



National Experience. Local Focus.

# Assessment of Interconnectd Subbasins for SGMA Water Budgets

Appropriate Use of Available  
Models

GRA Annual Conference  
October 3, 2017

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# Project Goal:

## Provide recommendations on approaches to account for groundwater flow between interconnected subbasins

- Funded by Water Foundation
- Administered by Butte County
- Project Team
  - Butte County
  - Technical Collaborators
  - RMC, a Woodard & Curran Company

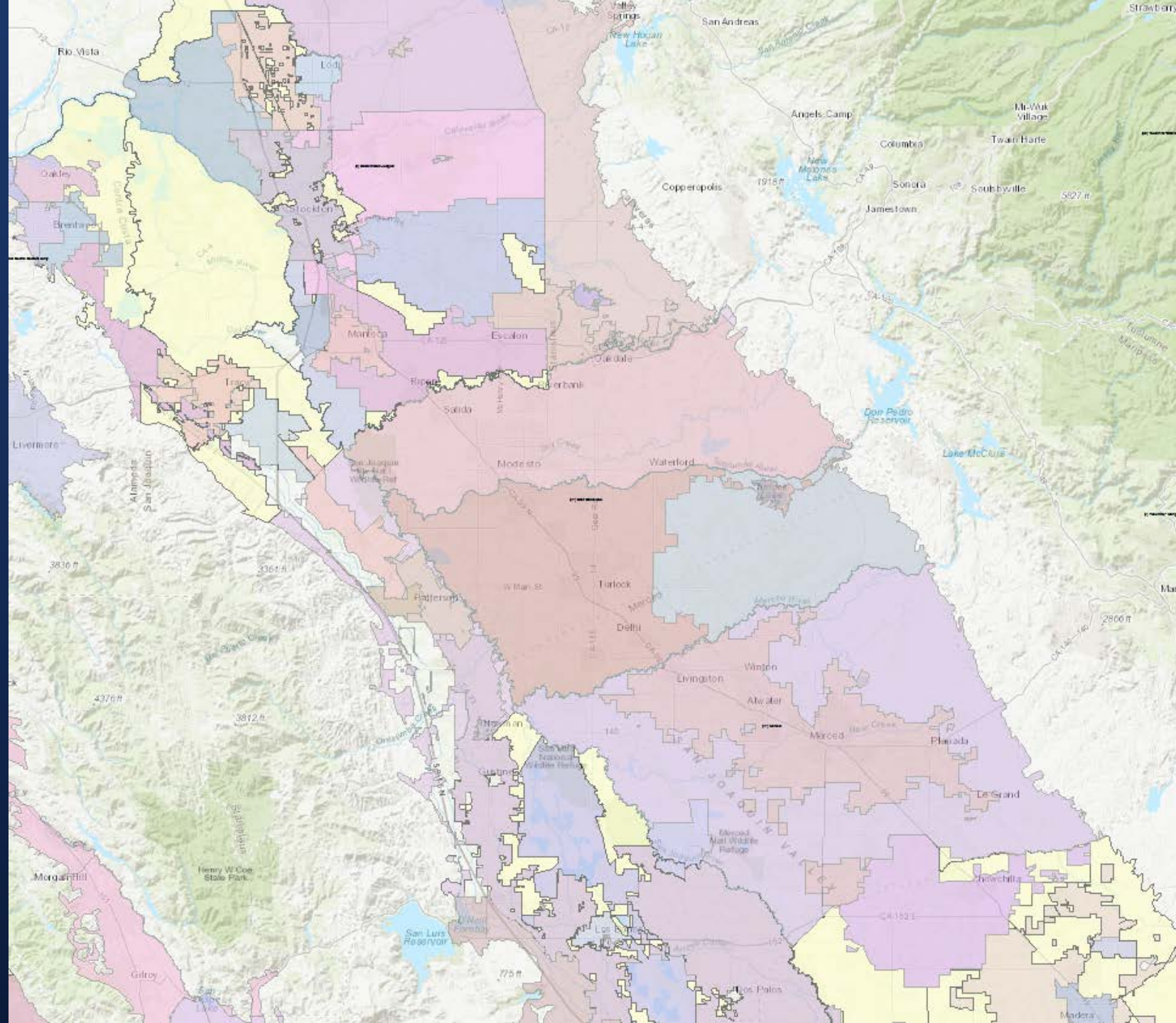
### Technical Collaborators

Name	Organization	NSVIRWM TAC Member?
Charlie Brush	DWR Bay-Delta Office, Modeling Support Branch	
Christina Buck	Butte County Department of Water and Resource Conservation	
Grant Davids	Davids Engineering, Inc.	
Bill Ehorn	DWR Northern Region Office	✓
Claudia Faunt	United States Geological Survey	
Allan Fulton	University of California, Cooperative Extension	✓
Thomas Harter	University of California, Davis	
Peter Lawson	CH2M	
Steffen Mehl	California State University, Chico	
Vickie Newlin	Butte County Department of Water and Resource Conservation	✓
Ben Pennock	Glenn Colusa Irrigation District (Retired)	✓
Steve Phillips	United States Geological Survey	
Mary Randall	DWR Northern Region Office	
Oscar Serrano	Colusa Indian Community Council	✓
Ali Taghavi	RMC, a Woodard & Curran Company	



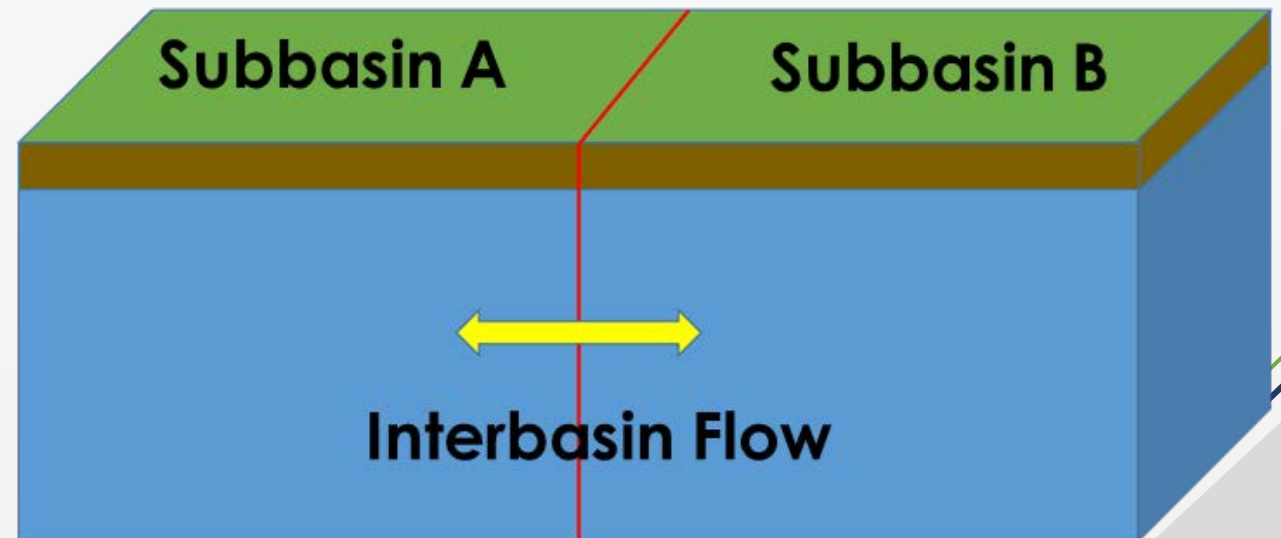
# GSAs and Interconnected Subbasins

Compliance with  
SGMA will require  
accounting for  
groundwater  
interactions with  
adjoining subbasins



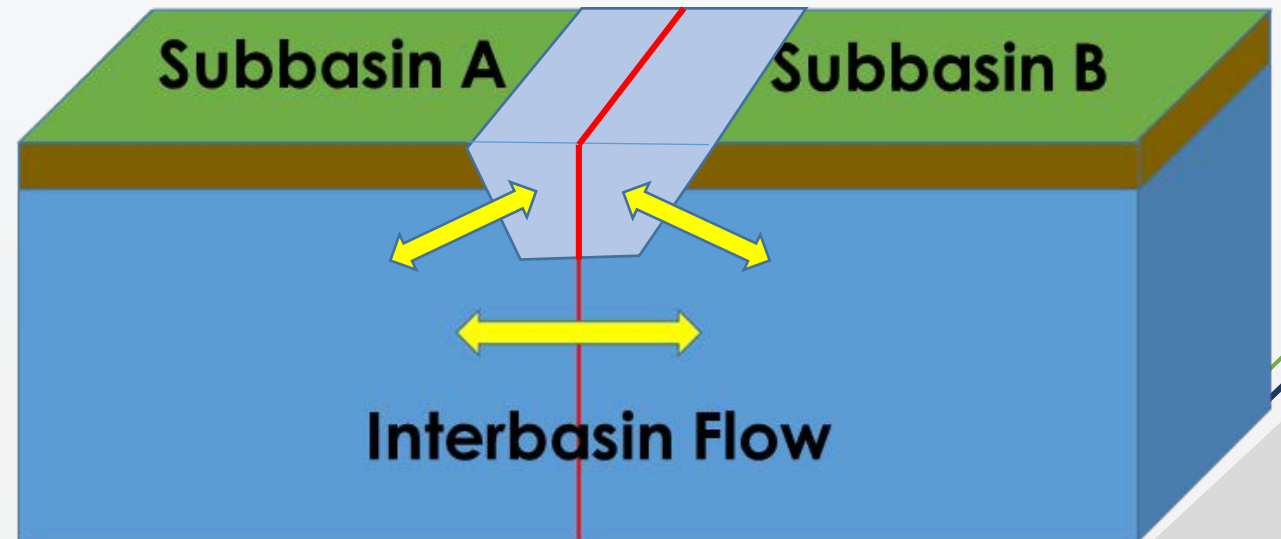
# Interbasin Groundwater Flow Characteristics

- Cannot be directly measured
- Vary significantly in space and time
- Depends on dynamics of recharge and discharge from subbasins
- Groundwater models are necessary for quantifying flows



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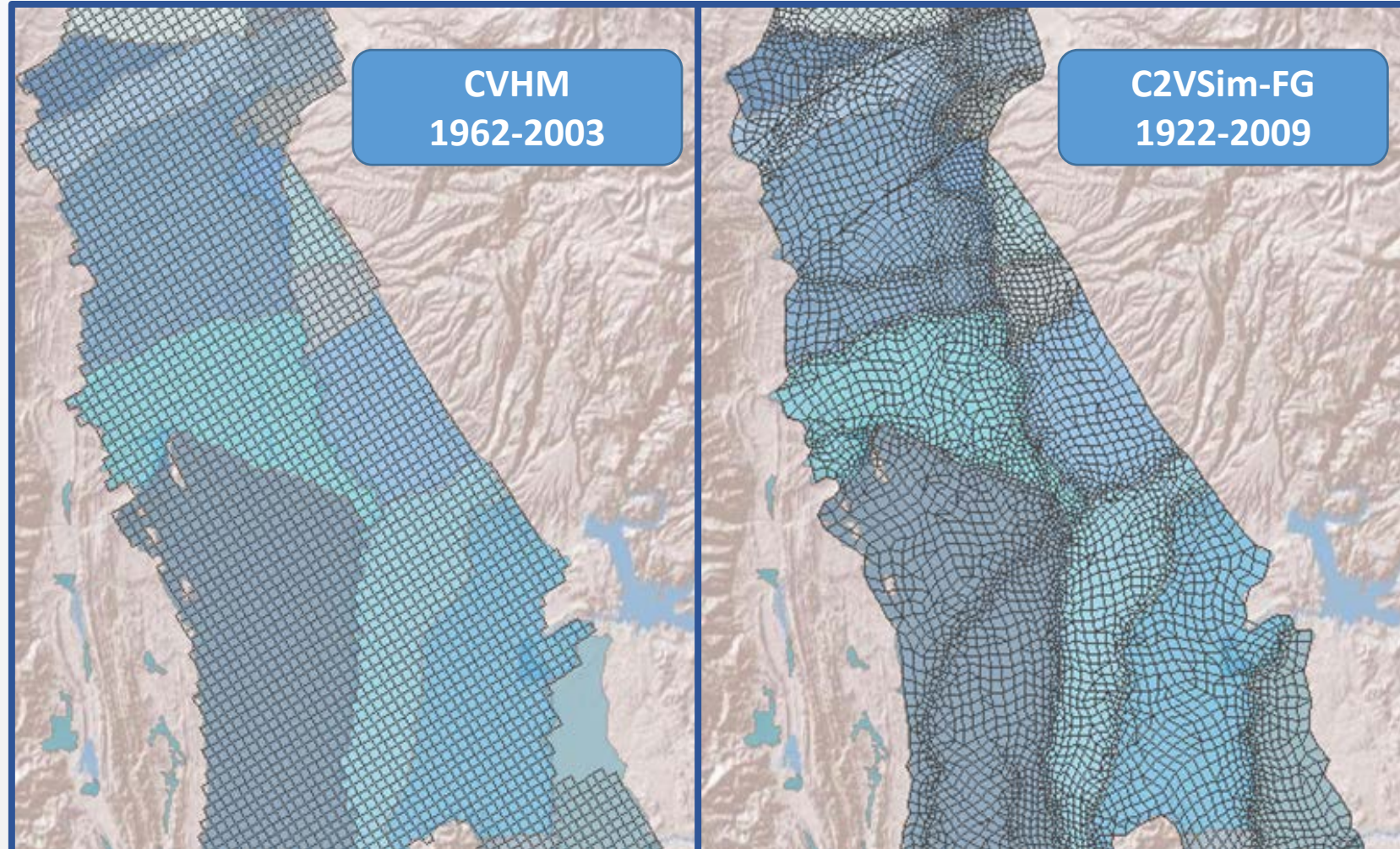




# Interconnected Subbasins in Central Valley

## Technical Aspects of Use of Available Models

- Two Primary Models:
  - C2VSim (DWR)
  - CVHM (USGS)
- Model Comparison:
  - Input Data
    - Land Use
    - Crop Acreage
  - Water Budgets
    - Ag water demand
    - Water supply
    - Recharge
    - Stream seepage
  - Surface Water Inflows
  - Calibration Status



# Detailed Analysis Unit (DAU) Ag Land and Water Use Estimates

- DWR estimates applied water (AW) for 20 crop categories each year.
- AW estimates reflect:
  - Irrigation efficiencies
  - Cultural practices
    - Ponding of water in rice fields
    - Leaching of accumulated salts
    - Etc.



The screenshot shows the California Department of Water Resources (DWR) website. The header includes the CA.GOV logo, navigation links (HOME, NEWSROOM & EVENTS, ISSUES, ABOUT US), and a search bar. The main content area is titled 'Land and Water Use' and features a large image of a drip irrigation system. Below this, the section 'Agricultural Land and Water Use Estimates' is highlighted. The text describes the department's estimates of irrigated crop acreages, crop evapotranspiration (ETc), evapotranspiration of applied water (ETAW), effective precipitation (EP), and applied water (AW) for 20 crop categories each year. It also mentions that data are estimated from reference evapotranspiration (ETo) or evaporation pan data (Ep), crop development over time (crop coefficients), soil characteristics, rooting depths, and the quantity and timing of precipitation. Applied water (AW) estimates reflect irrigation efficiencies as well as the water required for cultural practices such as the ponding of water in rice fields or the leaching of accumulated salts from the soil. A note states that data compiled by study area and year are available for download in spreadsheet (xls) format. A 'To Download Data' section provides instructions: 'Expand the menu under Statewide, County, Hydrologic Region (HR), or Detailed Analysis Unit (DAU), click on a year and select "Save As..."'. On the right side, there is a sidebar with links to 'Water Use Efficiency', 'Land and Water Use Home', 'Data Collections', 'Land Use Surveys', 'Public Water Systems Statistics Surveys', 'Statewide Irrigation Methods Surveys', 'Agricultural Land and Water Use Estimates', 'Agricultural Water Use Models', and 'California Seasonal Application Efficiency Program'.

CALIFORNIA DEPARTMENT OF  
**WATER RESOURCES**

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DWR California

Land and Water Use

## Agricultural Land and Water Use Estimates

The Department of Water Resources estimates irrigated crop acreages, crop evapotranspiration (ET<sub>c</sub>), evapotranspiration of applied water (ETAW), effective precipitation (EP), and applied water (AW) for 20 crop categories each year. Data are estimated from reference evapotranspiration (ET<sub>o</sub>) or evaporation pan data (Ep), crop development over time (crop coefficients), soil characteristics, rooting depths, and the quantity and timing of precipitation. Applied water (AW) estimates reflect irrigation efficiencies as well as the water required for cultural practices such as the ponding of water in rice fields or the leaching of accumulated salts from the soil.

Data compiled by **study area** and year are available for download in spreadsheet (xls) format.

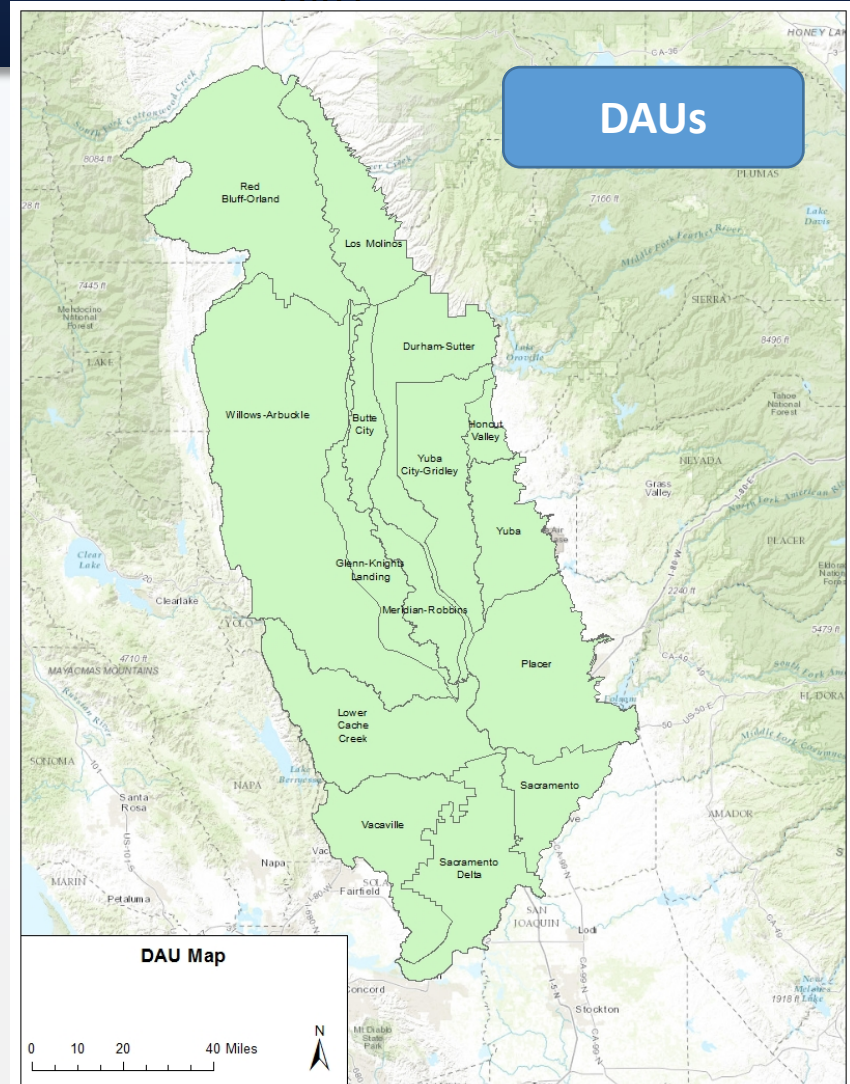
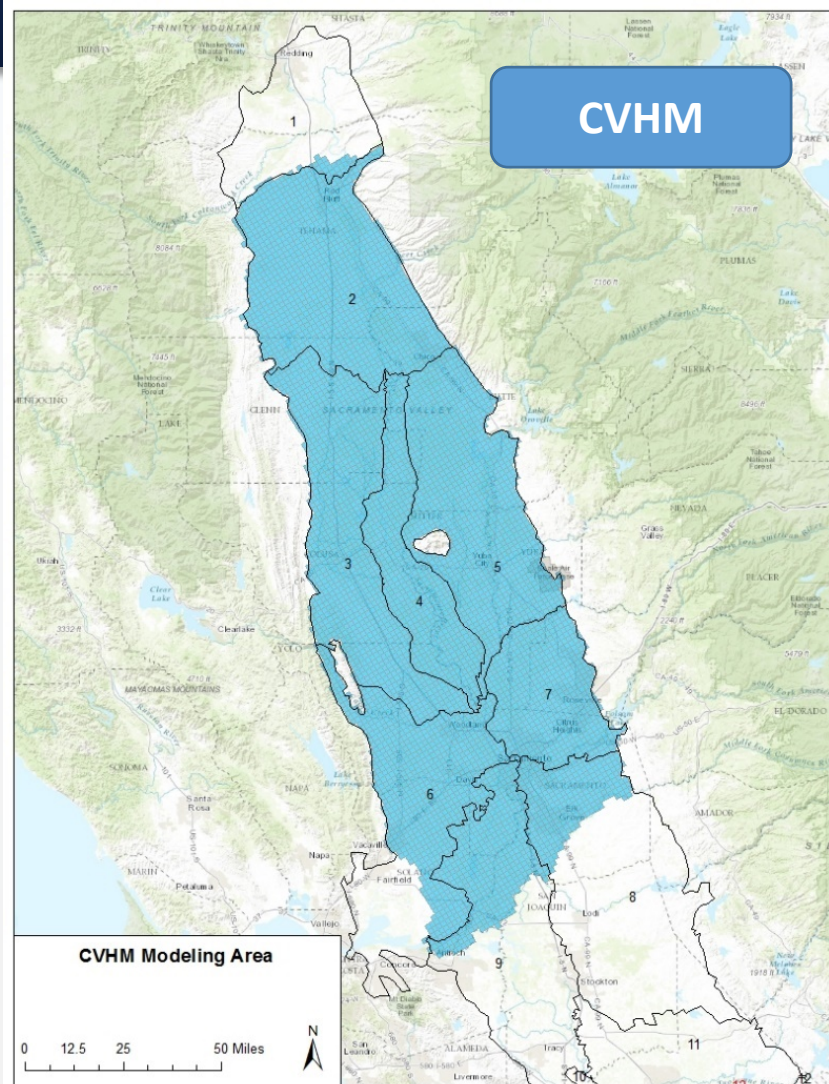
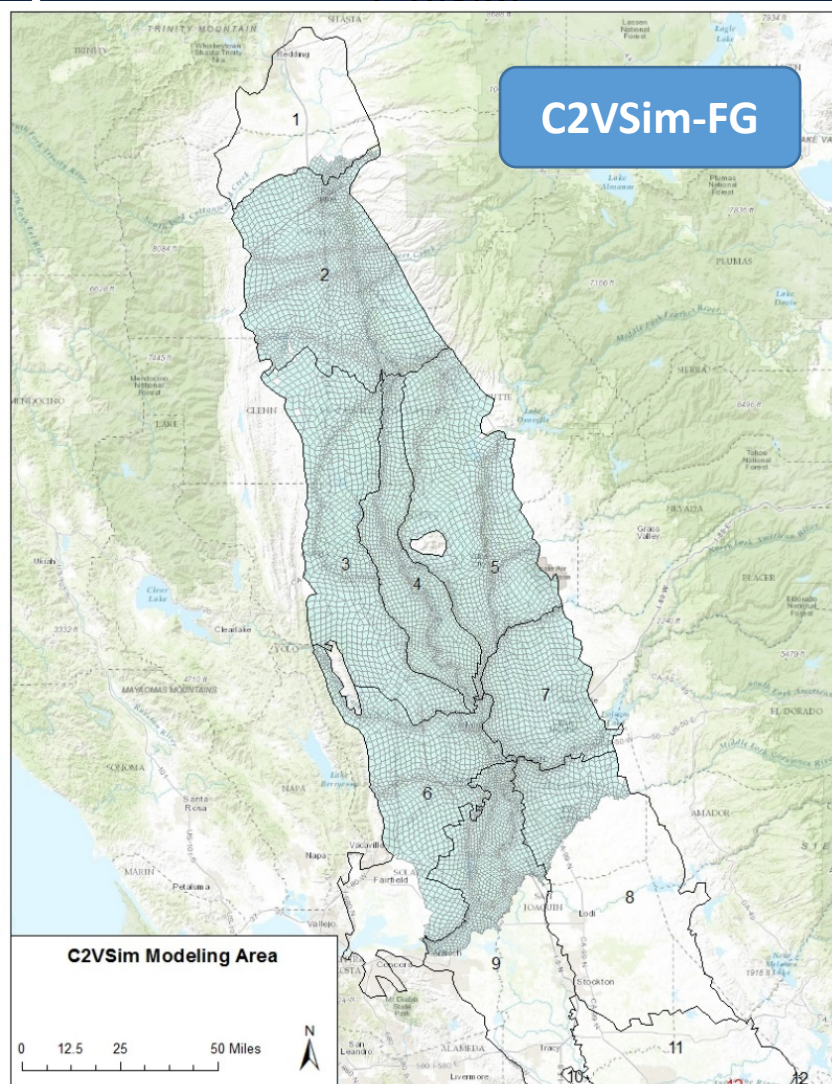
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**Water Use Efficiency**

- » Land and Water Use Home
- Data Collections**
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  - » California Seasonal Application Efficiency Program



# Study Area





# CVHM and C2VSim Land Use Data Sources

CVHM

Not Simulated

CSU & DWR

Anderson Level II

Landsat Thematic Mapper,  
1992

Gap  
Analysis

DWR

C2VSim

CVGSM Data

Ag Commissioners  
Reports

1922

1930

1938

1946

1954

1962

1970

1978

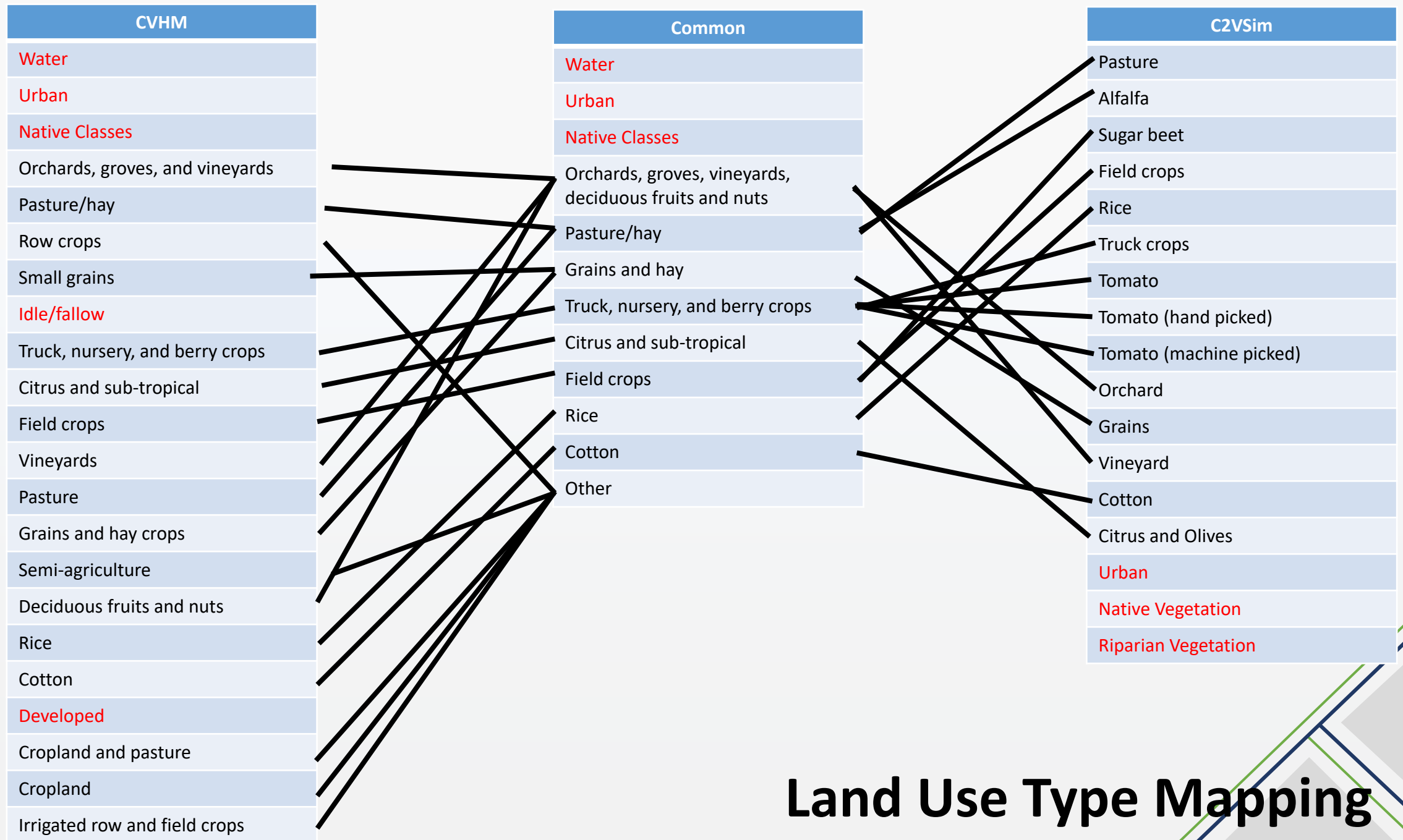
1986

1994

2002

2009

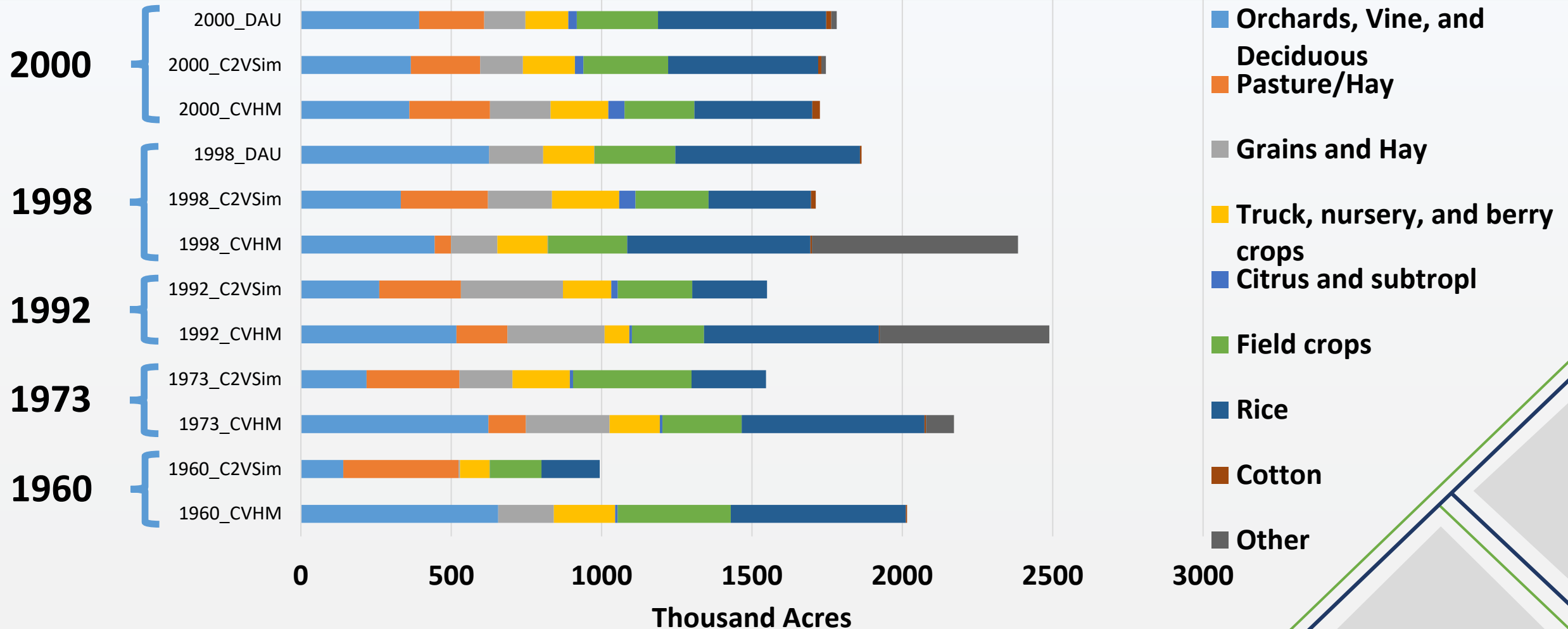
Generally increasing accuracy



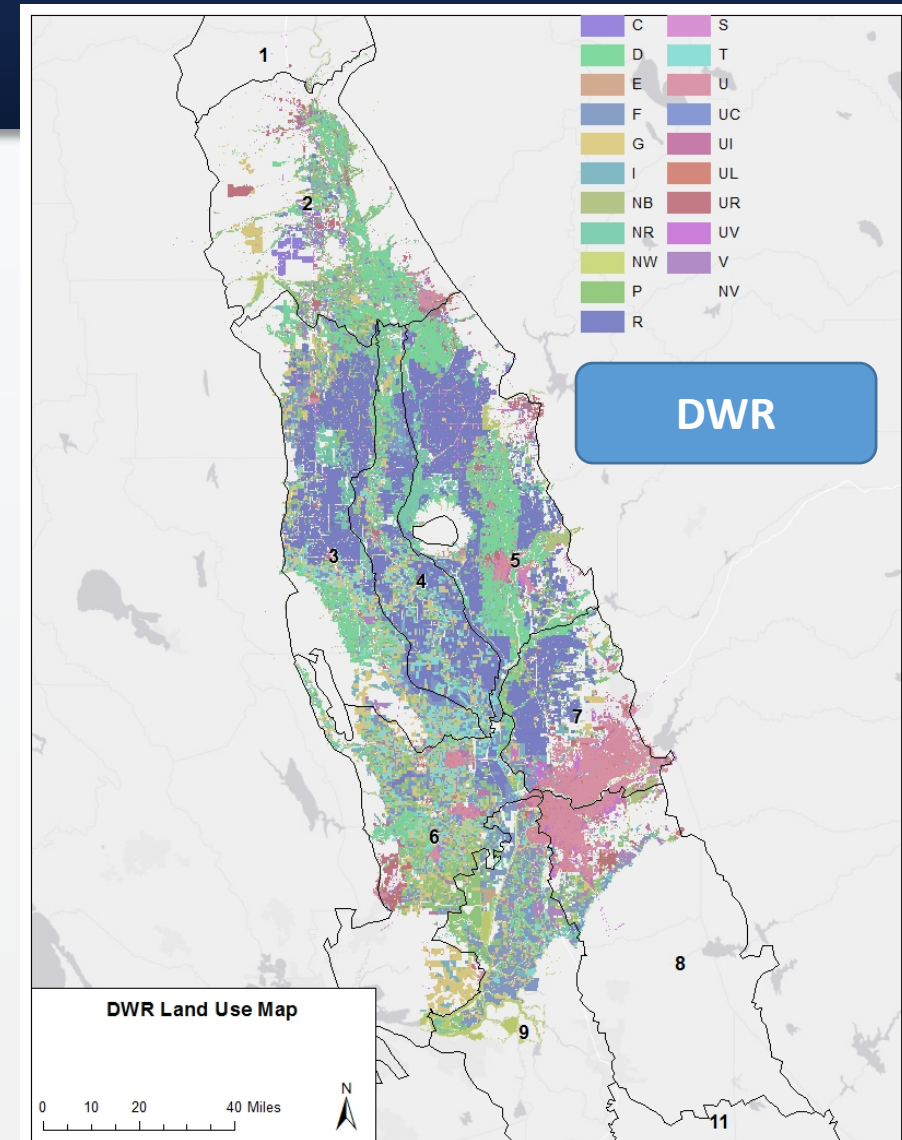
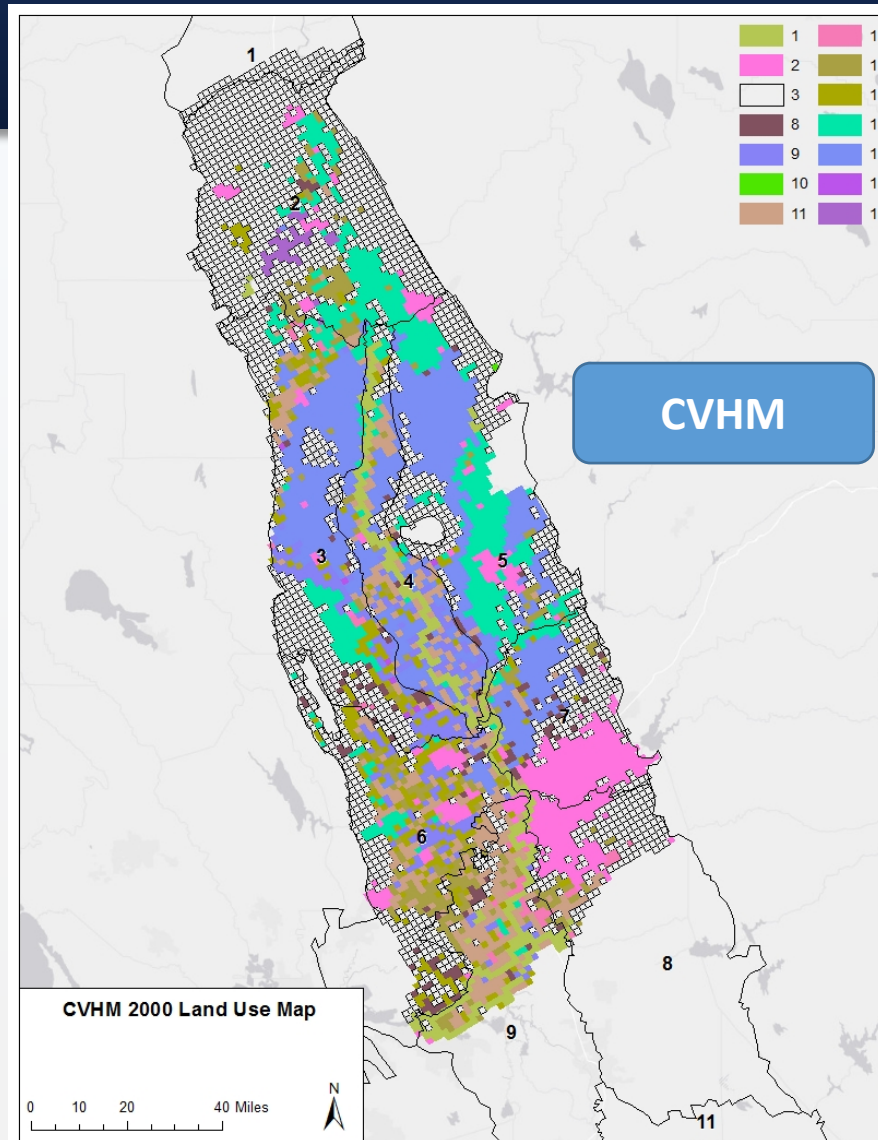


# Land Use/Crop Acreages for Sacramento Valley Region

Sacramento Valley Region Crop Acreage Comparison

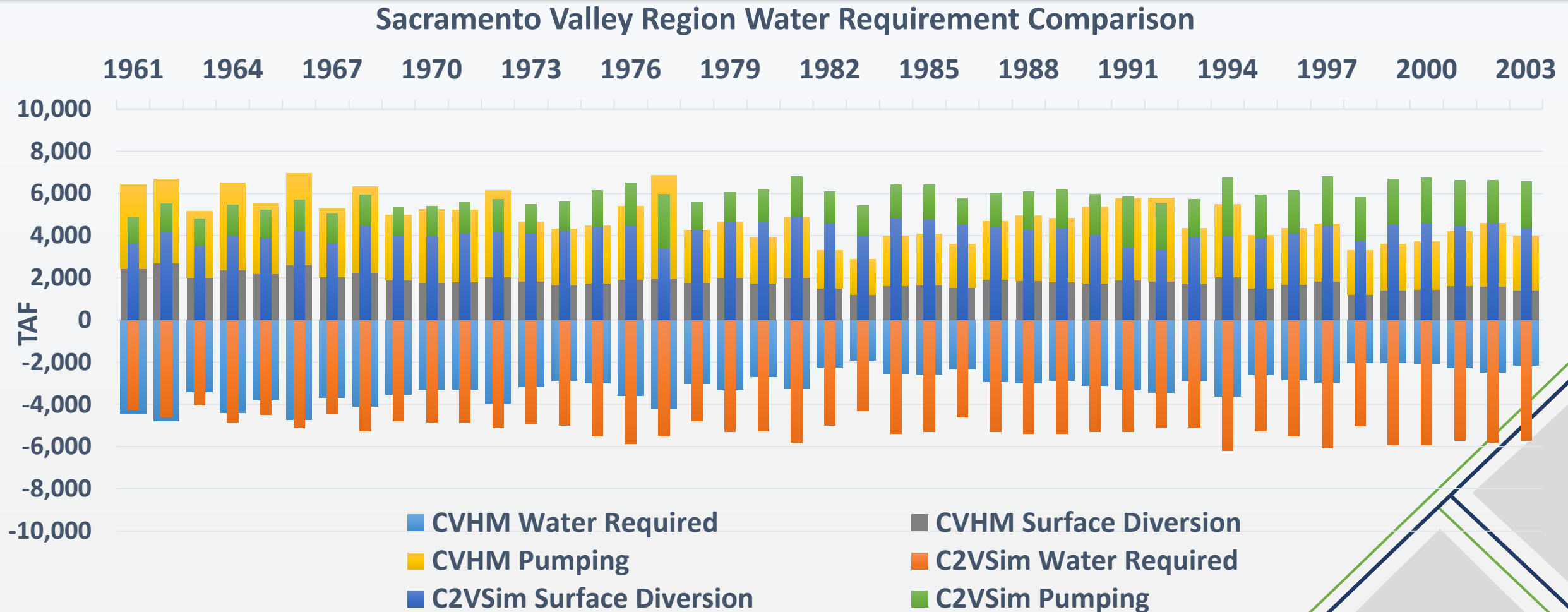


# Land Use Map - 2000

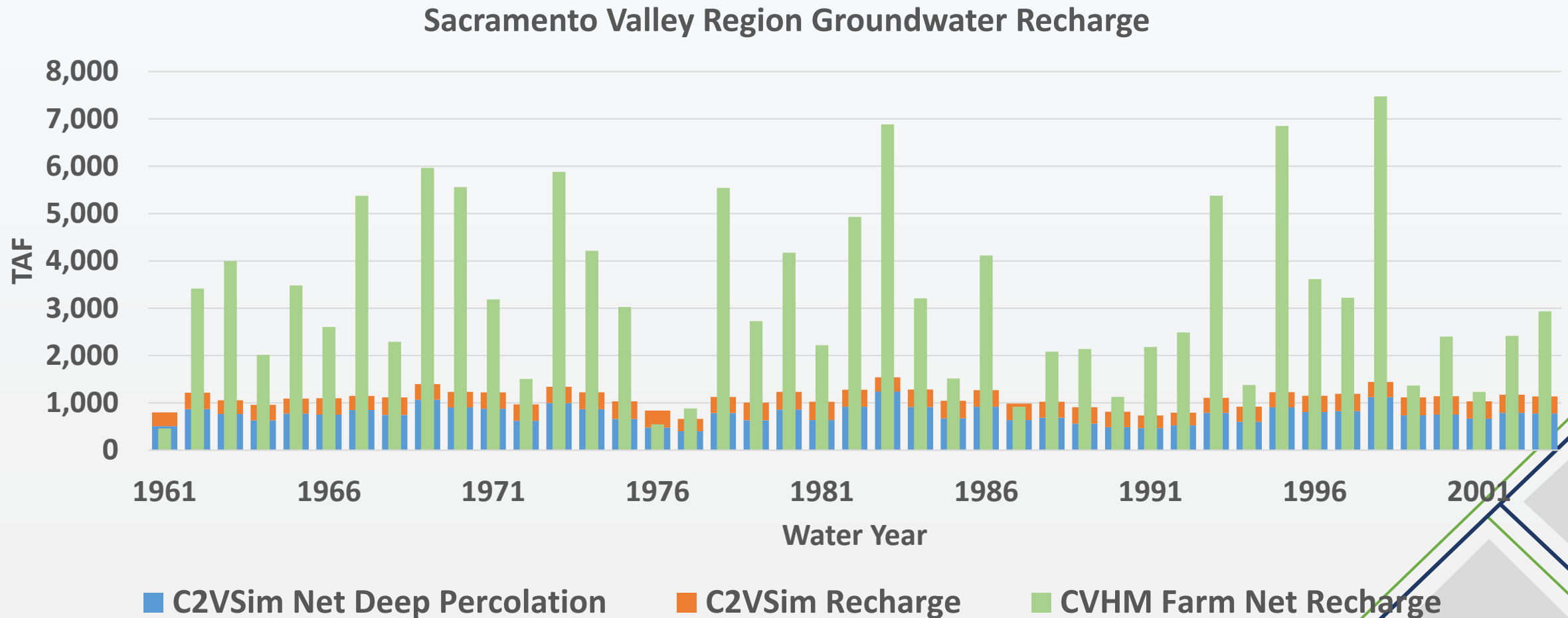




# Sacramento Valley Region Agricultural Water Demand

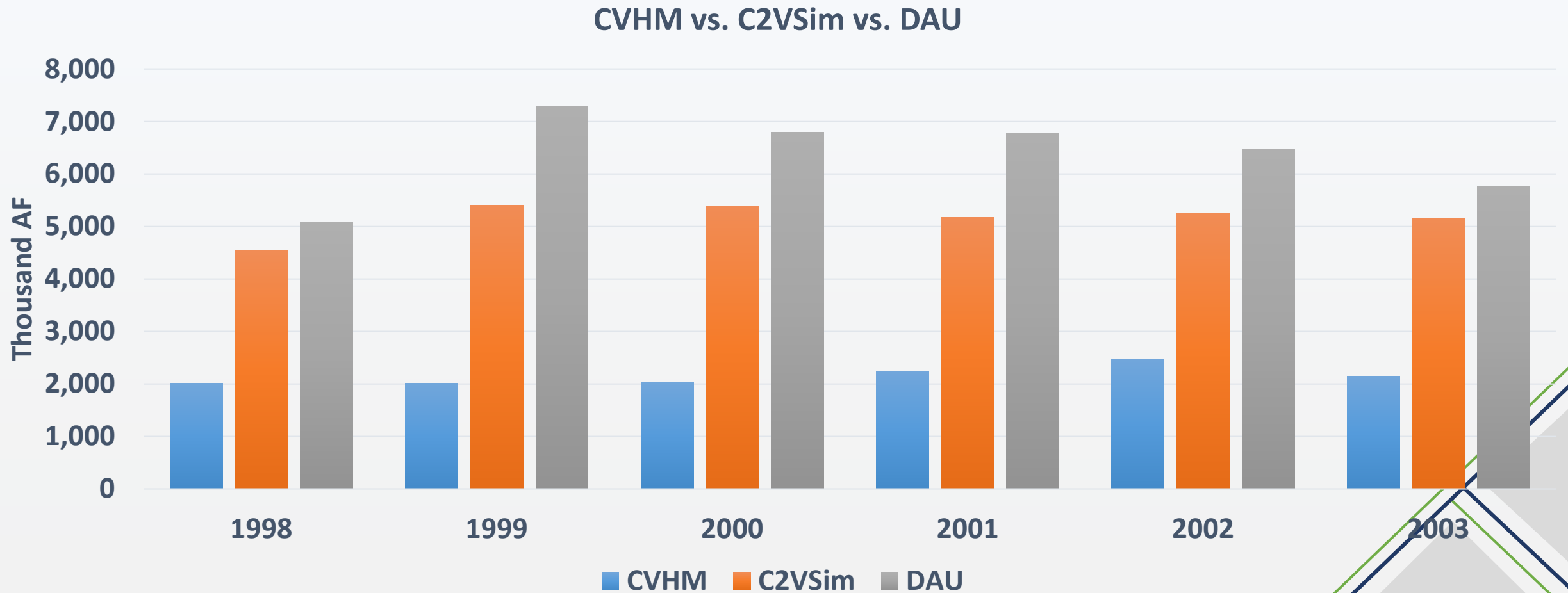


# Sacramento Valley Region Groundwater Recharge





# Agricultural Water Demand: Sacramento Valley Region



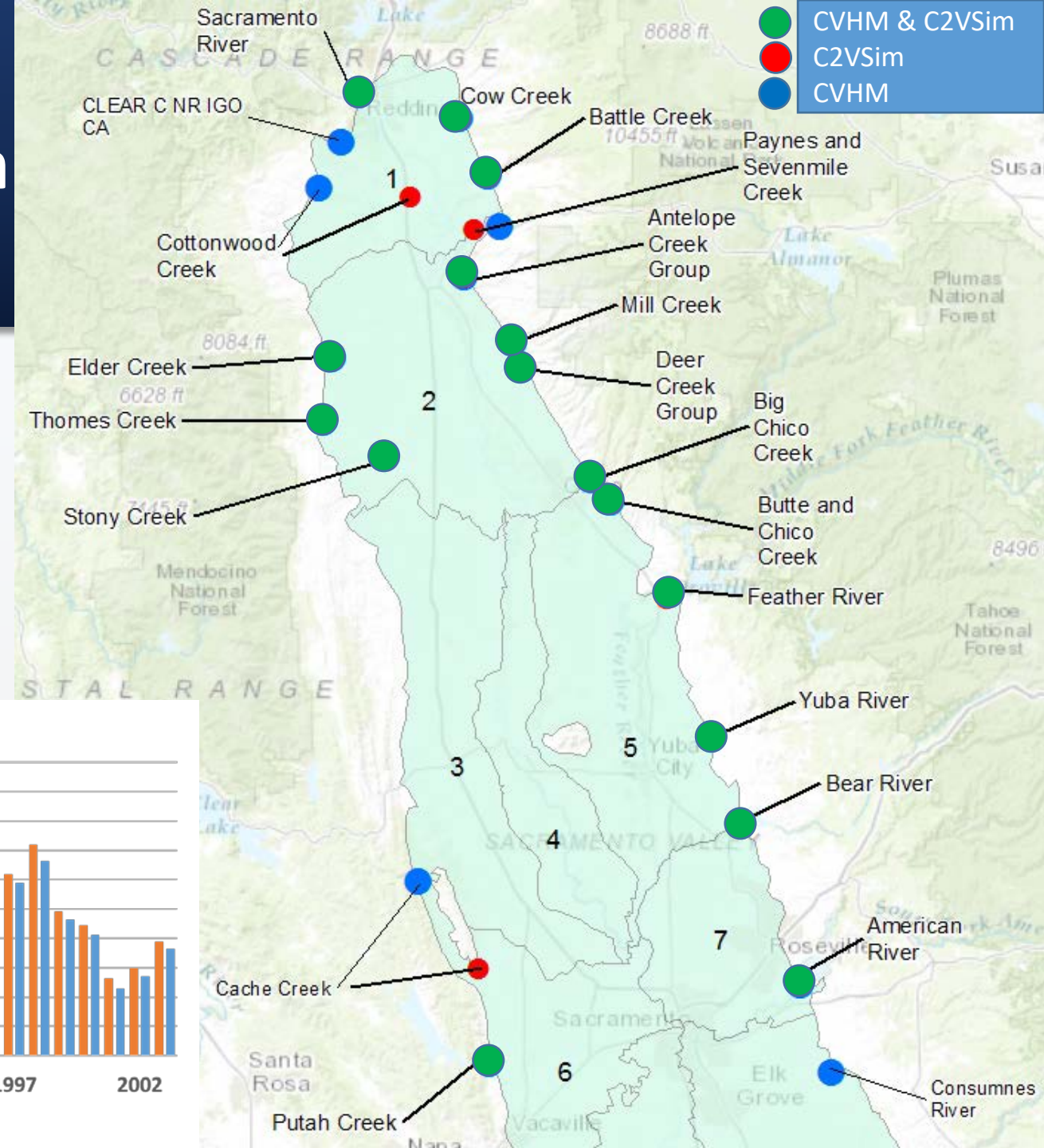
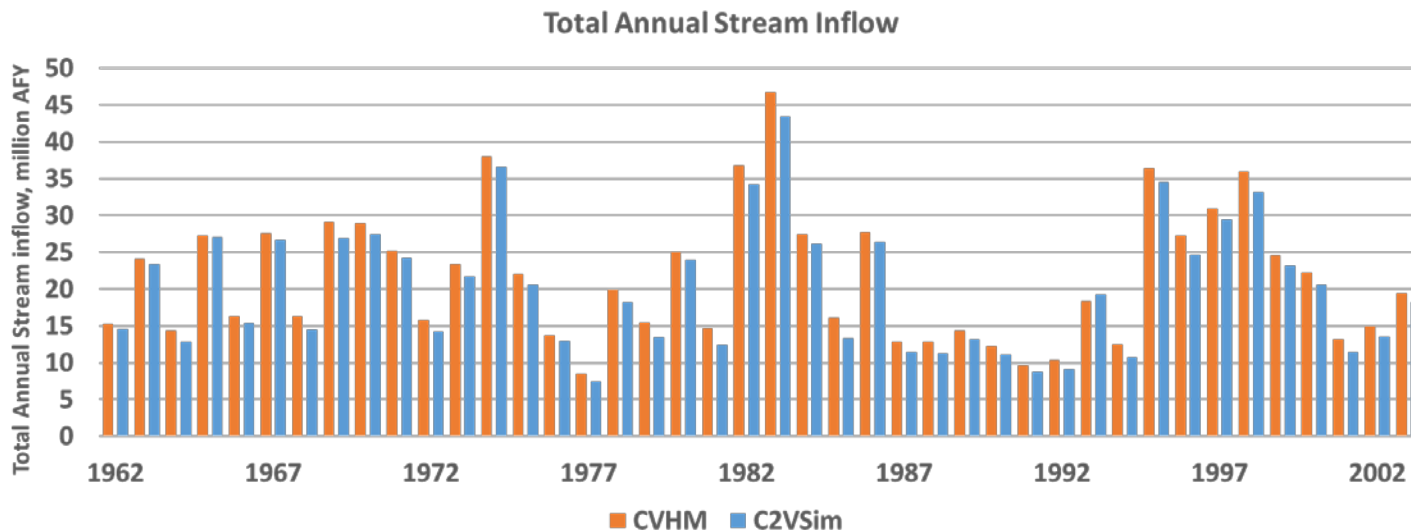
# Streams Inflow Comparison

## ■ C2VSim

- CVinflow.dat file (river names, and monthly inflow data 1921 to 2009)

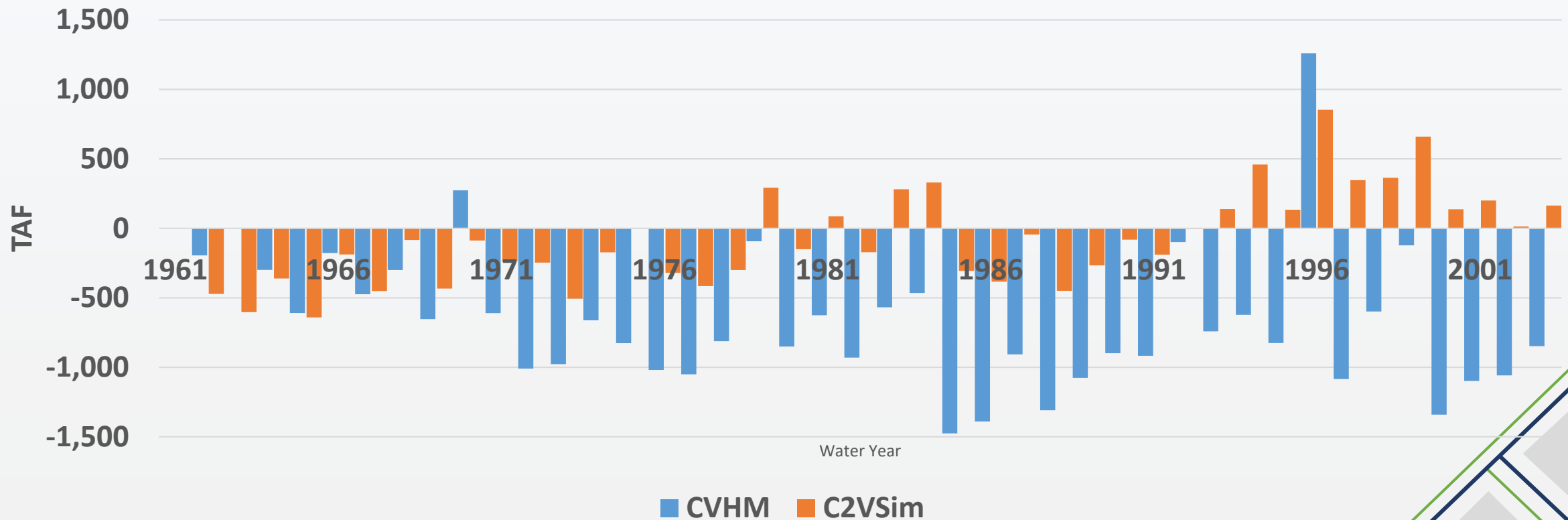
## ■ CVHM

- SFR.txt file (river names, inflow location, and monthly inflow 1961 to 2003)



# Sacramento Valley Region Stream Recharge

Sacramento Valley Region Stream Recharge





● CVHM Wells  
● Common Wells

## Calibration Wells

● C2VSim Wells  
● Common Wells

CVHM Calibration Wells

0 10 20 40 Miles



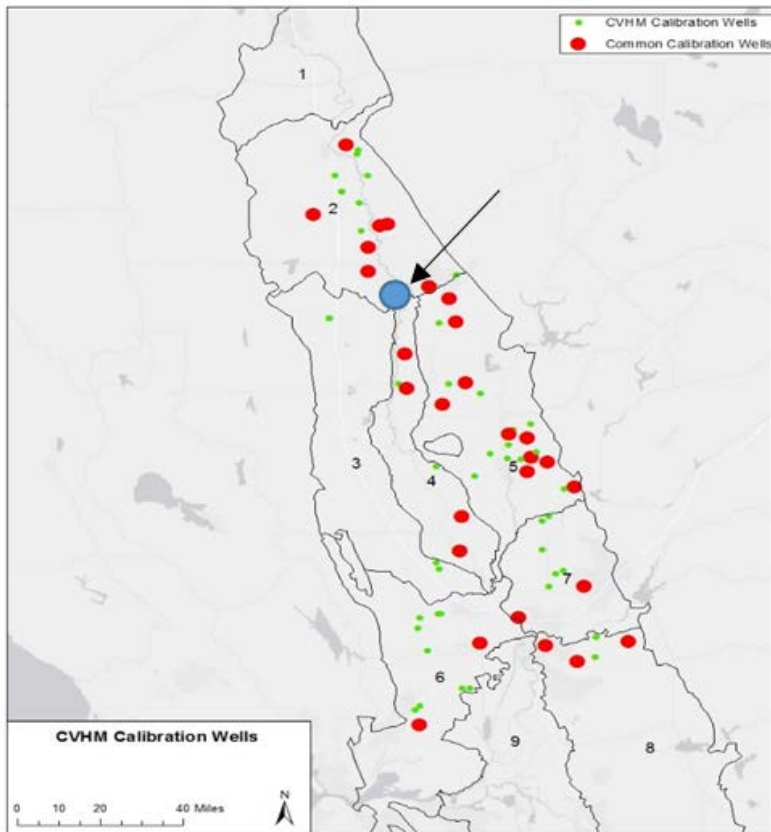
C2VSim Calibration Wells

0 10 20 40 Miles

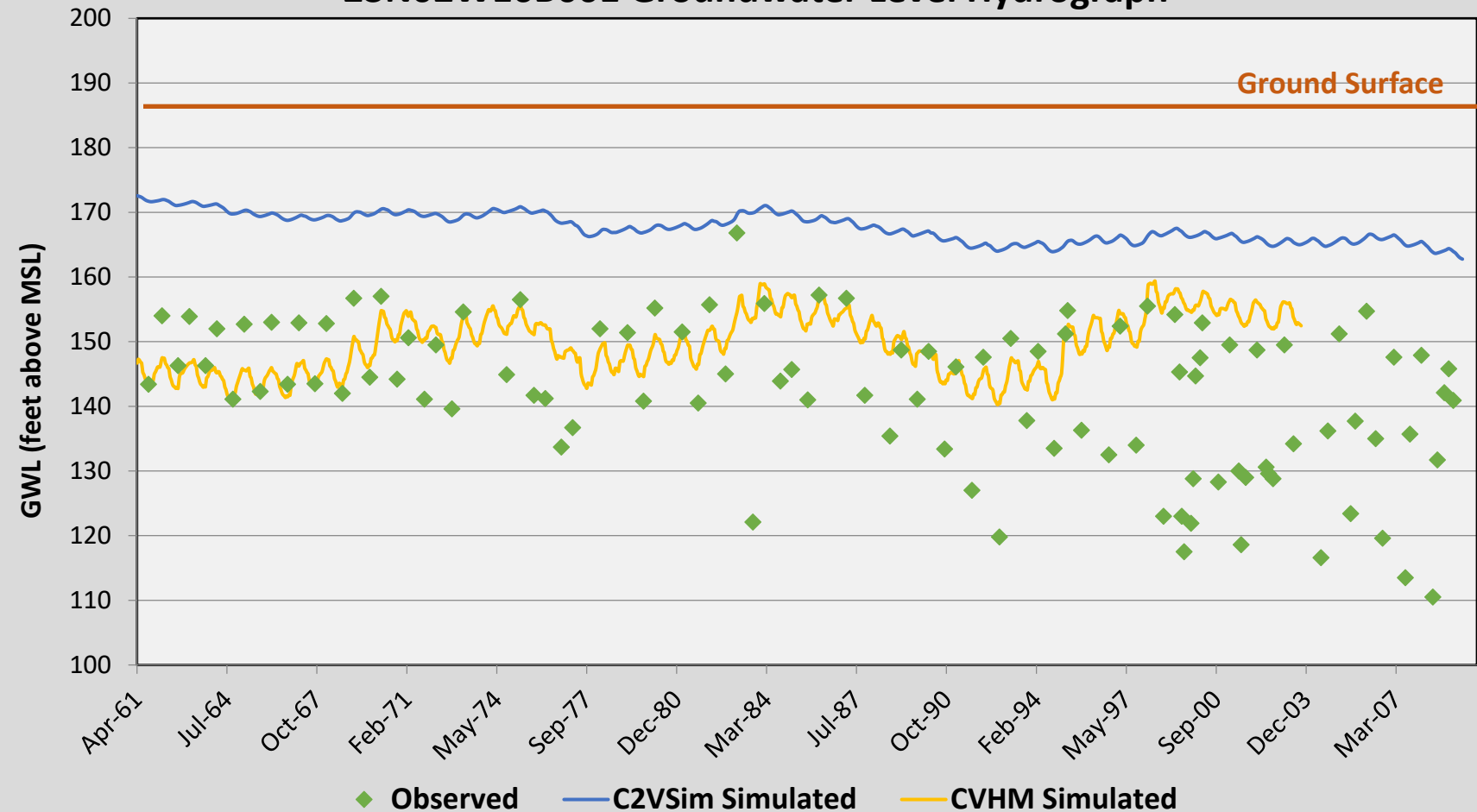


# Model Calibration

- Active Irrigation
- Shallow (100 – 120 ft)

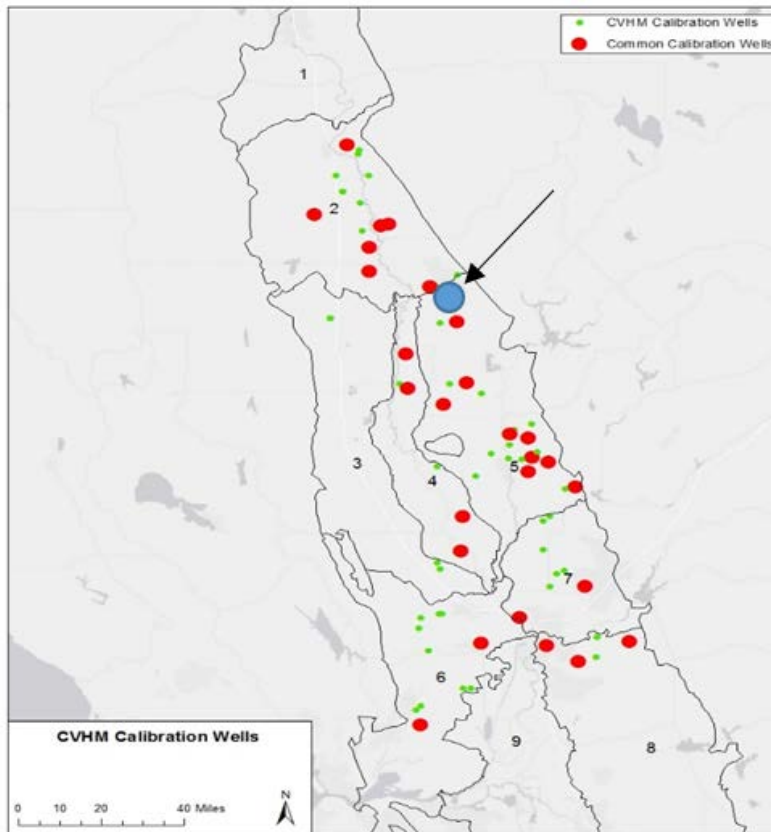


## 23N02W16B001 Groundwater Level Hydrograph

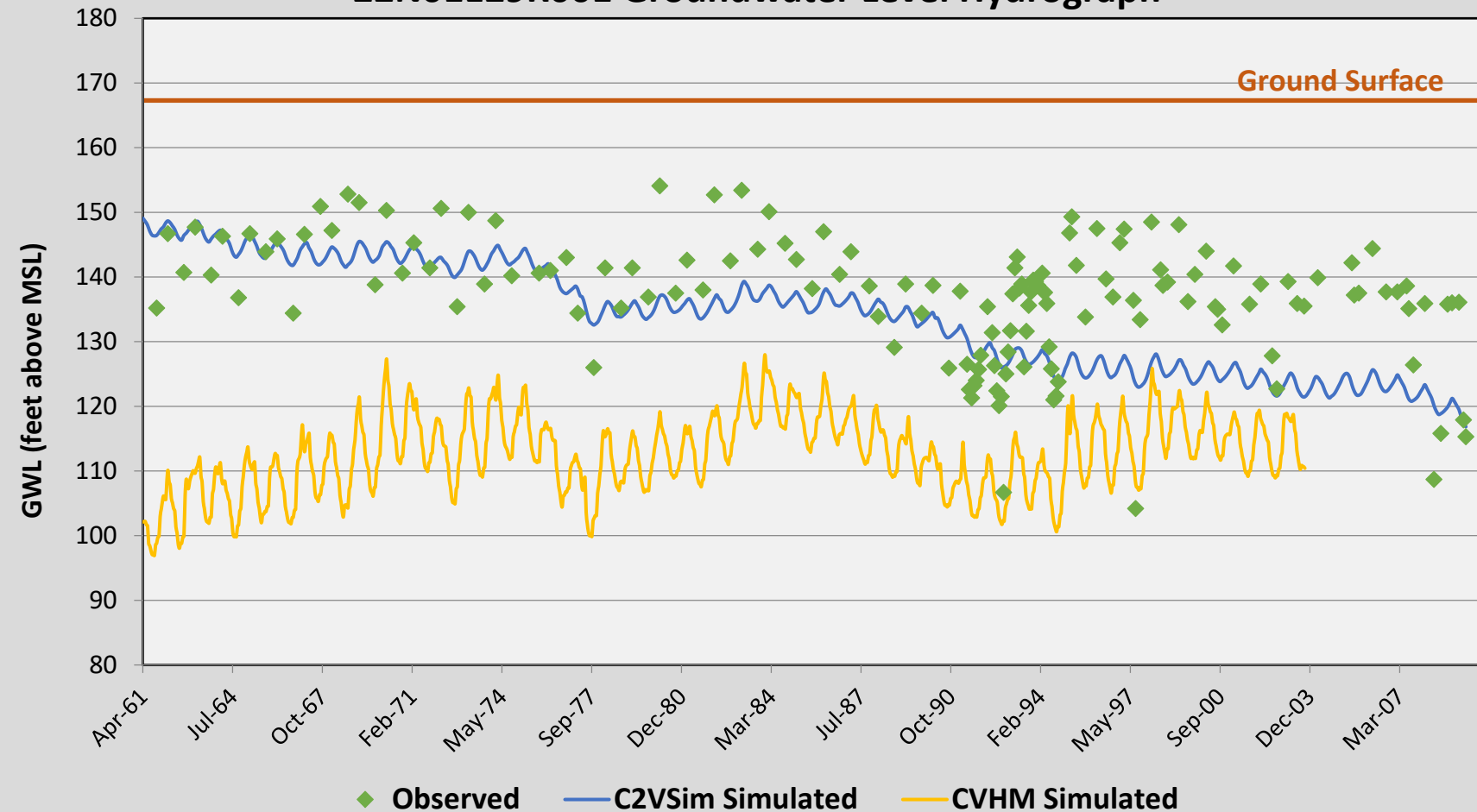


# Model Calibration

- Observation
- Intermediate (460 – 559 ft)



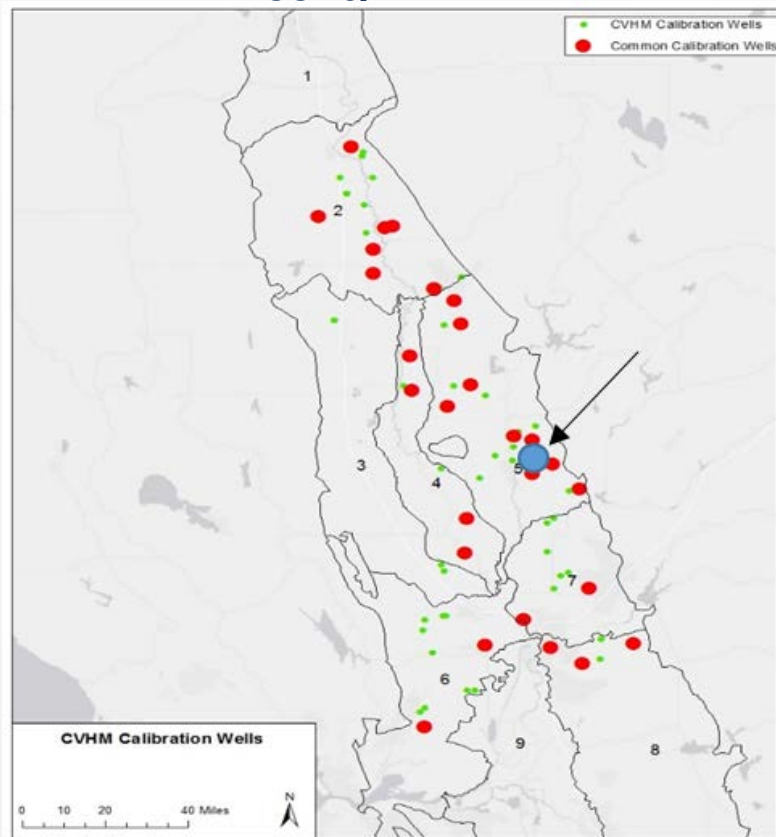
22N01E29R001 Groundwater Level Hydrograph



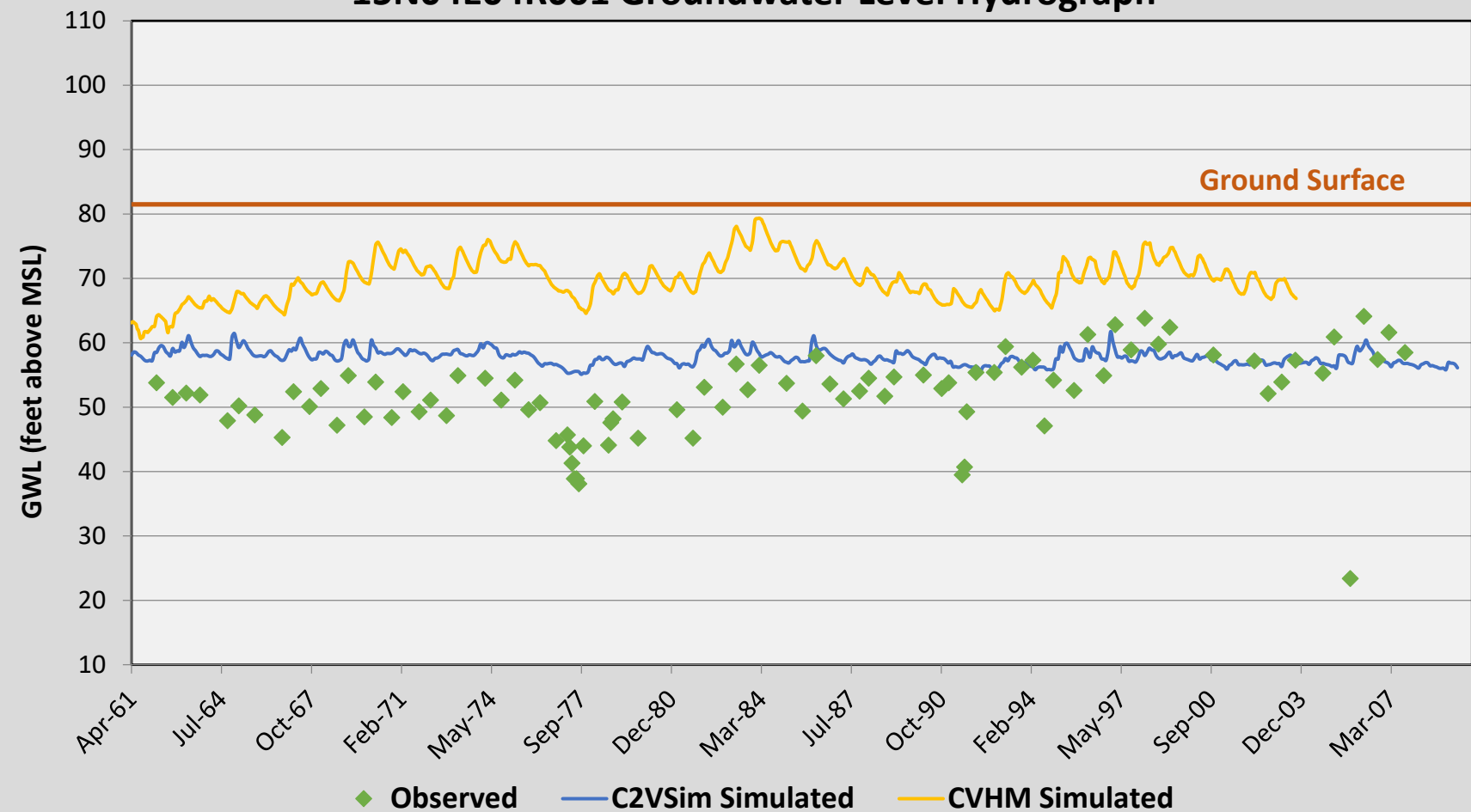


# Model Calibration

- Active Irrigation
- Intermediate (Total Depth 400 ft)



15N04E04R001 Groundwater Level Hydrograph



# CVHM and C2VSim Updates - Summary

Model Component	C2VSim	CVHM
Availability	Early 2018	Early 2018
Simulation Period	1922-2009 → 1922-2015	1962-2003 → 1962-2013 (forward run 1921-2013)
Land Use Refinement	<ul style="list-style-type: none"> <li>• DWR Land Use Survey</li> <li>• Cropland Data/Cropscape (Satellite Data)</li> <li>• 2014 Statewide Land Use Data</li> <li>• Ag Commissioner Reports</li> </ul>	<ul style="list-style-type: none"> <li>• DWR Land Use Survey</li> <li>• Other Historical Land Use Maps</li> <li>• Ag Commissioner Reports</li> </ul>
Managed Wetlands/Refuge	✓	✓
Surface Water Diversions at Water District Level	✓	✓
Model Code	Latest Version of IWFM	Latest Version of MODFLOW-OWHM
Aquifer Parameters Basis	DWR's Texture Model	USGS's Texture Model
Other improvements	4 Layers, Stream Data from Flood Studies	15 Layers, Stream Data based on C2VSim Data, Municipal Well Locations, Groundwater Banking Data, Enhanced Subsidence Simulation

# Recommendations for GSAs in NSV

- Evaluate most current version of available models at time of GSP development: C2VSim, CVHM, SVSim
- Compare to local surface layer models or water budget data to select model. Do not mix output from gw model with other local water budget sources.
- Over time, work with agencies to incorporate local knowledge/data into the selected regional gw model
- When evaluating a groundwater model, consider representation of:
  - Crop acreage
  - Irrigation practices
  - Surface water supplies and diversions
  - Rivers and streams (does it include ones the GSA considers important?)
  - Subsurface flows from outside the subbasin boundaries (eastern or western foothills)





# Recommendations for DWR and USGS

- **Important opportunity to provide specific recommendations for technical assistance to GSAs**
  - Develop tools and guidance to **ease comparison of models** (inputs like crop data, and outputs of water budget components)
  - Process to **incorporate local data** into regional tools
  - Provide guidance on use of these tools to address the six undesirable results defined by SGMA
  - Other specific technical assistance needs (e.g. methods for developing water budgets where boundaries are co-located with streams)
- 