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Managing Water in the West

CalSim-II – San Joaquin River Valley Peer Review

August 4, 2005



U.S. Department of the Interior
Bureau of Reclamation

Project Team

– Reclamation

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Agenda

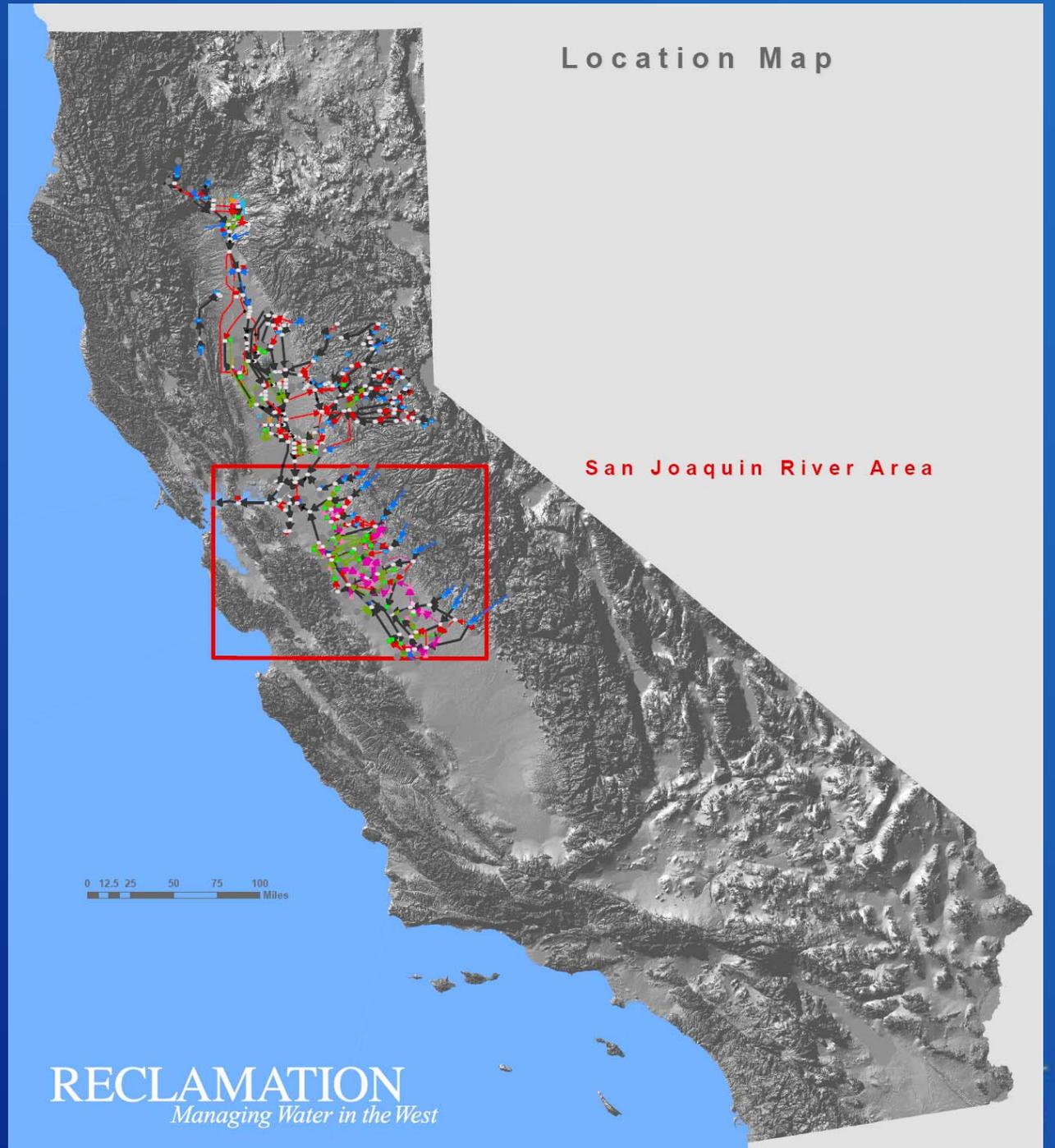
- **CalSim-II Overview**
- **San Joaquin River Valley Representation**
- **Demand Development**
- **Hydrology and Operations Development**
- **Water Quality Module**
- **Current and Future Development**
- **Documentation, Quality and Applications**
- **Key Messages from Presenters**
- **Comments on Questions to Peer Review Panel**
- **Closing**

CalSim-II Overview

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CalSim-II Overview

- Statewide Water Resources Planning Model
- Represents the Sacramento and San Joaquin River systems and the Bay-Delta



CalSim Overview

- **A generalized modeling tool for river system analysis**
- **Management and surface water allocation**
- **Mass balance accounting tool**
- **Represents physical system by a network of arcs and nodes**
- **Simulates system operation, routing flow through the system network, making reservoir release and surface water allocation decisions in each time step**
- **Developed by DWR's Office of SWP Planning**

CalSim Use of LP

- **Decision Variables:**
 - Flows through system during a particular time step
 - Storage at the end of a time step
- **Constraint Set:**
 - Mass balance at system nodes
 - Upper bound constraints for physical capacities
 - Lower bound constraints for minimum flow requirements
 - Relational constraints reflecting operating criteria and contractual and regulatory requirements
- **Cost Coefficients:**
 - Set of priorities or weights for the allocation of water

CalSim-II Overview (cont.)

- An application of the CalSim software
- Developed jointly by DWR and Reclamation
- Simulates inter-dependent CVP and SWP operations
- Common model has shared assumptions & data sets
- Primary purpose is to evaluate the water supply delivery potential of the CVP and SWP system within given regulatory environments:
 - At current or future levels of development
 - With and without various assumed future facilities
 - With different modes of facilities operations

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CalSim-II Overview (cont.)

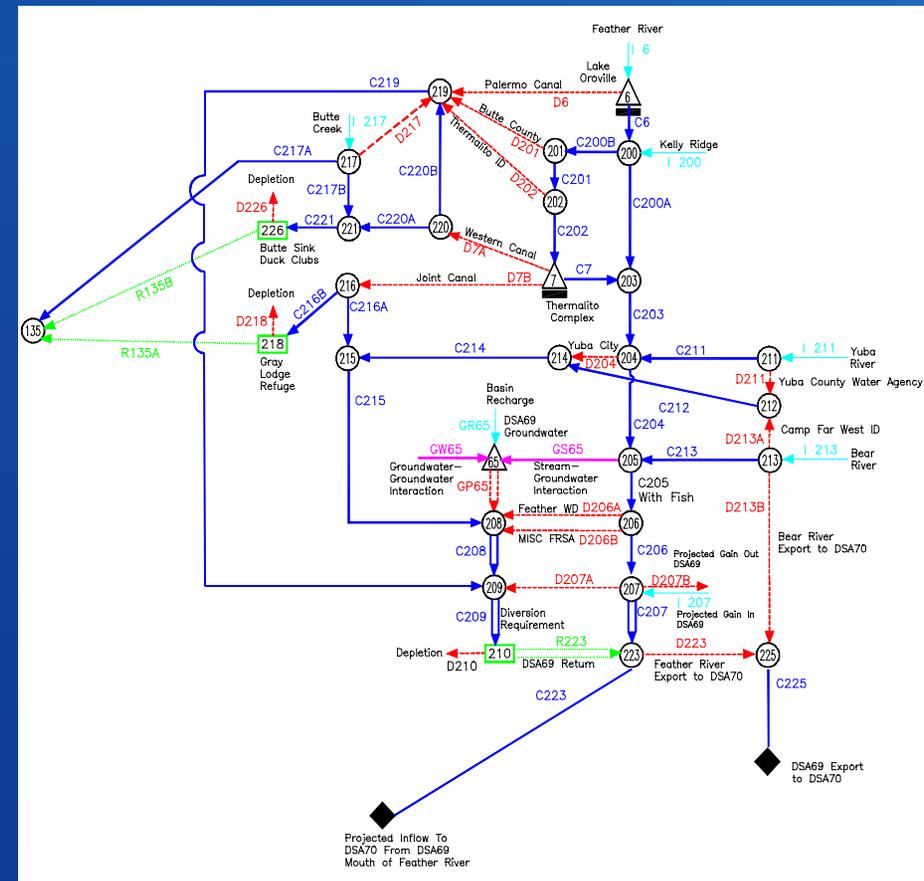
- **Currently study period is comprised of 73 water years (1922-1994)**
- **Accounts for system operational objectives, physical constraints, and legal and institutional agreements and statutes such as:**
 - **USACE Flood Control guidelines, Navigation flows**
 - **Channel, Outlet, Pump capacities**
 - **SWRCB Decisions, NMFS Fish Protections**
 - **Coordinated Operations Agreement**
 - **CVPIA (b)(2) Accounting, Environmental Water Account**

CalSim-II Information

- CALFED Science Peer Review (December 2003)
 - http://science/calwater.ca.gov/pdf/CALSIM_Review.pdf
- Peer Review Response Report (August 2004)
 - <http://baydeltaoffice.water.ca.gov/modeling/index.cfm>
- CalSim-II Software and Documentation Download
 - <http://modeling.water.ca.gov/hydro/model/index.html>

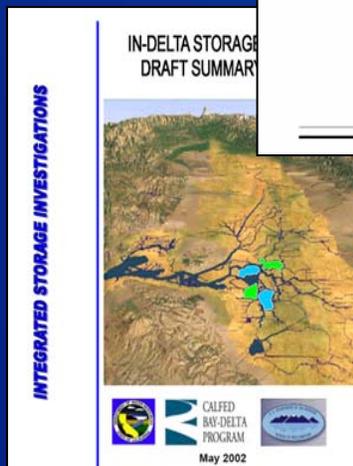
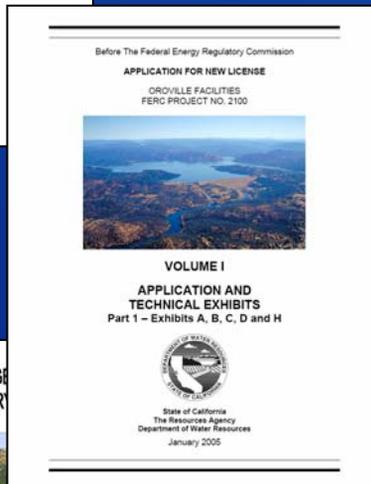
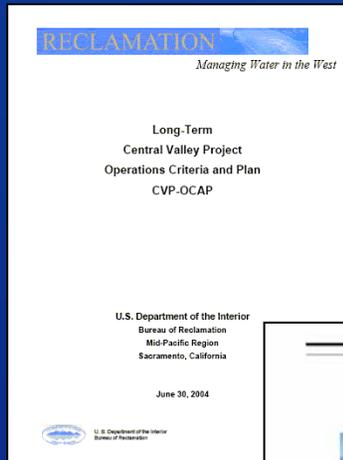
River System Model Applications

- Operations and Management
- Planning Models
- Policy Development Models
- Models for Regulation
- Forecasting Models



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CalSim-II Studies



- Operations Criteria and Plan (OCAP), CVPIA (b)(2) and Environmental Water Account Operations
- Oroville FERC License Application
- CALFED Integrated Storage Investigations

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Potential CalSim-II Applications for Evaluation of :

- **Project Yields**
- **Water Supply Reliability**
 - under current and future demands
 - under alternative project operation policies (risk curves)
 - under existing and future environmental regulations
- **CVPIA (b)(2) , EWA & ERP program implementation**
- **New Facilities**
- **Joint-Point-of-Diversion operations**
- **Coordinated Operations Agreement ratios**
- **Carriage water requirements for water transfers**
- **WQ and Energy impacts of alternative operations**
- **Changing Land Use Practices**

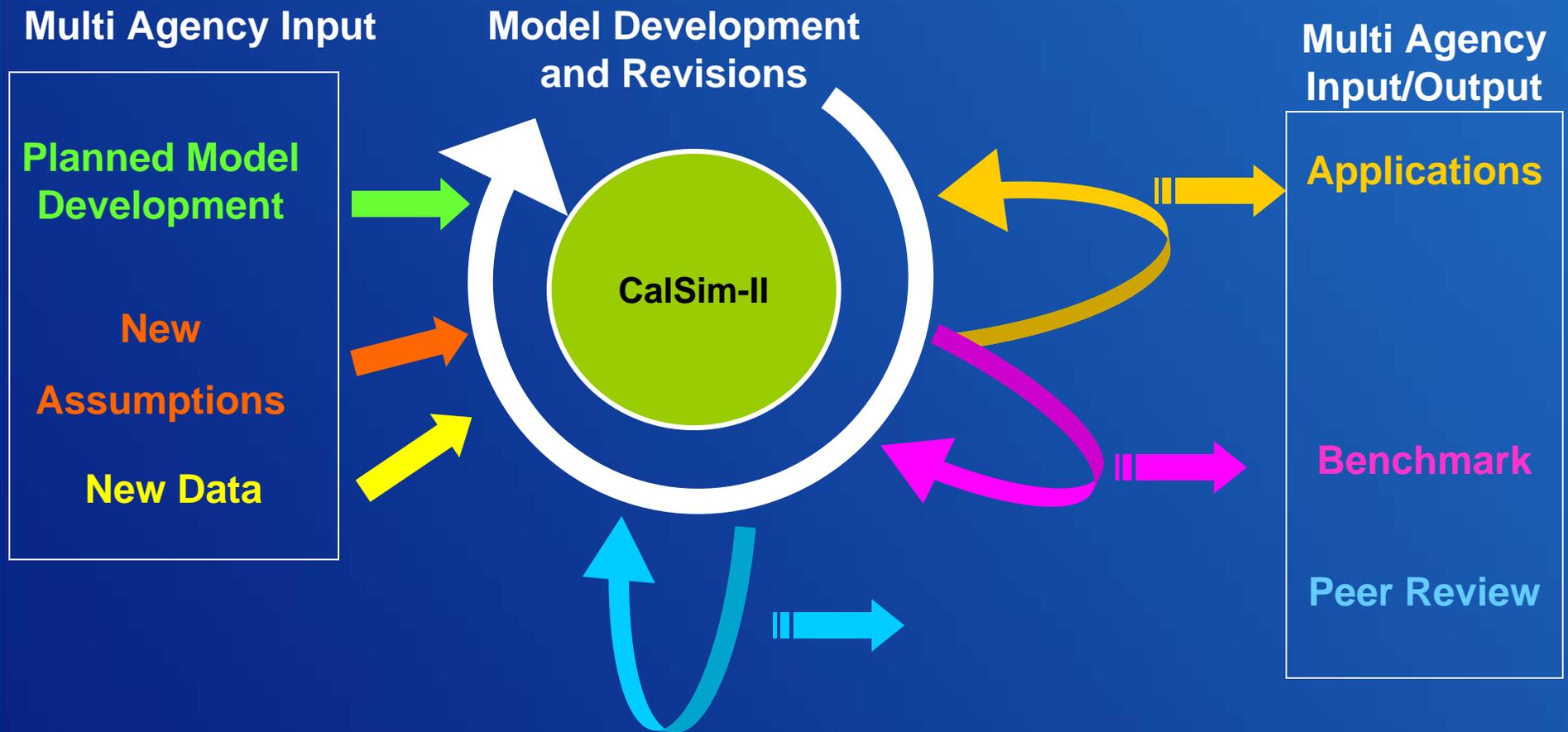
CalSim-II Peer Review and Response

- **Peer Review conducted in Fall 2003**
 - Is CalSim a reasonable modeling approach?
 - What are major strengths and weaknesses?
 - Scientific, technical, and institutional limitations & uncertainties?
 - Management and oversight for quality assurance and long term use and development?
- **Agency Response to Peer Review**
 - Establish Credibility and Trust
 - Hydrology Enhancements
 - Software Development Needs
 - Module Enhancements
 - Application/Software Extensions

San Joaquin River Model Development

- **Water Quality**
 - Address SJR salinity management questions
 - Identify and incorporate source-specific concerns
 - Resolve questions regarding water quality modeling strategies
- **Land use based hydrology**
 - Common basis for representation of demand
 - Apply methodology consistent with California Water Plan Update (Bulletin 160)
- **Operations protocol**
 - Reflect recent operational practices

Development Process



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Collaborators

Cooperating Entities

- Madera Irrigation District
- Chowchilla Water District
- Merced Irrigation District
- Turlock Irrigation District
- Modesto Irrigation District
- Oakdale Irrigation District
- South San Joaquin Irrigation District
- Stockton East Water District
- The San Joaquin River Exchange Contractors
- Friant Water Users

Lead Agencies

- Reclamation
- Department of Water Resources



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Past and Current Development



1990

2000

2005

2000 JOINT
MODEL

Sept. 2002
BENCHMARK

Nov. 2003 PEER
REVIEW

Jun 2004
OCAP

Aug. 2005 SJR
PEER REVIEW

Milestones

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Future Development

CalSim-II

CalSim-III

2005

2010

2015

2006
BENCHMARK

2008
RESPONSE
PLAN SHORT
TERM GOALS

2013
RESPONSE
PLAN LONG
TERM GOALS

Milestones

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Focus

- **Representation of San Joaquin River Basin in CalSim-II**
 - “Existing” Model (June 2004 OCAP)
 - “New” Model (April 2005)
- **Hydrology development**
 - Land use based demands
 - Accretions / depletions
 - Water budgets
- **Operations**
- **Water quality**

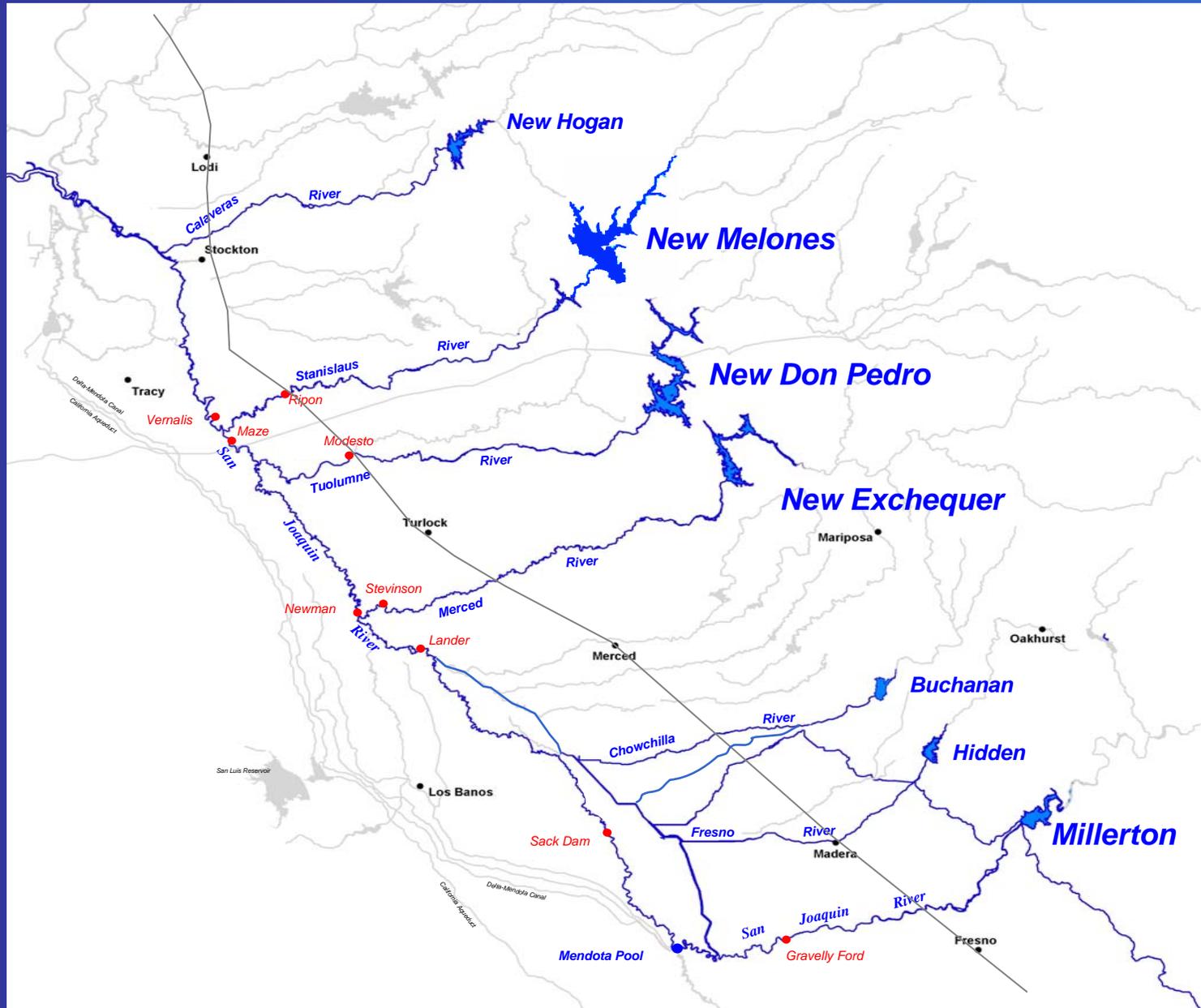
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San Joaquin River Basin Representation

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Geographic Scope



San Joaquin River Basin Enhancements Project Objectives

- Create a contemporary depiction of San Joaquin River Basin hydrology and operations
- Develop a structure within CalSim-II that recognizes physical linkages and processes that can be responsive to data driven changes in the future
- Document the development of the model and its data

San Joaquin River Basin Enhancements

Elements of Enhancement

- Revised hydrology
- Land use based demands for Eastside water districts and adjacent areas
- Improved system operating rules
- Revised mapping of Westside and Eastside connectivity
- Refinement / Addition of Friant and Calaveras systems
- New formulation for calculation of water quality at Vernalis

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Model Development

- **Development of**
 - **System representation in CalSim-II**
 - **Water demands**
 - **Stream accretions / depletions**
 - **Operations**

Model Development

- **Spatial resolution**
- **Data availability**
 - Long-term stream flow records
 - Water district records

Water Management Areas (Demand Centers)

- Use of DAU and Water District boundaries
- Aggregate land use based water supply source
 - Districts with Reservoir(s)
 - Ground water only
 - Riparian



East side of San Joaquin River

- Main focus of model enhancements
 - Land use based demands
 - District operations



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West side of San Joaquin River

- **Water Districts**
 - Simple relationship between deliveries and returns to system
- **Refuges**
 - Simple relationship between deliveries and returns including ponding operation



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Demand Development

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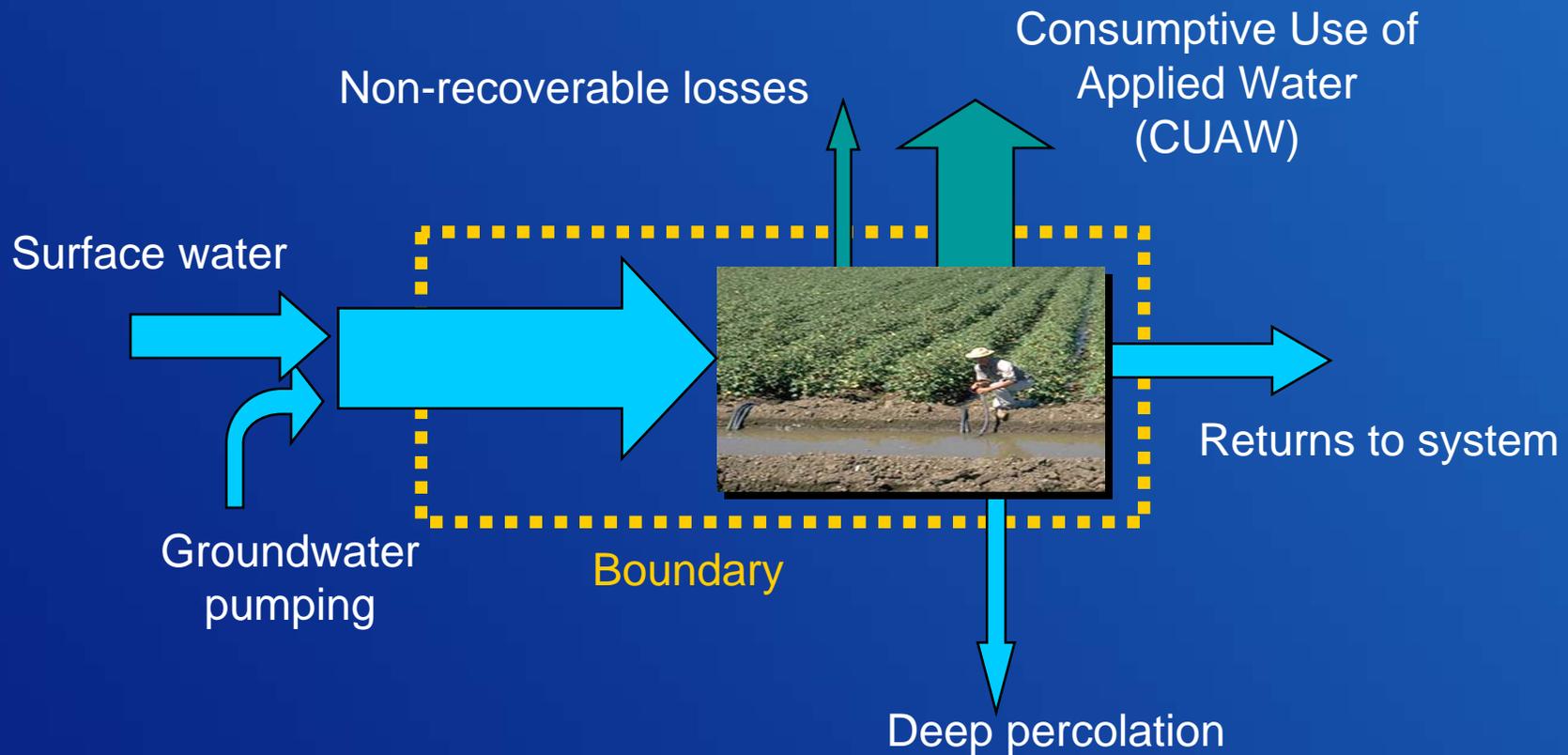
Water Demands



- Agricultural water demands
- Urban water demands

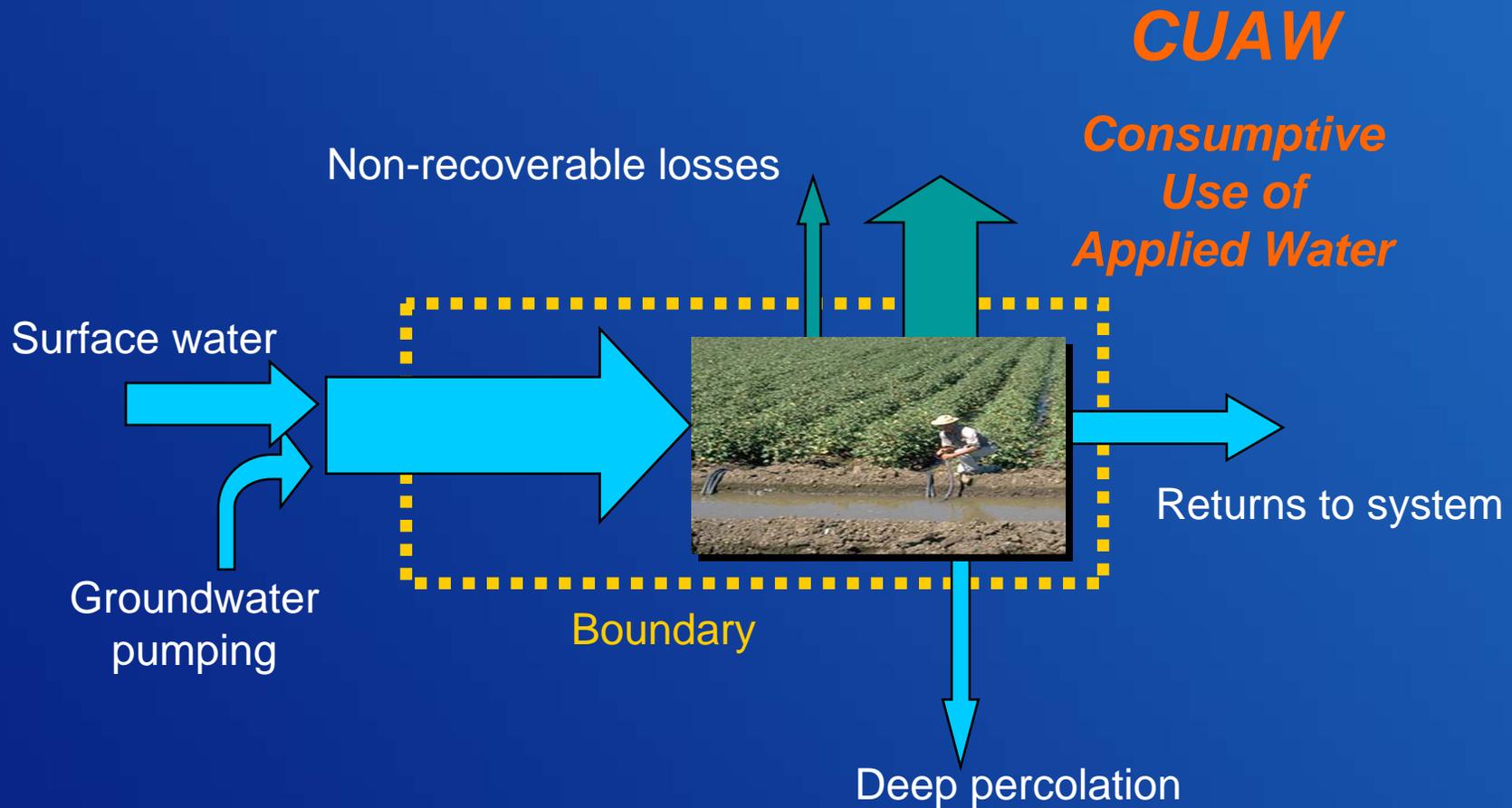
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Components of Agricultural Demand



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Components of Agricultural Demand



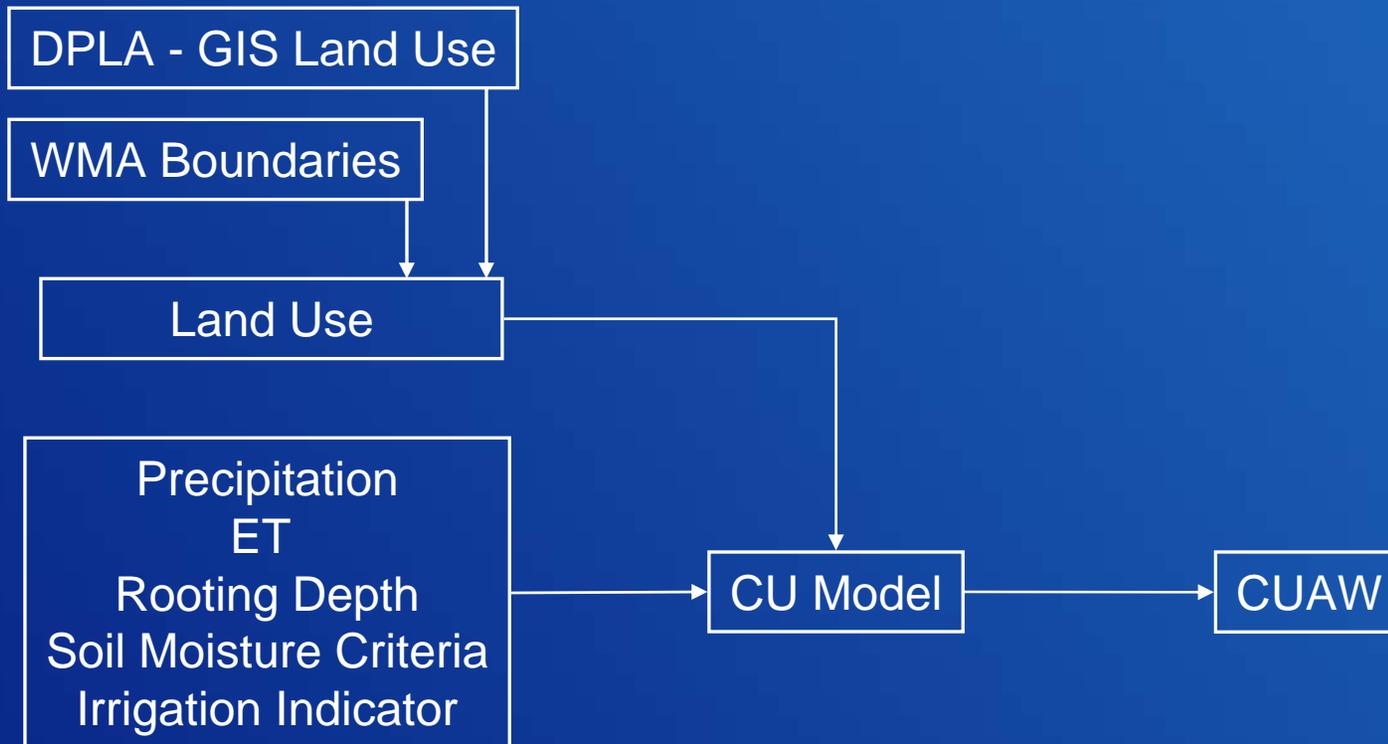
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CUAW Based on Agricultural Land Use

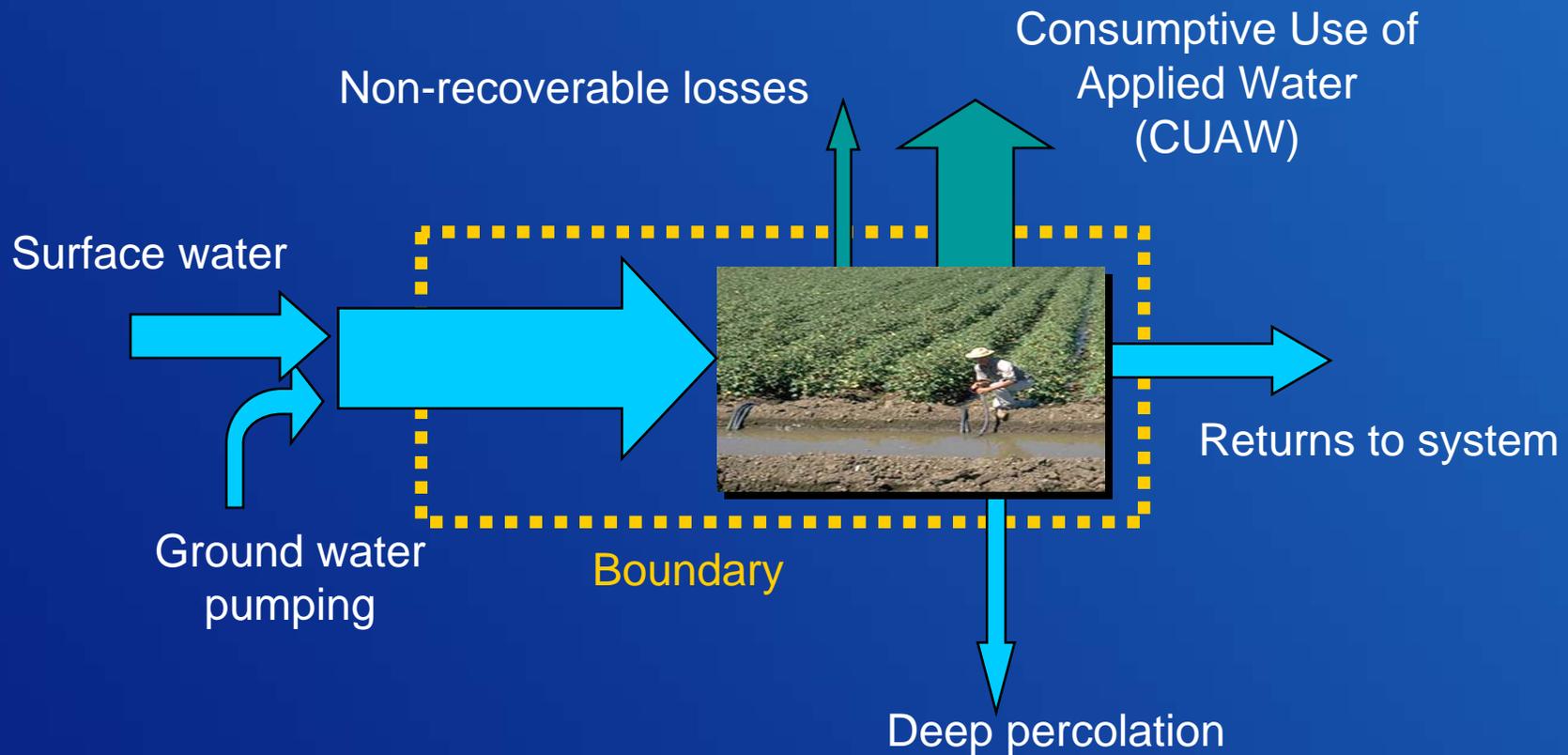
- **Land use data from DPLA**
 - Use GIS to aggregate land use
- **Projected level of development**
 - Based on land use



Consumptive Use of Applied Water (CUAW)



Components of Agricultural Demand



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Hydrology and Operations Development

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Water Budgets

- **Use historical data to perform water budgets for Water Management Areas**
- **Methodology varies depending on data and input from water districts**
- **Results of water budgets are used to develop:**
 - **Stream diversion requirements**
 - **Groundwater use parameters**
 - **District operations**

Collaboration with Districts

Merced ID



Modesto ID



Oakdale ID

Exchange

Chowchilla



Stockton East WD

South San Joaquin ID



Madera ID

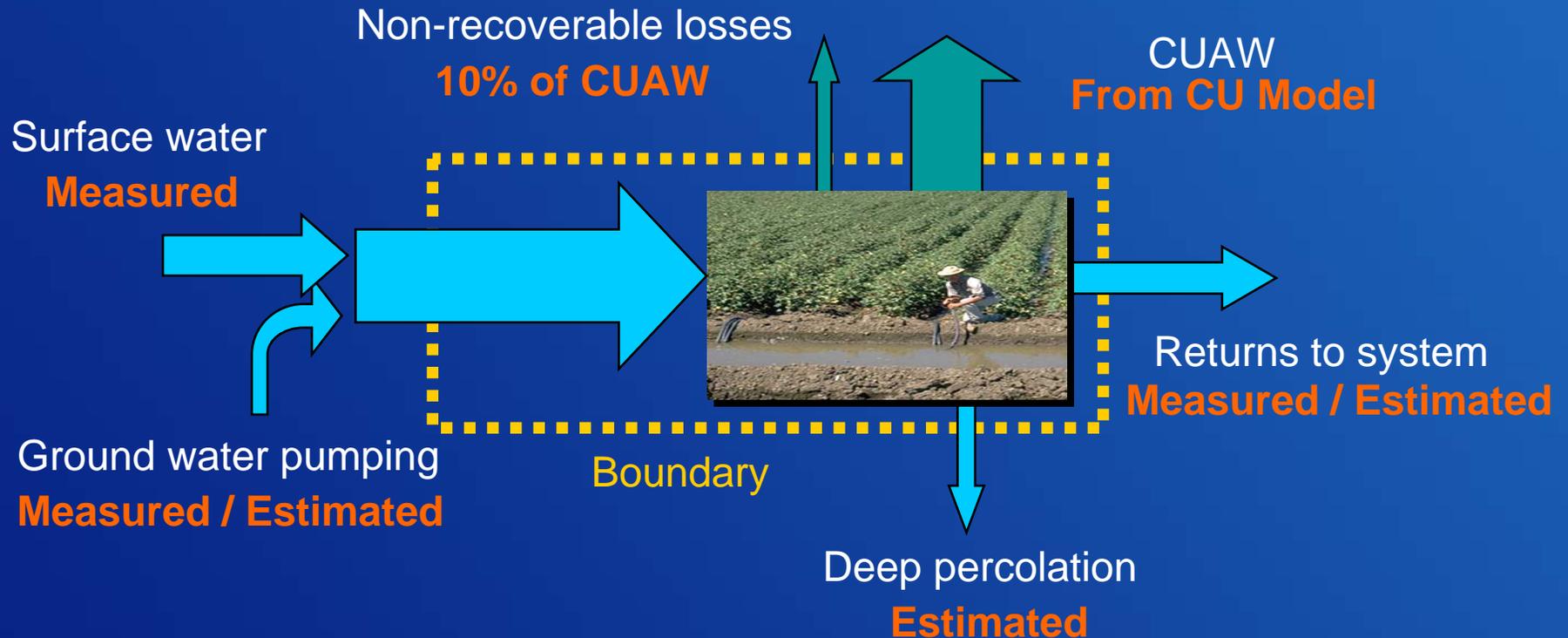


Turlock ID



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Components of Agricultural Demand



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Water District Budgets

Demand

CUAW
Deep percolation
Returns to system
Non-recoverable loss

→ Diversion requirement

Supply

Surface diversion
Ground water pumping

→ Diversion requirement

Demand

CUAW
Deep percolation
Returns to system
Non-recoverable loss

=

Supply

Surface diversion
Ground water pumping

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Water District Budgets

Demand

CUAW
Deep percolation
Returns to system
Non-recoverable loss

→ Diversion requirement

Supply

River diversion
Ground water pumping

→ Diversion requirement

Demand

CUAW
Deep percolation
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=

Supply

River diversion
Ground water pumping

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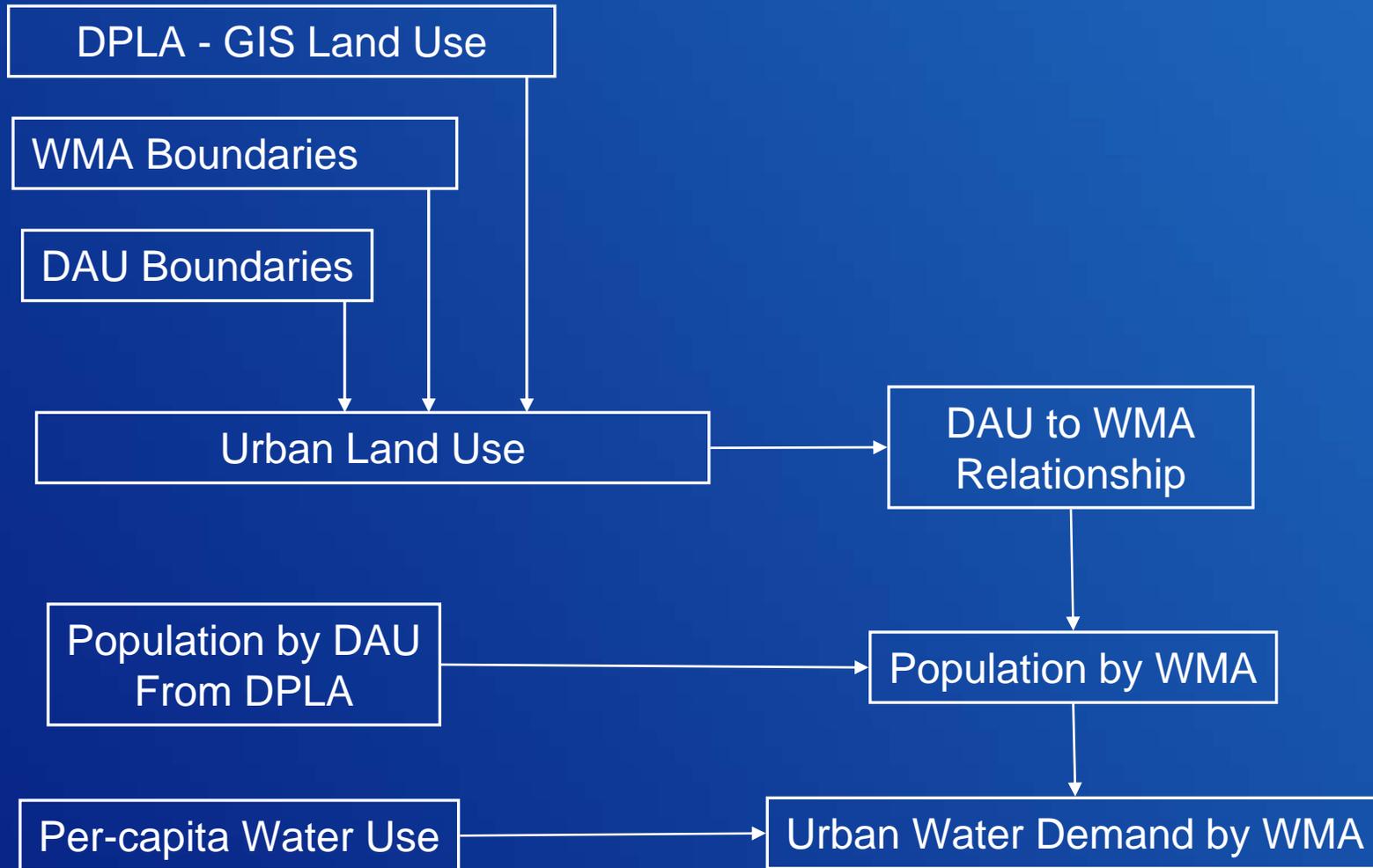
Non-District Budgets

- **Similar to Sacramento Basin approach**
 - Use CUAW from CU model
 - Assume 75% efficiency for surface water use
 - Assume 30% deep percolation of applied water
 - 10% Non-recoverable loss
- **Diversion = CUAW / Efficiency**
- **Compared to historical data**

Urban Water Demands

- Based on population and per-capita water use
- Urban demands primarily met by ground water pumping
- Surface urban diversions by
 - Modesto ID
 - South San Joaquin ID
 - Stockton East WD

Urban Water Demands



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Diversion Requirements (Existing Approach)

- **Fixed annual demands with fixed monthly distribution**
 - Merced ID – 630 TAF
 - Turlock ID – 733 TAF
 - Modesto ID – 417 TAF
 - Madera ID – 386 TAF
 - Chowchilla WD – 293 TAF
 - Oakdale ID and South San Joaquin ID – 600 TAF

Operations Protocol

- **Federal Facilities**
 - Friant Division
 - New Melones
- **Water Districts and Facilities**
 - Madera ID (Hensley Lake)
 - Chowchilla WD (Eastman Lake)
 - Merced ID (Lake McClure)
 - Turlock ID (New Don Pedro Reservoir)
 - Modesto ID (New Don Pedro Reservoir)
 - Stockton East WD (New Hogan Reservoir)



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