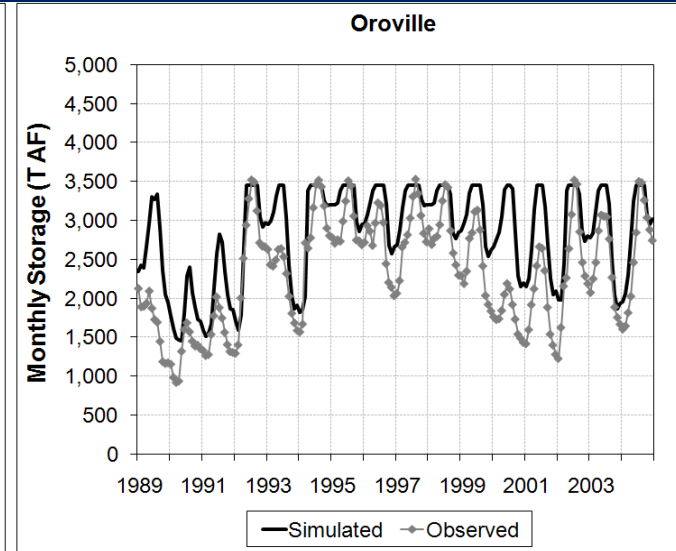
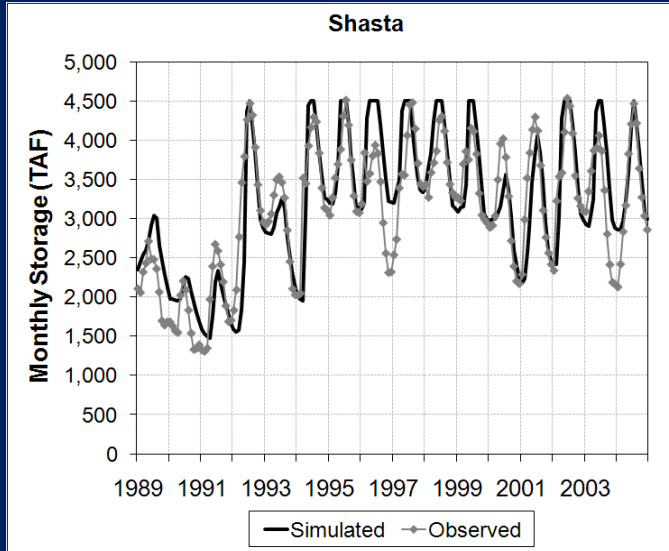
Model Calibration: Water Use

Outdoor Urban



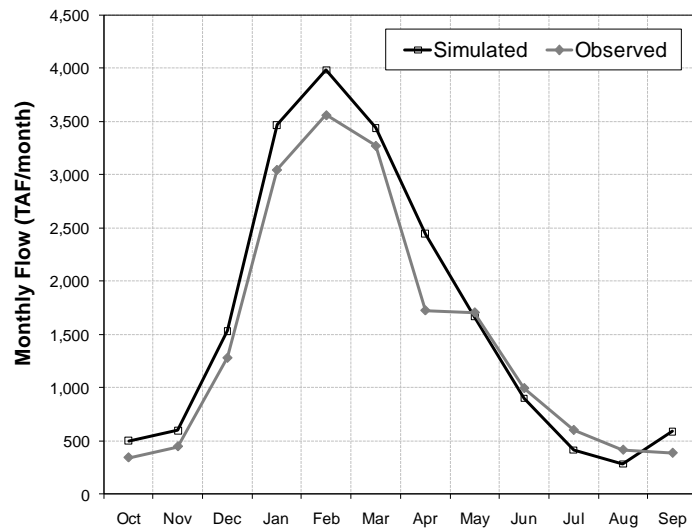
Model Calibration: Reservoir Storage

Sacramento River HR

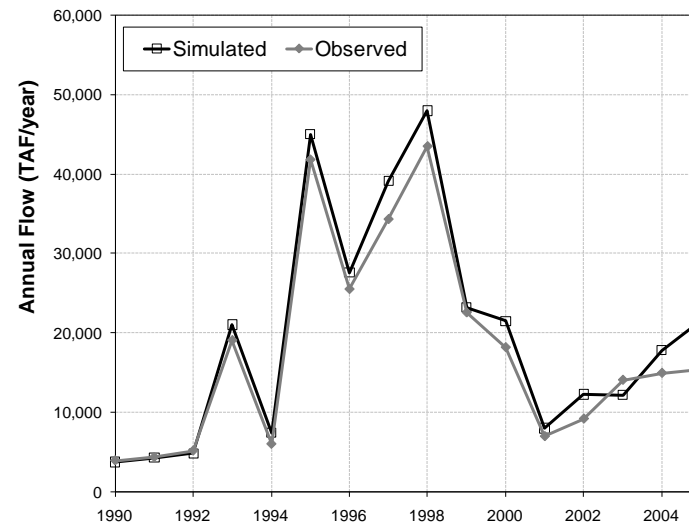


Model Calibration: Delta Outflow

Net Delta Outflow

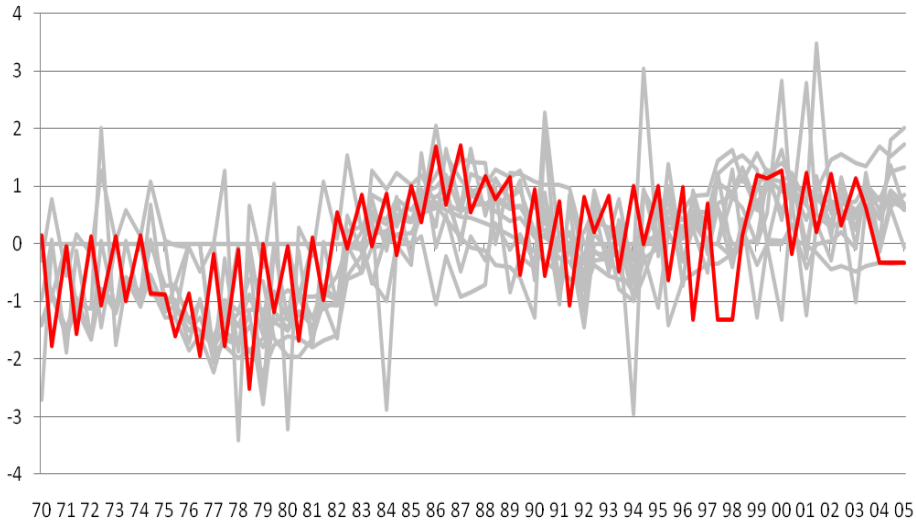


Net Delta Outflow

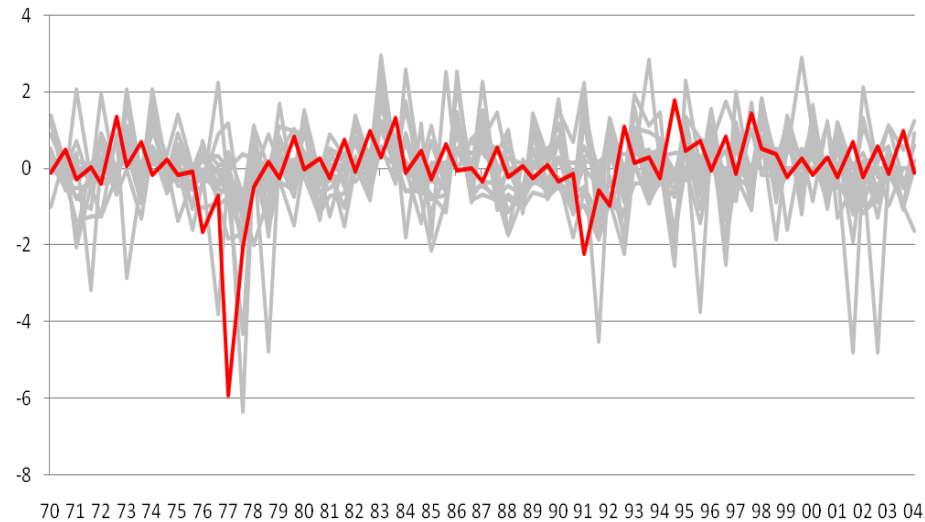


Model Calibration: Groundwater Elevation

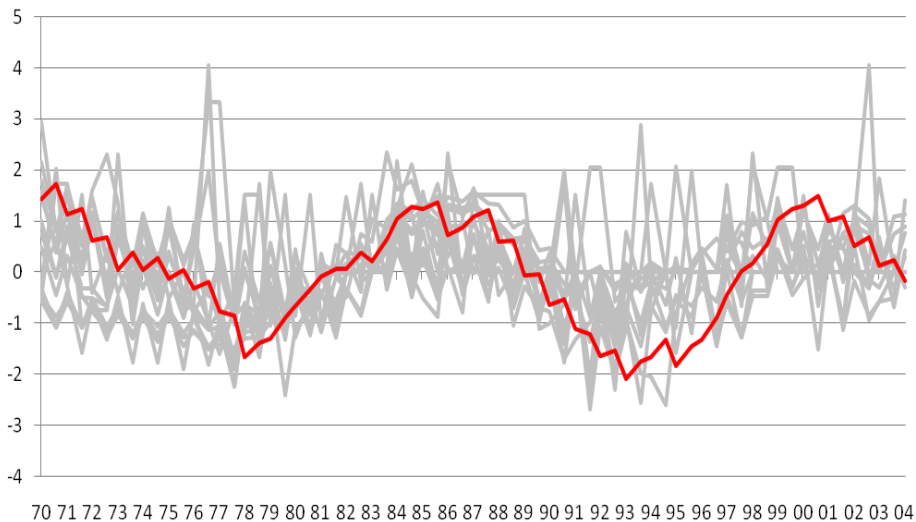
Colusa Normalized WSE



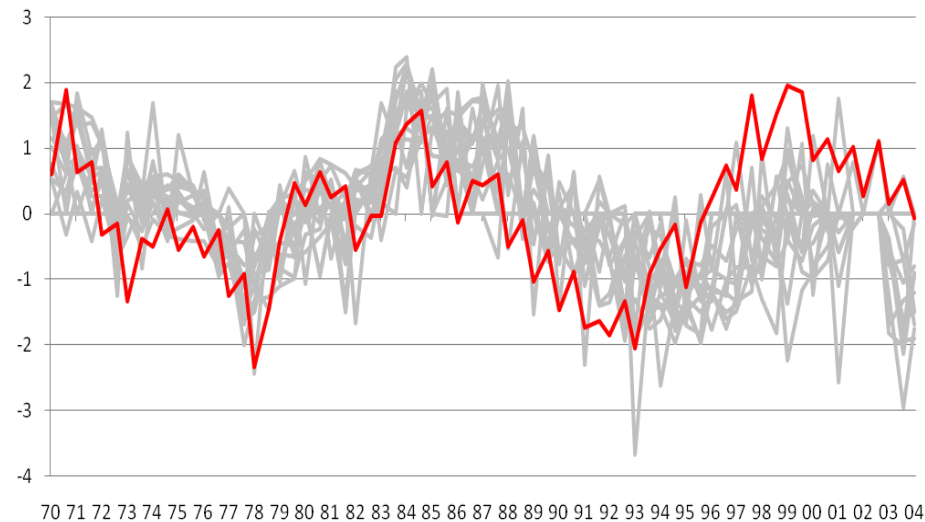
Butte Normalized WSE



Eastern San Joaquin Normalized WSE



Chow-Chilla Normalized WSE



Scenarios Analysis Framework

Uncertainties:

- Demographic
- Land Use / Land Cover
- Climate Change

Response Strategies:

- Add infrastructure
- Improvements in system efficiency
- Wastewater reuse
- Demand Management



Outcome Metrics:

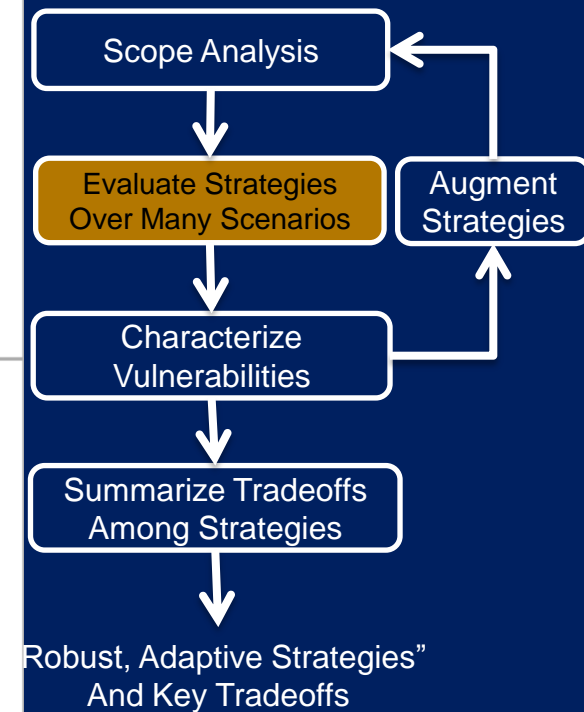
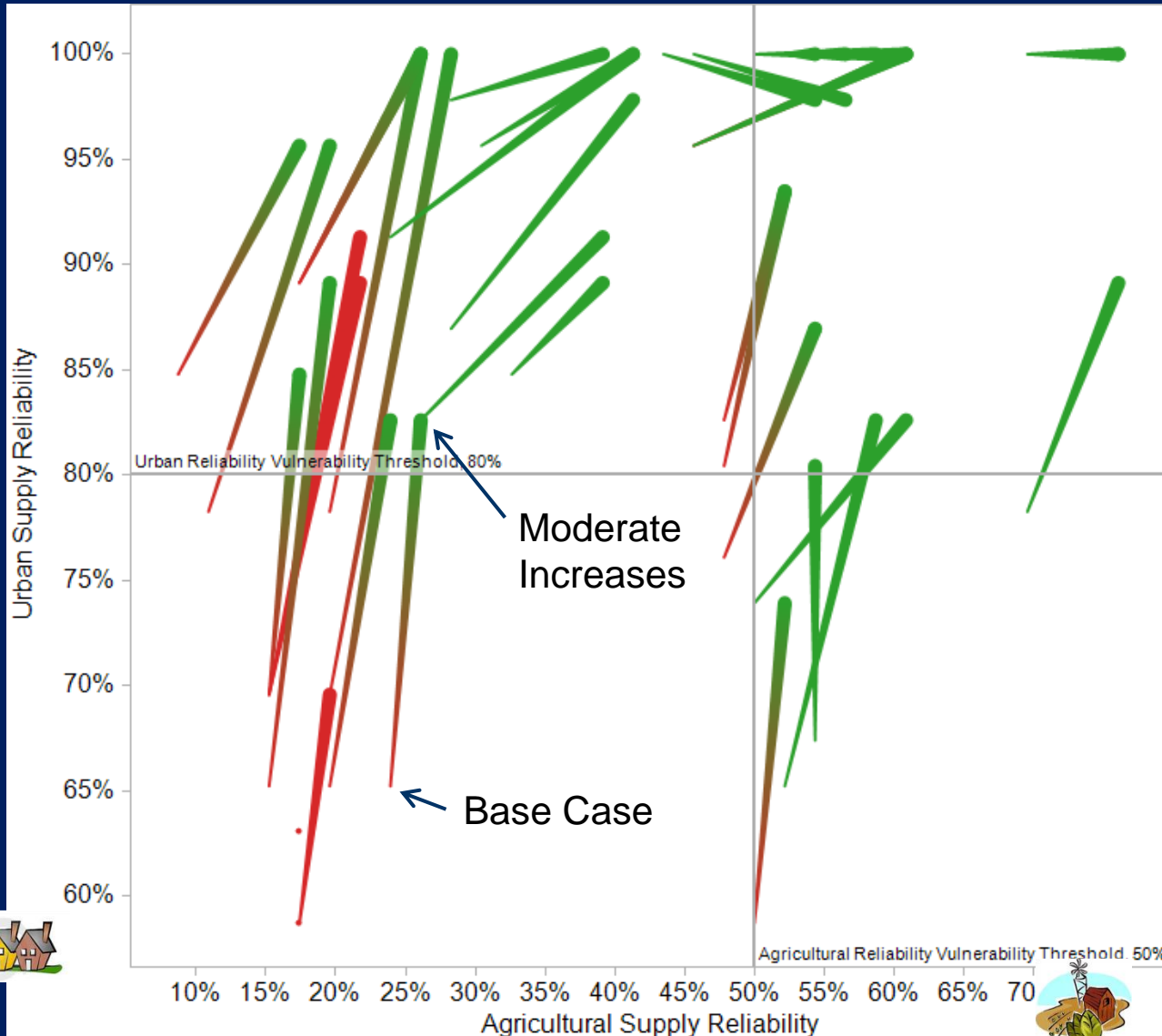
- Delivery reliability
- Unmet demands
- Groundwater & surface water storage

Grouped Strategies into Response Packages for Analysis

← Response Packages →

Strategies	Baseline (#1)	#2	#3	#4	#5	#6	#7
Urban Water Use Efficiency	0 (current)	+	+	++	++	++	+++
Agricultural Water Use Efficiency	0	0	0	+	+	+	+++
Groundwater Recharge	0	0	+	0	+	+++	+++
Recycled Water Use	0	+	++	+	++	+++	+++

Vulnerabilities Are Reduced With Response Packages



Some Other California WEAP Applications

- **Santa Clara Valley (utility planning)**
- **South Fork American River (utility planning)**
- **San Gregorio Creek (State Board hearings)**
- **East Bay Area (utility planning)**
- **Western Sierra Nevada (research)**
- **Cosumnes, American, Bear, and Yuba Basins (IRWMP)**
- **Inland Empire (urban water management plan)**
- **Butte Creek (research)**
- **Cache Creek (research)**

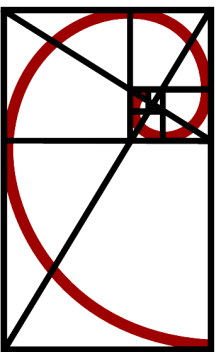
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- **WEAP** is modern modeling software,
 - not site specific code.
- **WEAP** has a global user community,
 - not a small number of proficient users.
- **WEAP** is continuously upgraded by software engineers,
 - not a static code managed by water engineers.
- **WEAP** is free for California government,
 - no need for expensive solvers.
- **WEAP** includes NO dependencies on historical time series,
 - Not restricted to period of record hydrology.
- **WEAP** integrates issues of concern in a consistent analytical platform.
 - Not an assemblage of otherwise disconnected models.
- **WEAP** has been constructed for scenario analysis.
 - Does not require extensive coding to represent new management arrangements.
- **WEAP** is used for major system level planning exercises:
 - DWR State Water Plan Update;
 - USBR Sacramento-San Joaquin Basin Study.

Thank You



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