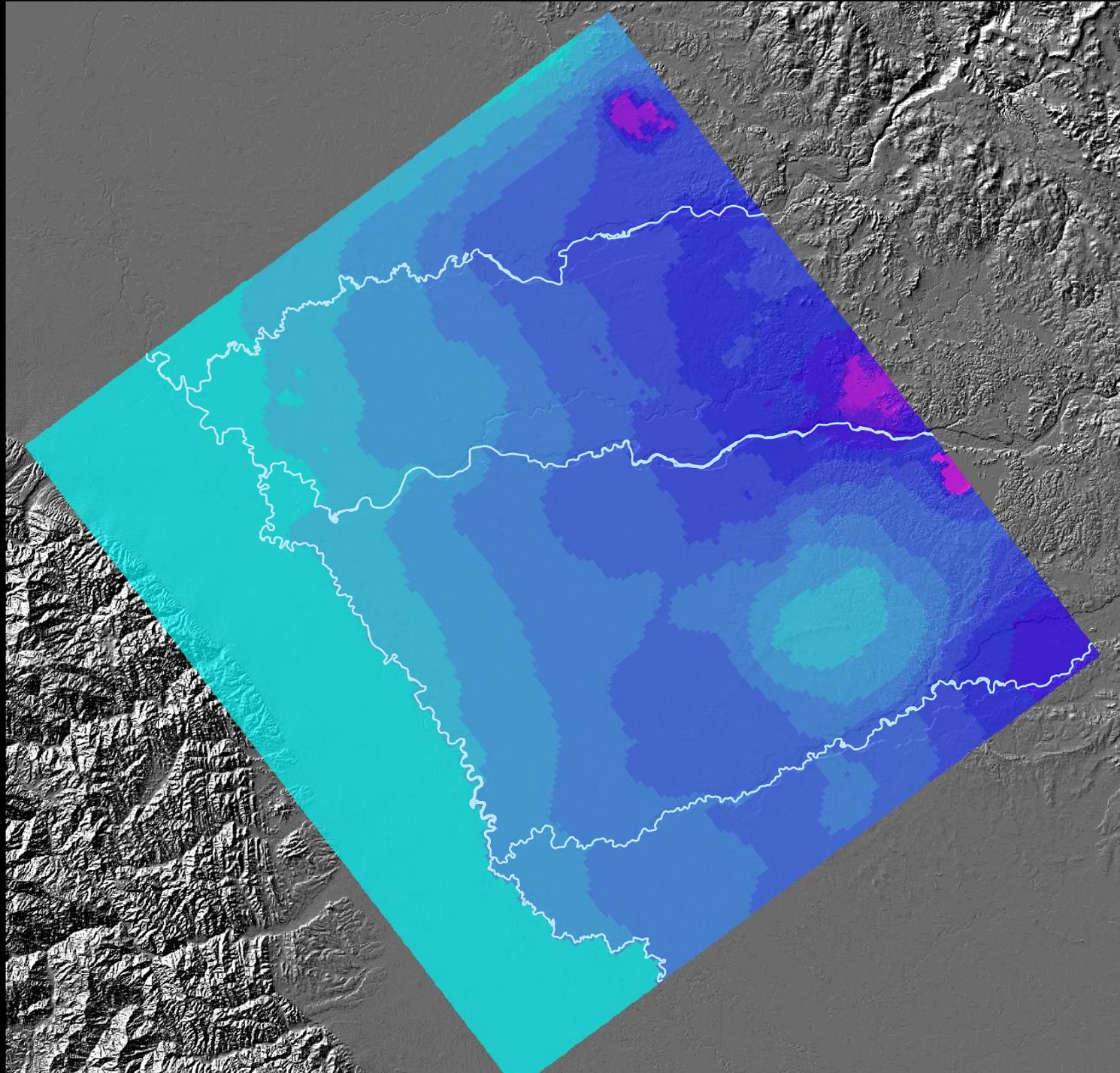


Development of Hydrologic Model of Modesto Region

*A cooperative effort between USGS and
the Stanislaus-Tuolumne Rivers
Groundwater Basin Association*

USGS Team: Steve Phillips, Diane Rewis,
Jon Traum, Jennifer Shelton, Wolfgang
Schmid, Randy Hanson, Karen Burow,
Joe Hevesi

Simulated
water
levels, 5m
(~15 ft)
interval,
year 2000



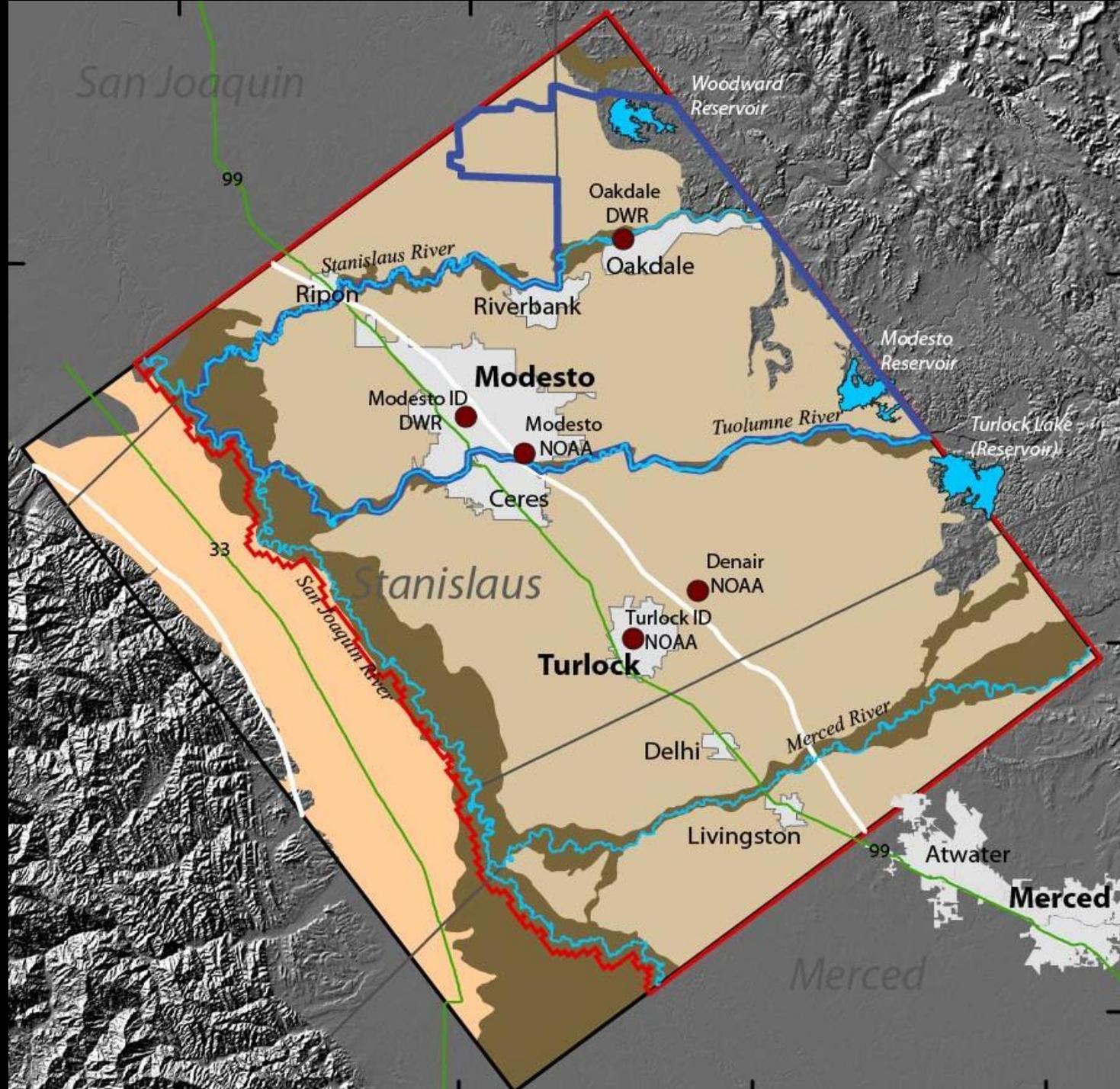
History of Model Development

- 2002-3, basin characterization, incl. borehole data – STRGBA/USGS
- 2004-05 developed WY2000 groundwater model – USGS, NAWQA
- Present: transient 1960-2004 model – STRGBA/USGS

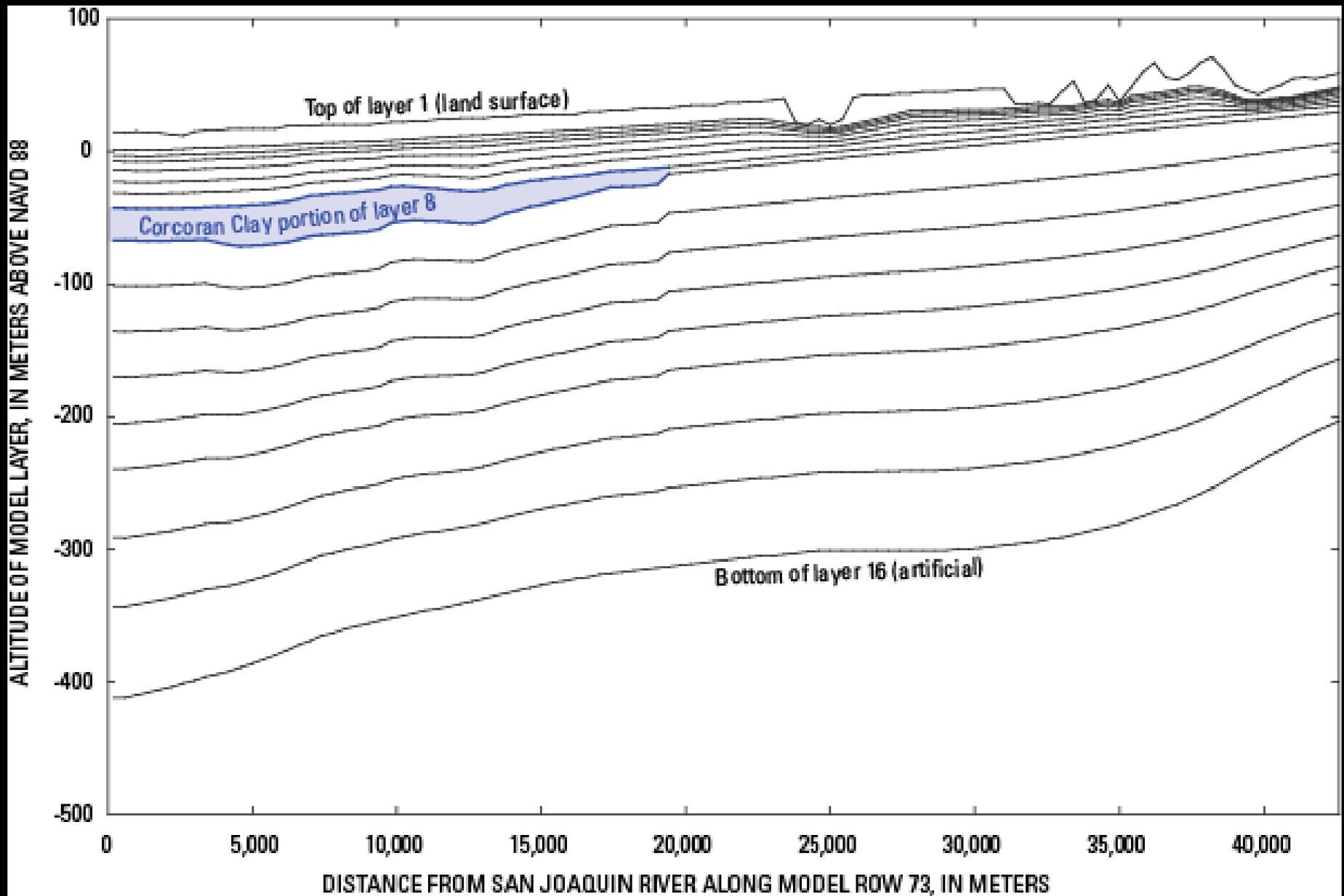
Model Area

1/4-mile grid spacing

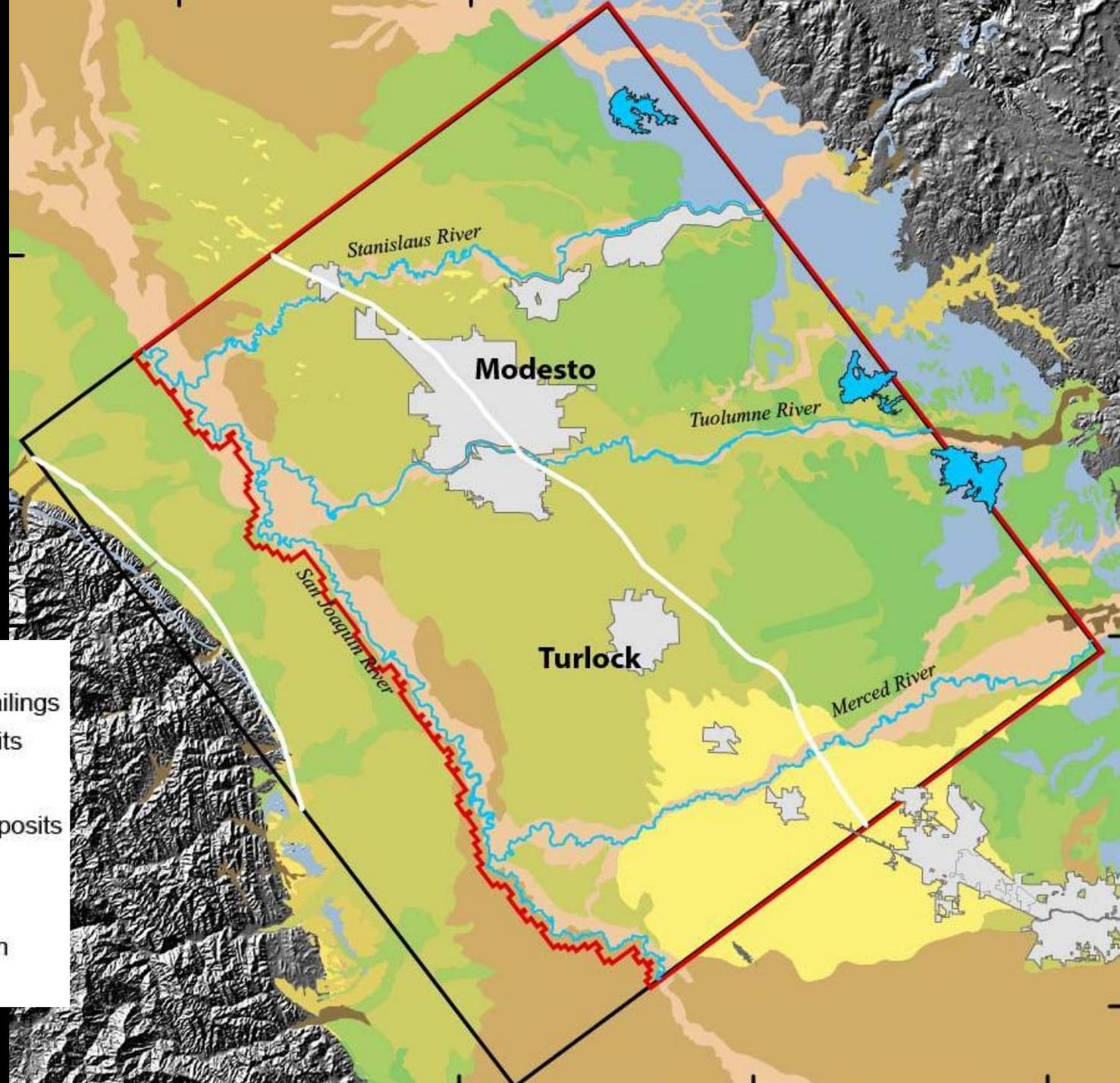
16 layers



Model Layers



Local Geology



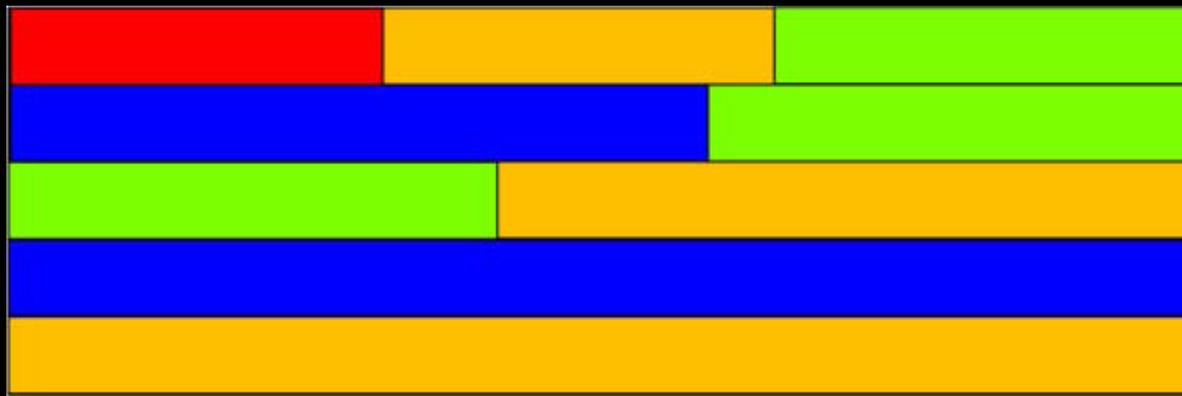
- Dunes
- Alluvium and dredge tailings
- Stream channel deposits
- Flood-basin deposits
- Non-marine terrace deposits
- Modesto Formation
- Riverbank Formation
- Turlock Lake Formation
- Mehrten Formation

Incorporation of Geology into the Model

- Used sediment texture data from over 3,500 boreholes
- Estimated hydraulic conductivity for every model cell on basis of sediment texture

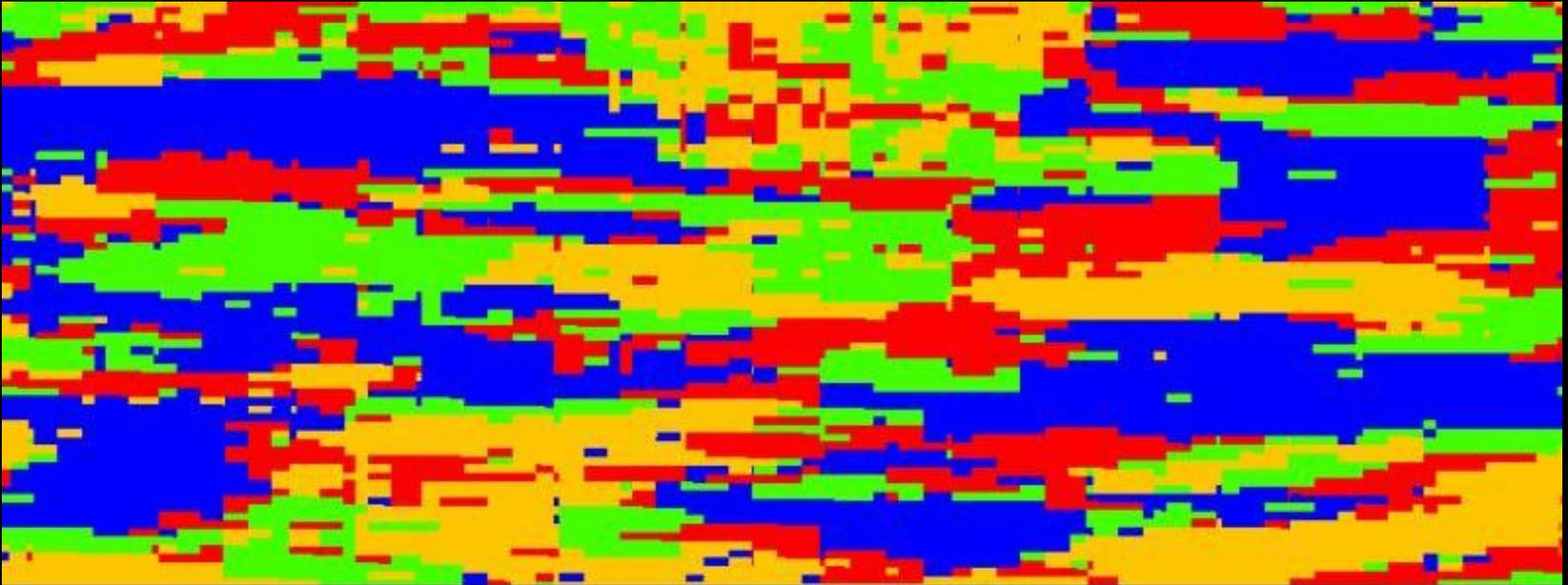
Accounting for the Influence of Geology on Ground-Water Flow

Typical “layer-cake” model construction



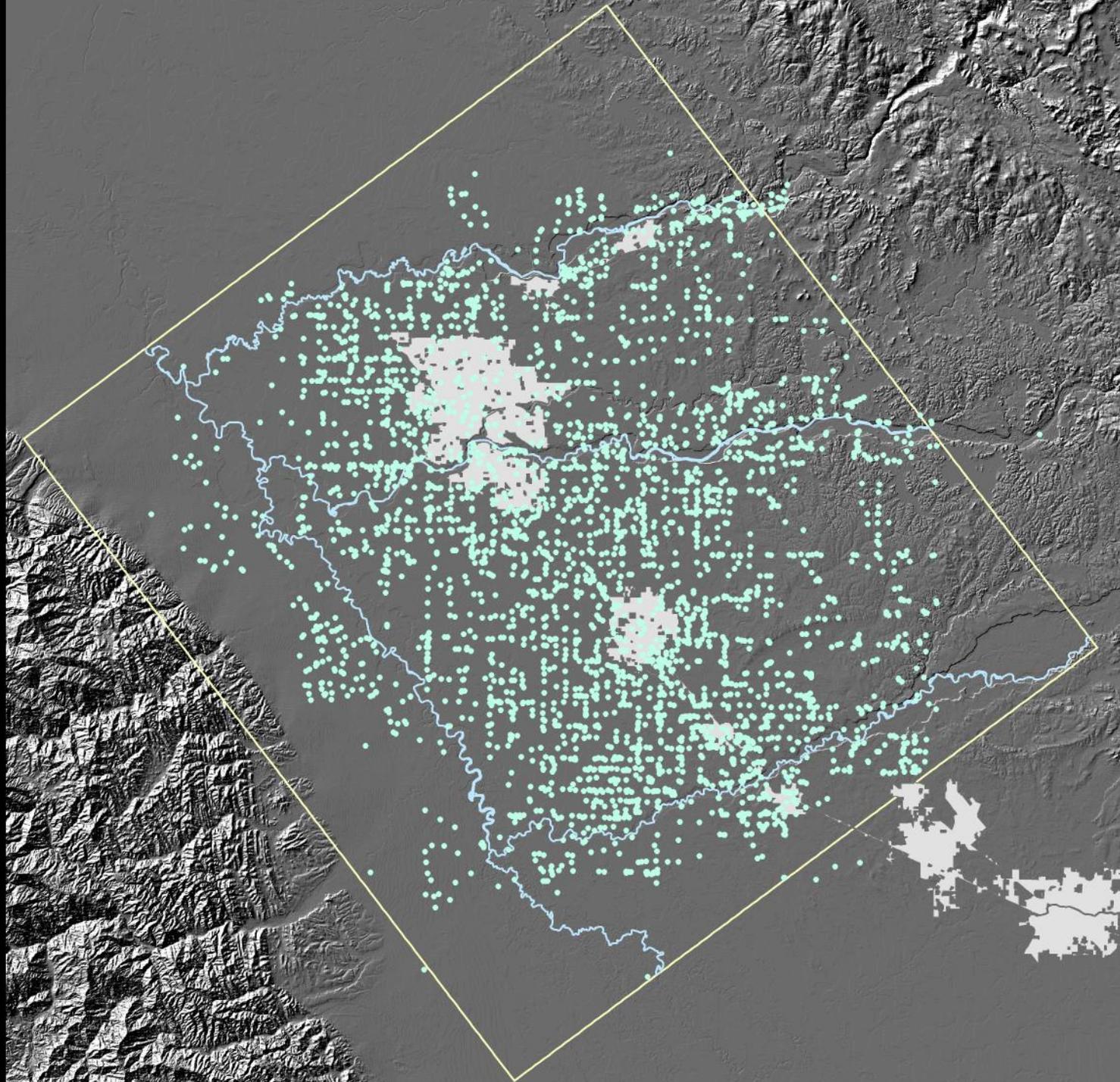
- Flow is strongly controlled by modeler’s layering scheme
- Solute transport highly dependent on assigned dispersion

More realistic model construction

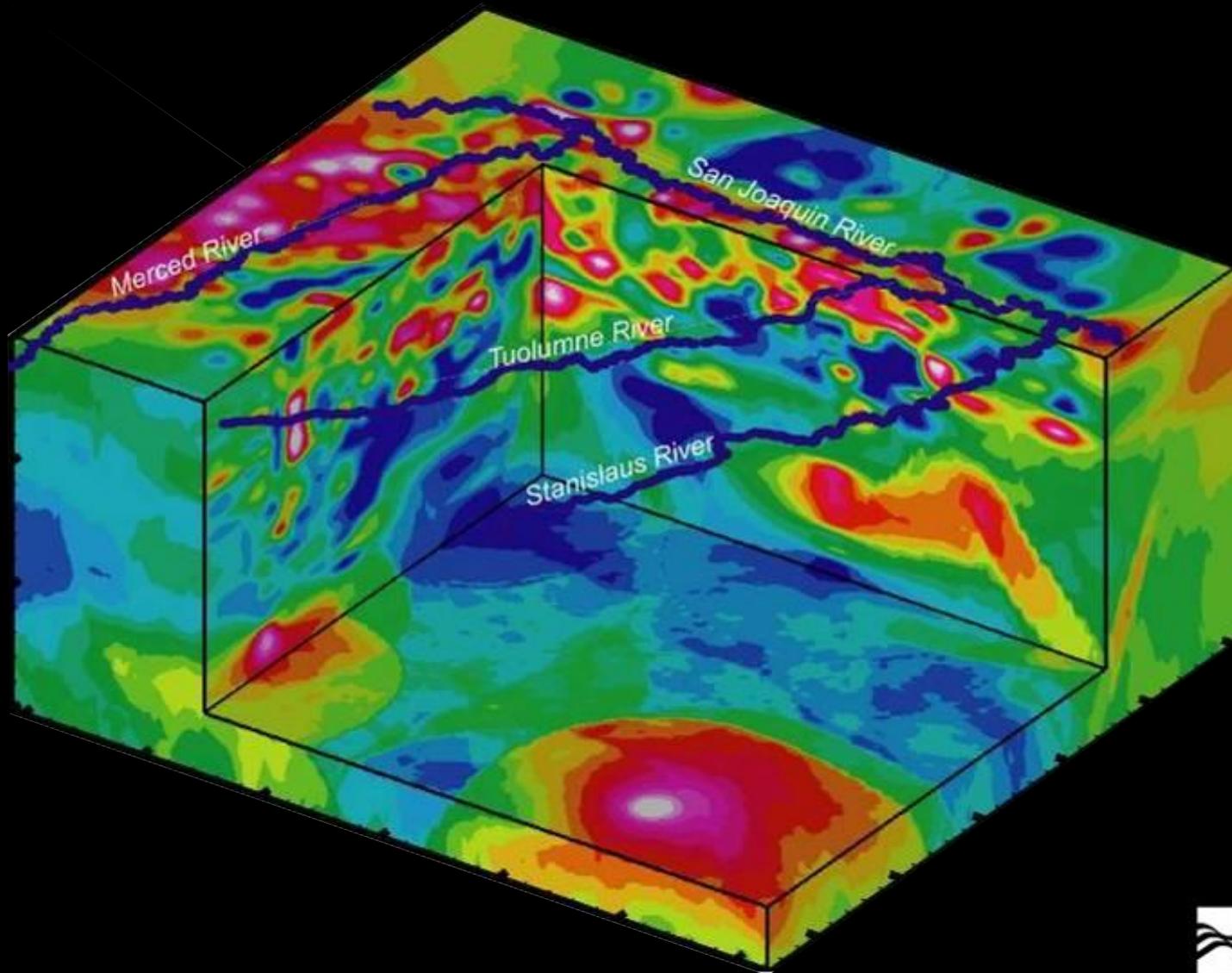


- Flow is not strongly controlled by modeler's decisions
- Solute transport not as dependent on assigned dispersion

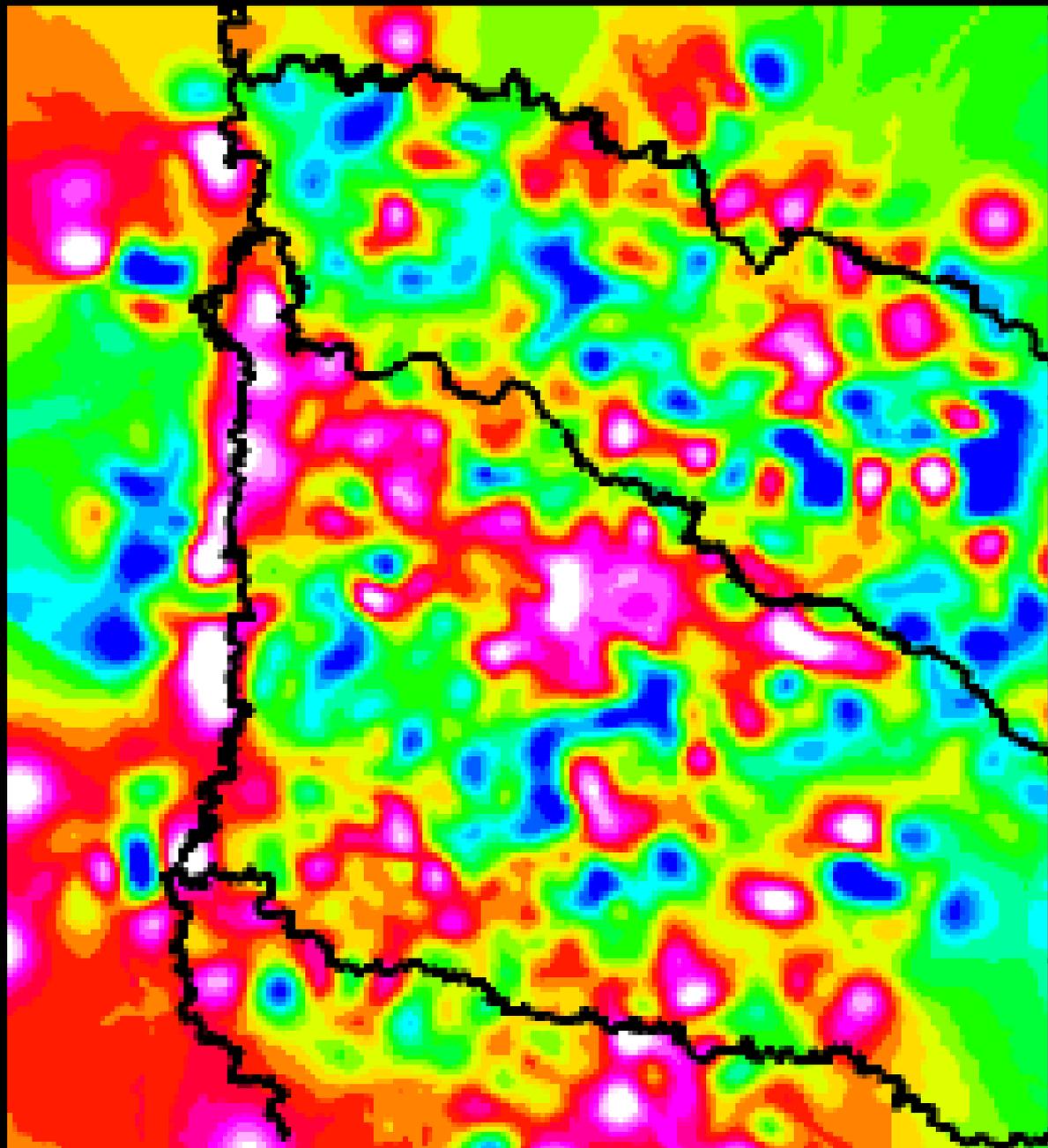
Locations
of 3,500
drillers'
logs



3-Dimensional Realization of Sediment Texture



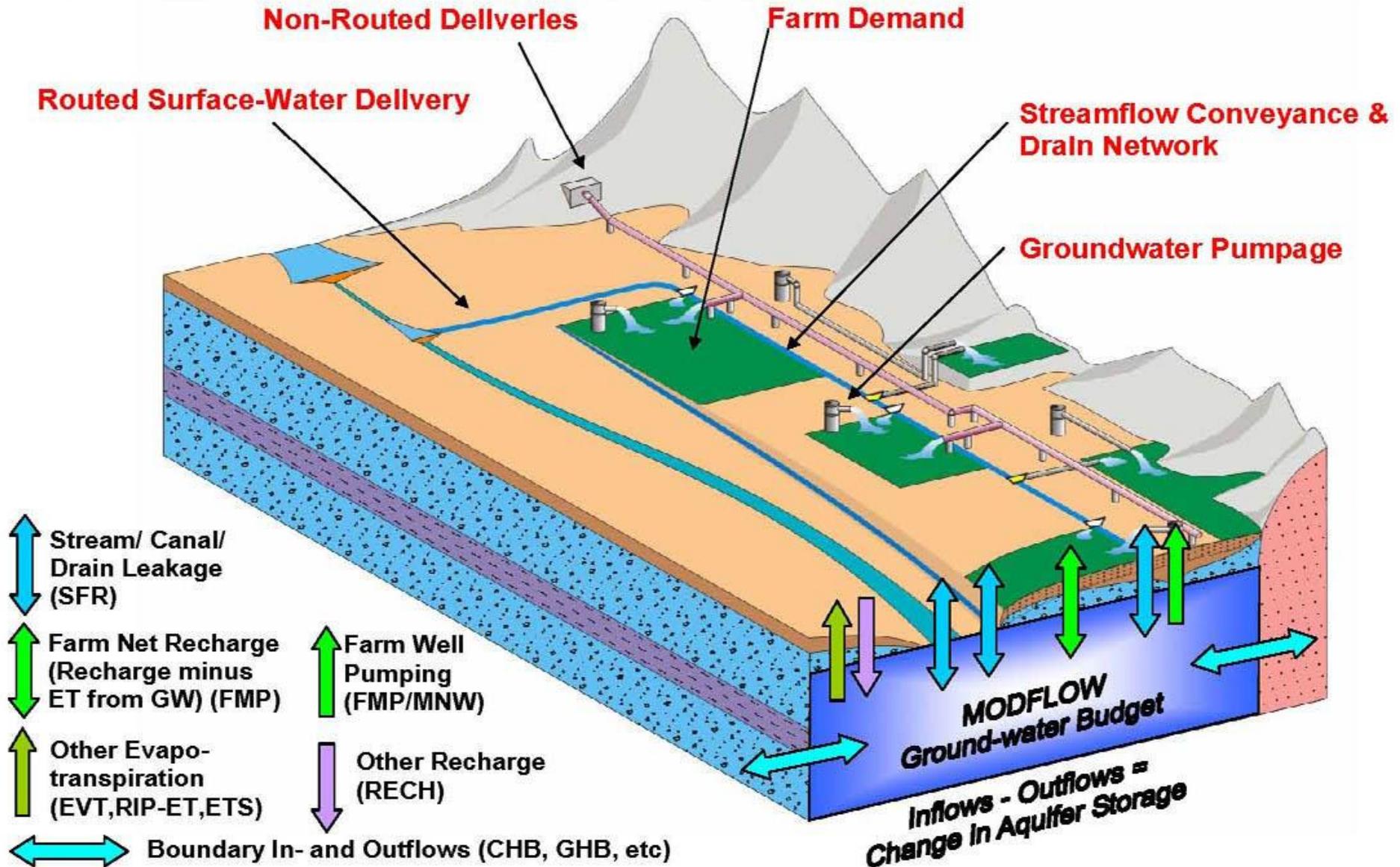
Sediment
texture at
25 meter
(~80 ft)
depth



The water budget is dominated by agricultural use → using the Farm Process in MODFLOW

Current Features of FMP

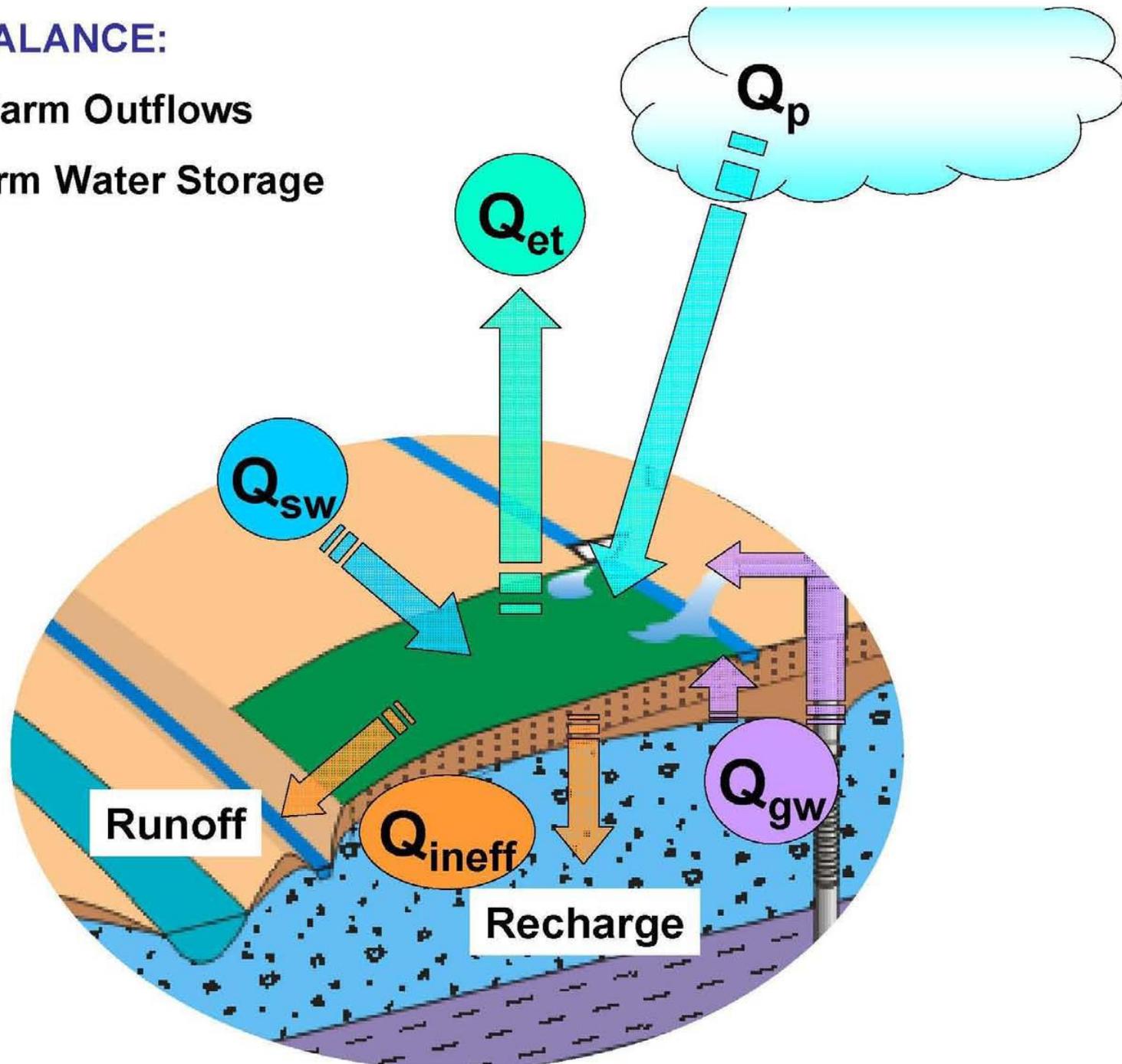
Demand & Supply and Mass Balances



FARM MASS BALANCE:

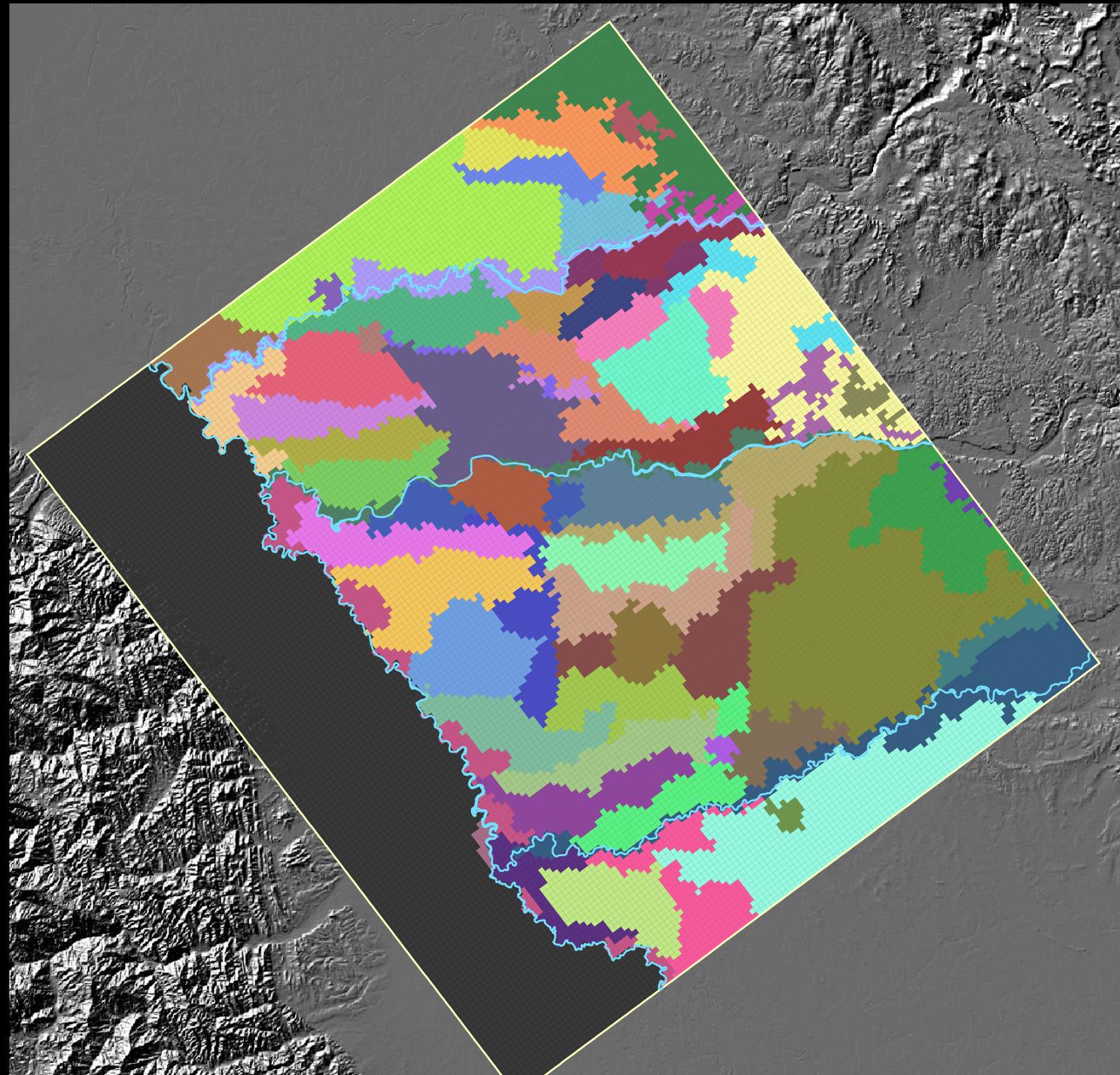
Farm Inflow – Farm Outflows

= Change in Farm Water Storage



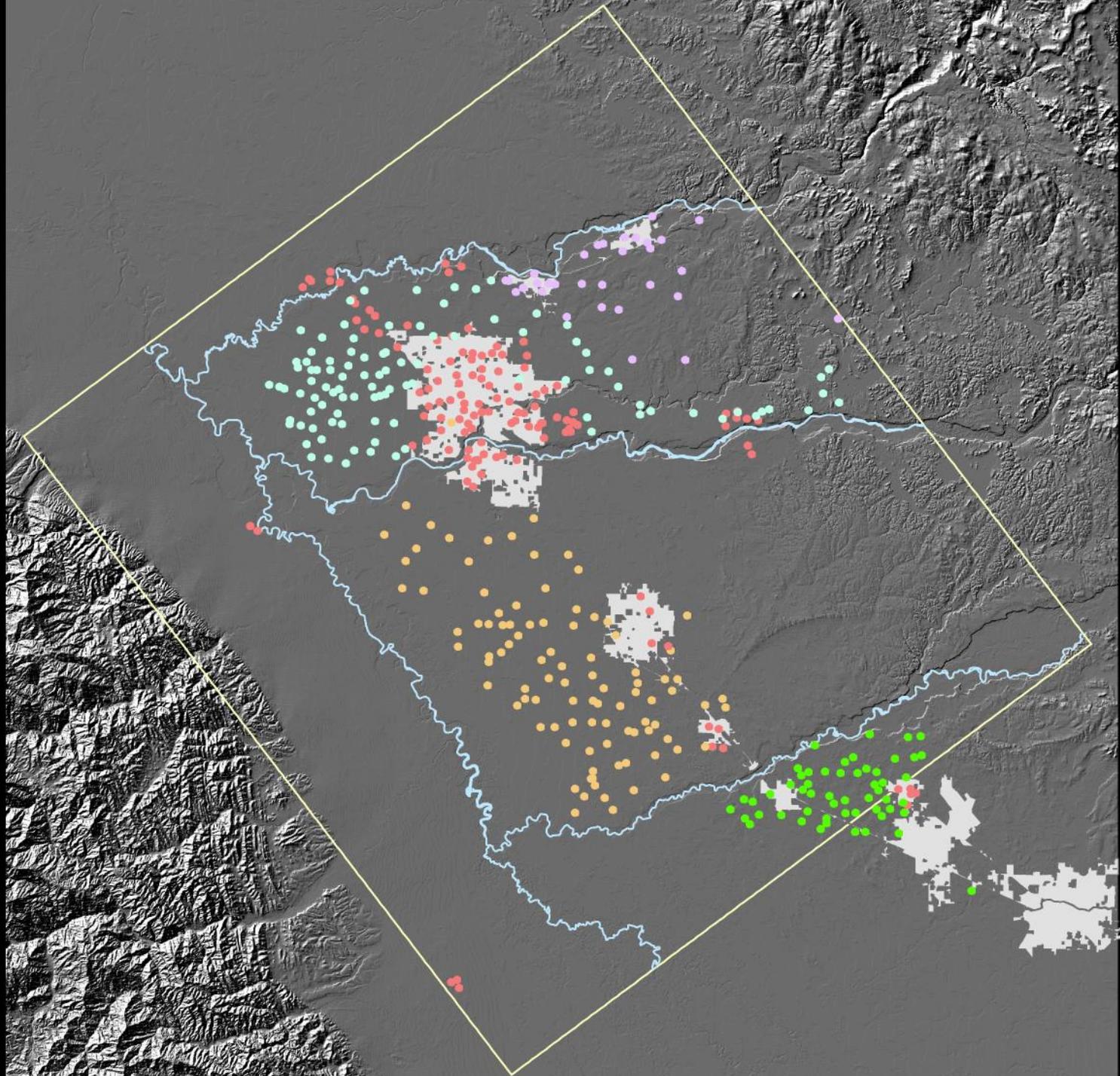
Designation
of water
budget
areas

Based
primarily on
known
water
deliveries



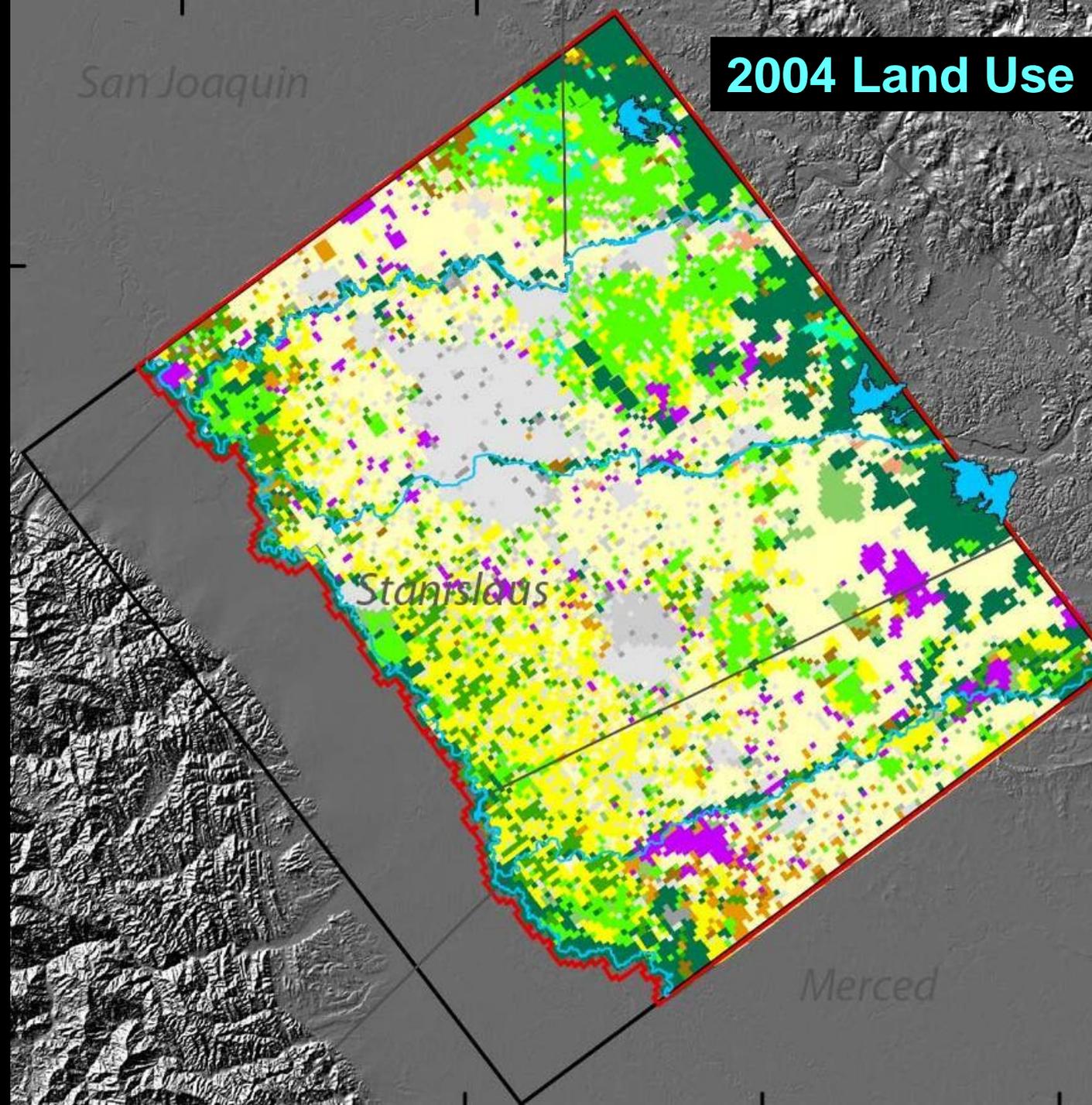
Wells with
known
pumpage
(urban,
drainage,
and some
ag.)

→ Farm
Process
estimates
private
irrigation
pumpage

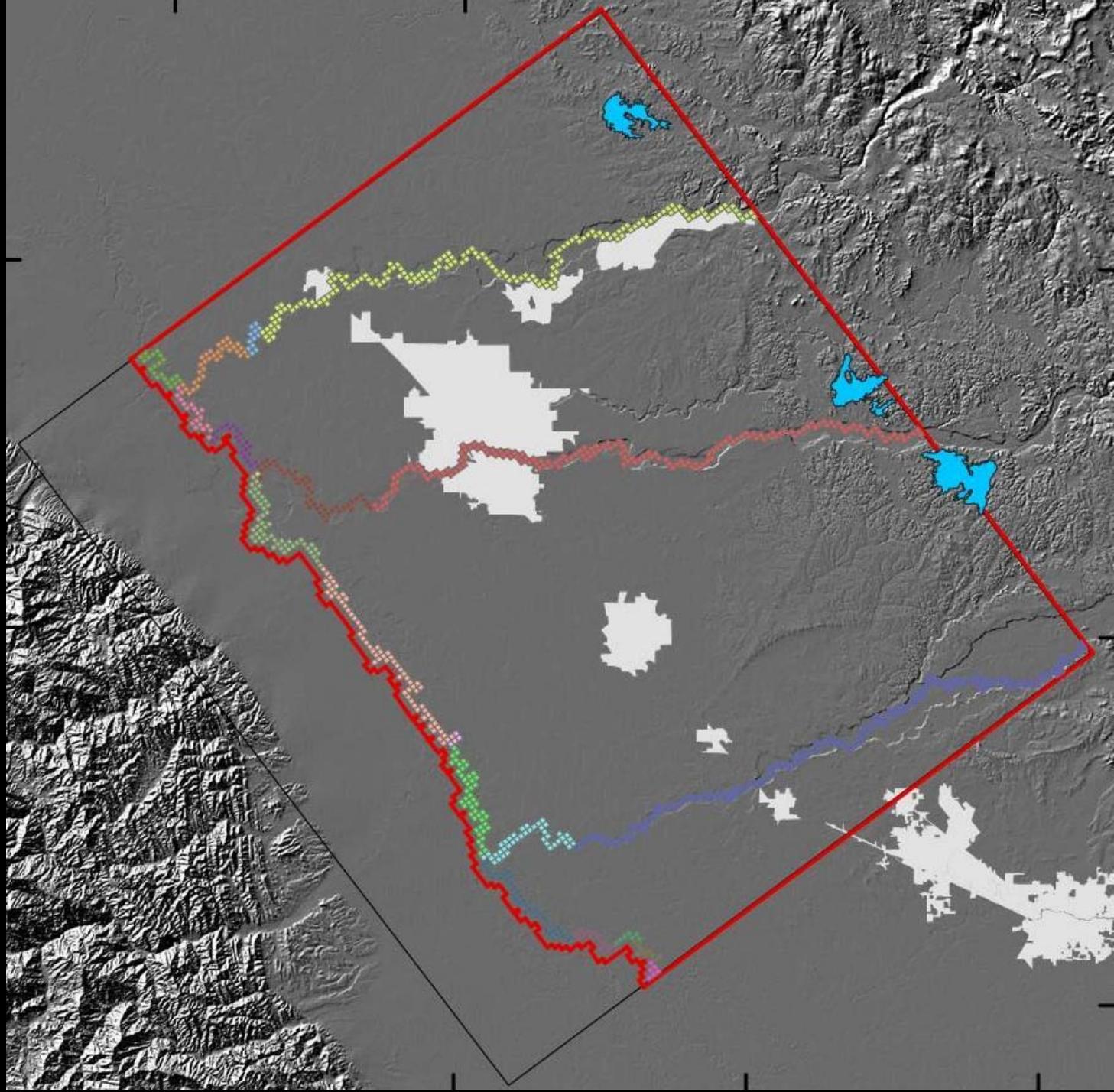


Farm
Process
input
includes:

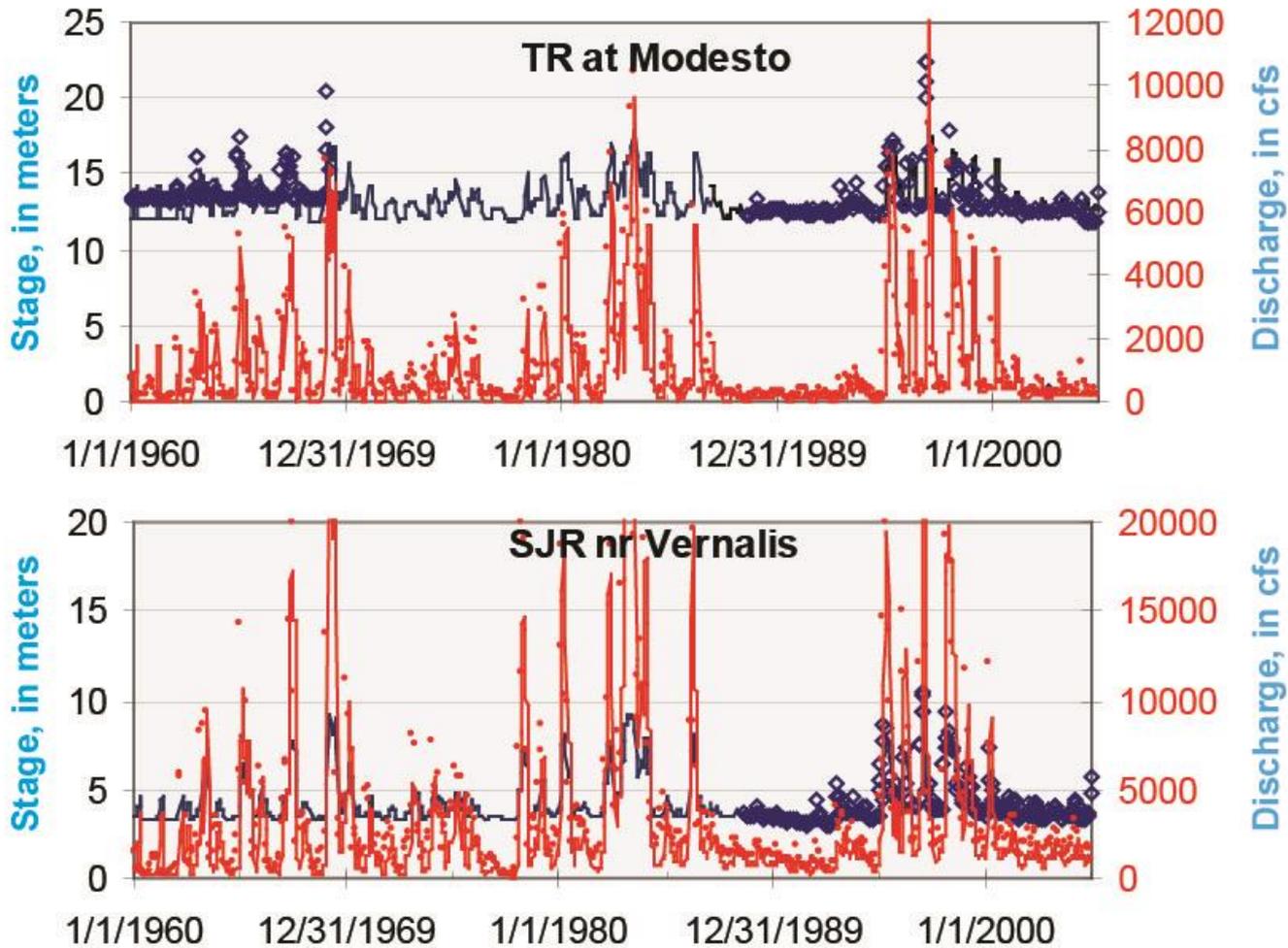
- Land use
- Precip
- ETo
- Kc
- Root depths
- Soil type
- % runoff
- and more



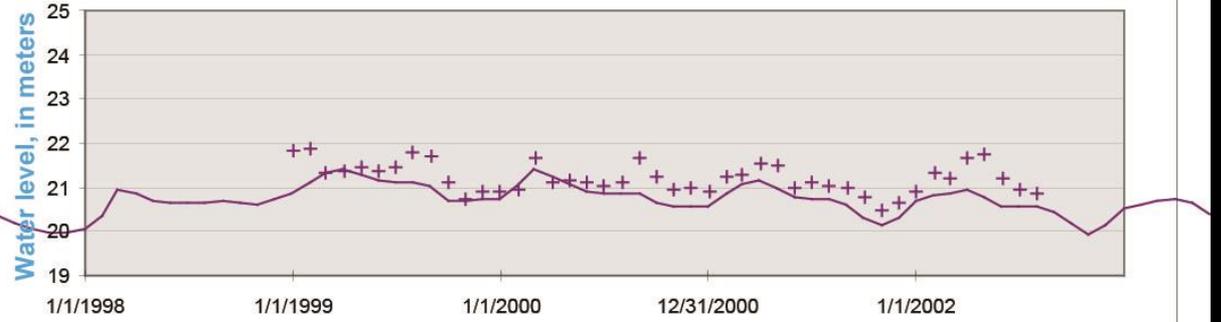
Simulation
of rivers &
stream-
aquifer
interaction



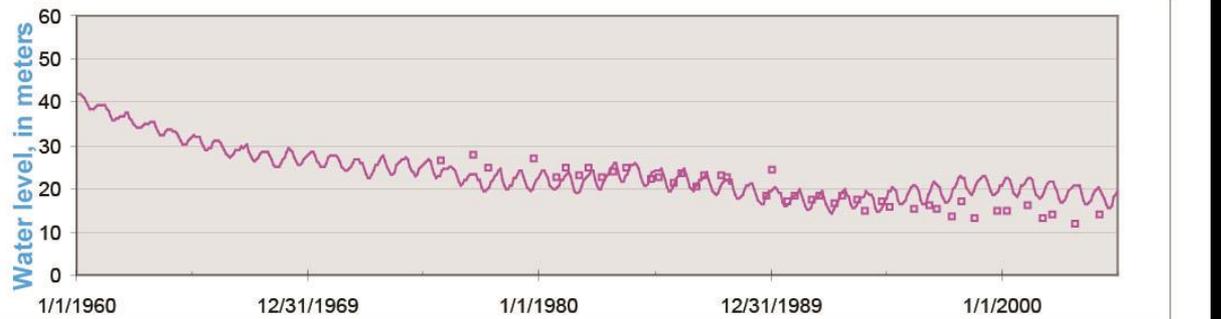
Calibration to streamflow



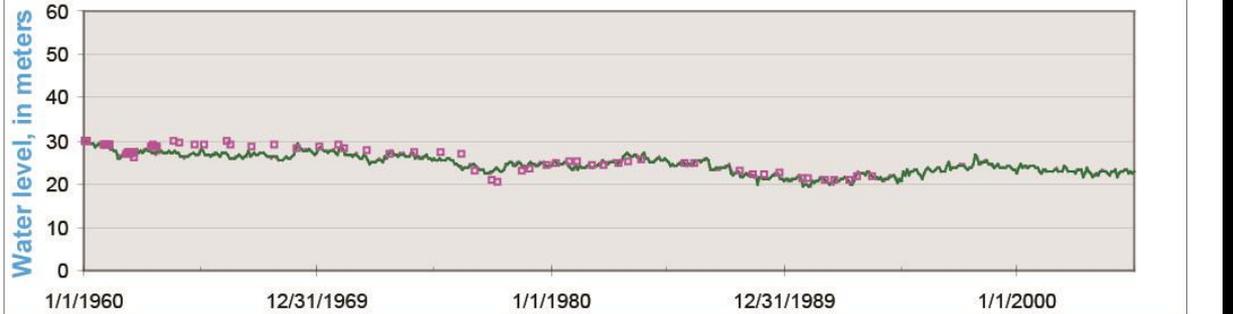
TID, shallow well



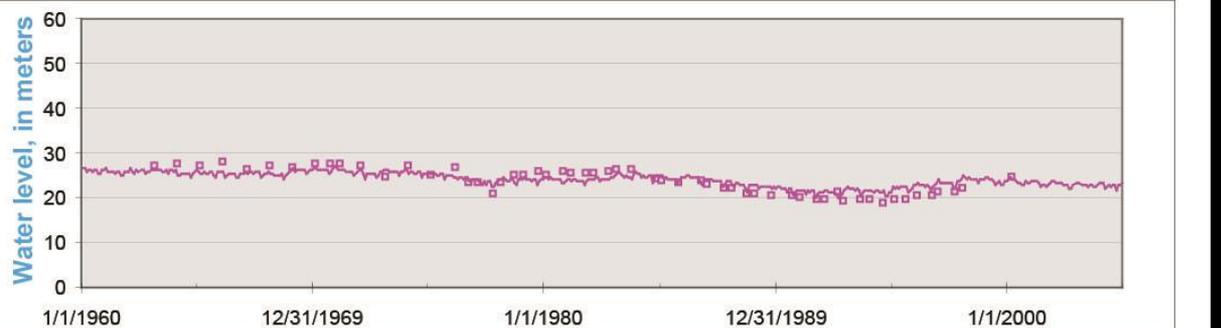
Eastside WD,
deep well



OID, deep well

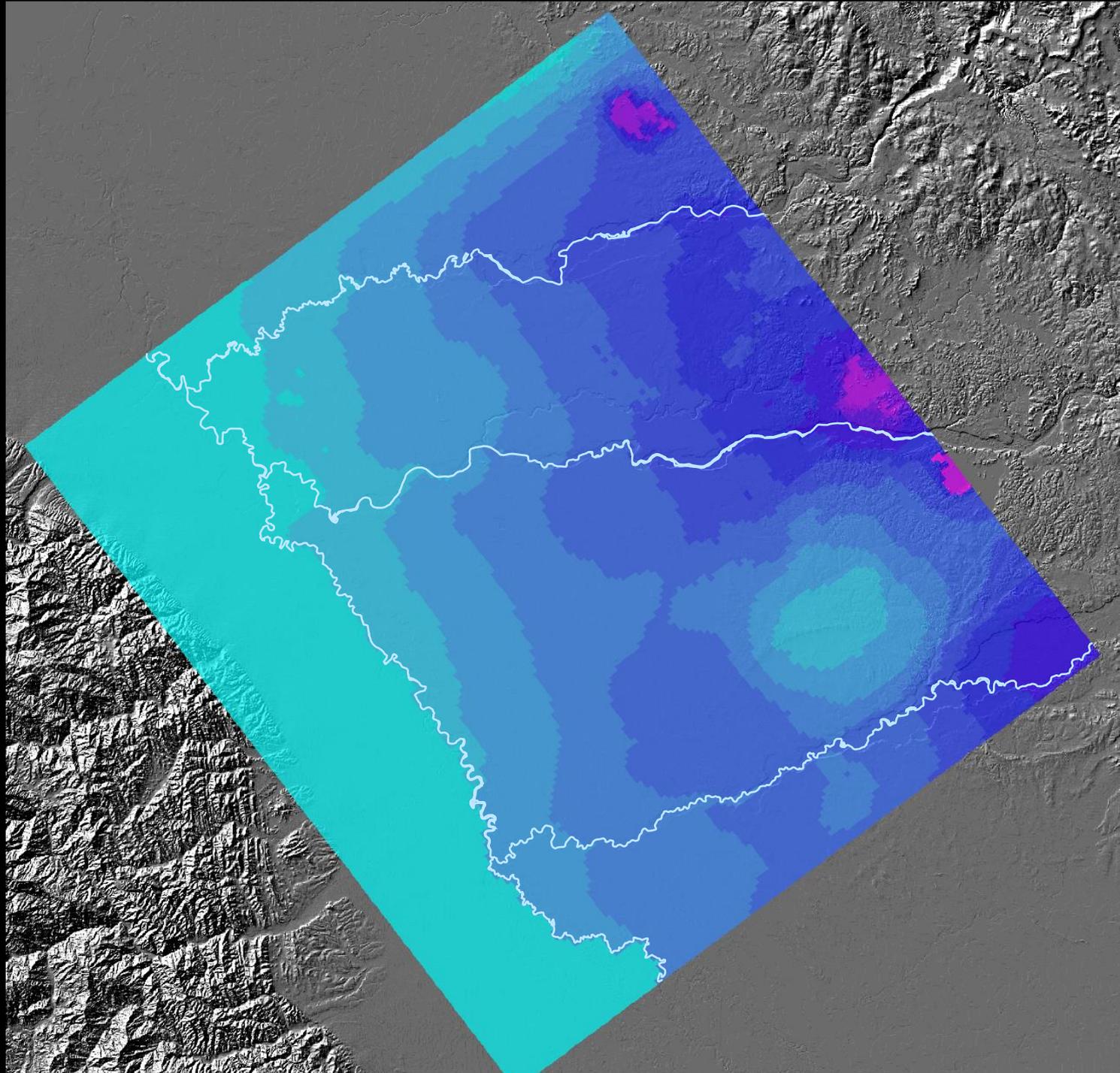


MID, deep well



Model
Output:

Simulated
water
levels, 5m
(~15 ft)
interval,
year 2000



Next Steps

- Model documentation report – publication target is Sept 30, 2014
- Potential applications of the model
 - Evaluation of water management options
 - Groundwater/surface-water interactions
 - Effects of recent development in upslope areas [will require updating the model]
 - Potential effects of drought & climate change
 - etc.



Thank You!

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sphillip@usgs.gov