Westlands Water District

Westside Subbasin's Groundwater Model

WWD Special Board Meeting
September 17, 2018

Outline

- SGMA
- Westside Subbasin
- Groundwater Model
  - Layers
  - Boundary Conditions
  - MODFLOW Farm Process
  - Development
  - Model Calibration
  - Outputs
  - Water Balance

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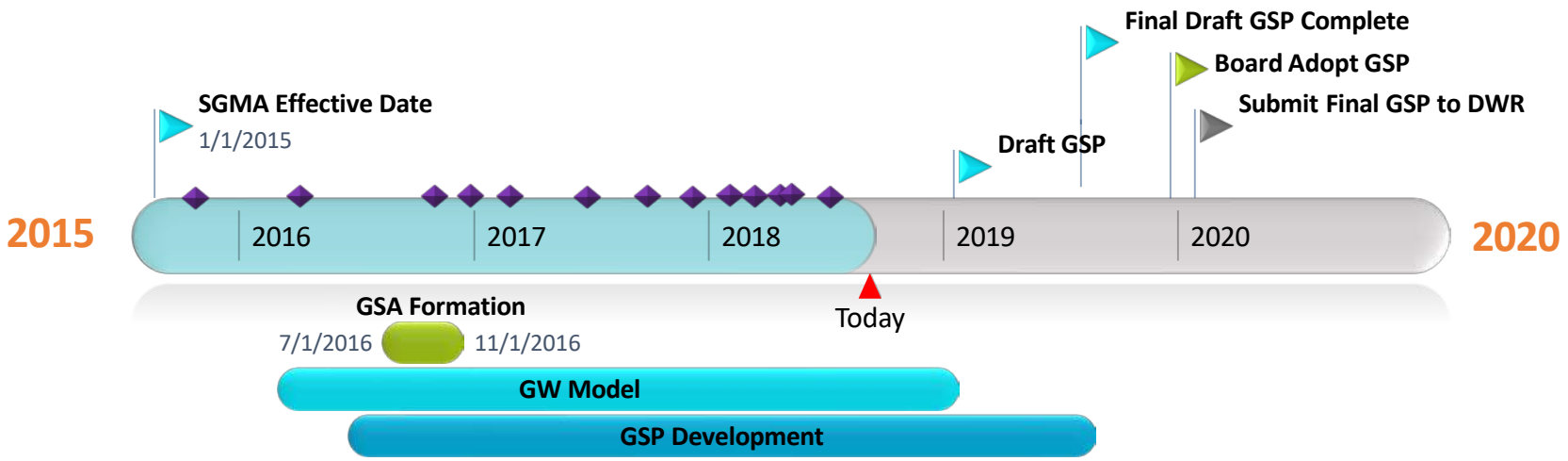
SGMA Implementation Timeline



- SGMA workshops & outreach events

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Groundwater Model & SGMA Nexus

- Tool to Sustainability Manage the Westside Subbasin
  - **GSP development**

  - **Undesirable Results**

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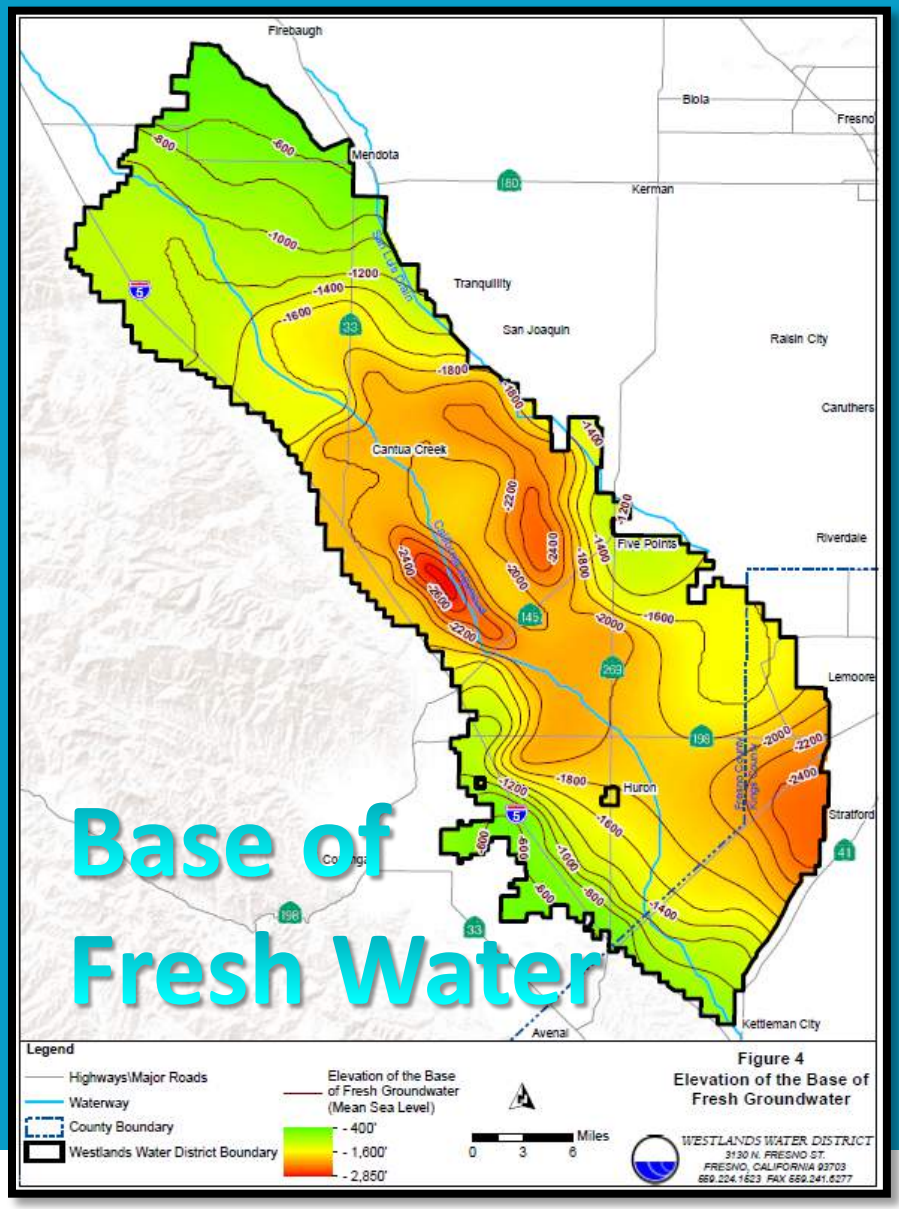
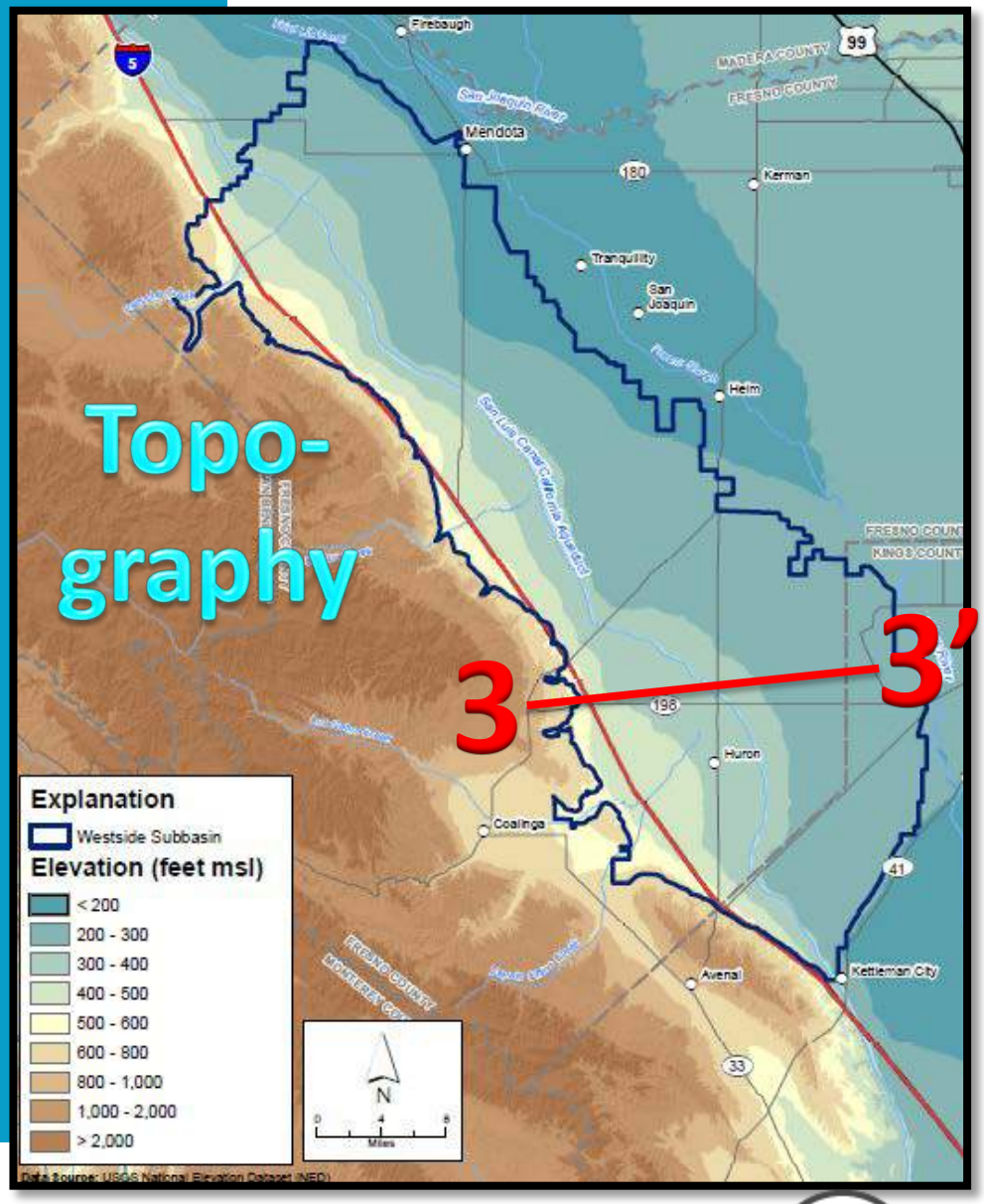

Base of Fresh Water
Firebaugh
Biola
Fresno
Mendota
Kerman
Tranquillity
San Joaquin
Raisin City
Caruthers
Cantua Creek
Five Points
Riverdale
Lemoore
Huron
Stratford
Coalinga
Avenal
Kettleman City
Legend
Highways\Major Roads
Waterway
County Boundary
Westlands Water District Boundary
Elevation of the Base of Fresh Groundwater (Mean Sea Level)
- 400'
- 1,600'
- 2,850'
Miles
0 3 6
Figure 4
Elevation of the Base of Fresh Groundwater
WESTLANDS WATER DISTRICT
3130 N. FRESNO ST.
FRESNO, CALIFORNIA 93703
559.224.1523 FAX 559.241.6277


Topo-graphy
3
3'
Firebaugh
Mendota
Kerman
Tranquillity
San Joaquin
Helm
Huron
Coalinga
Avenal
Kettleman City
MADERA COUNTY
FRESNO COUNTY
KINGS COUNTY
Explanation
Westside Subbasin
Elevation (feet msl)
< 200
200 - 300
300 - 400
400 - 500
500 - 600
600 - 800
800 - 1,000
1,000 - 2,000
> 2,000
N
Miles
Data Source: USGS National Elevation Dataset (NED)

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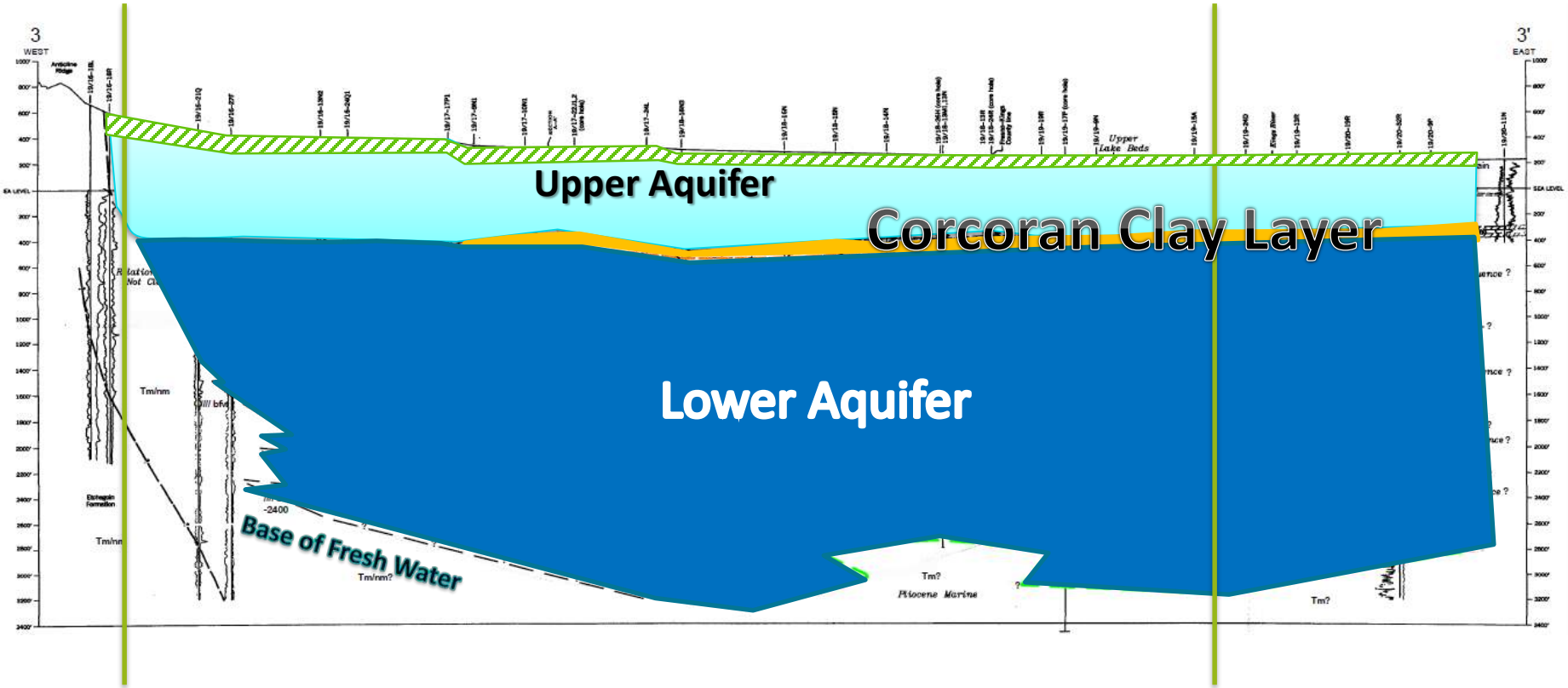
Cross Section 3-3’



Westside Subbasin Boundary

Westside Subbasin Boundary

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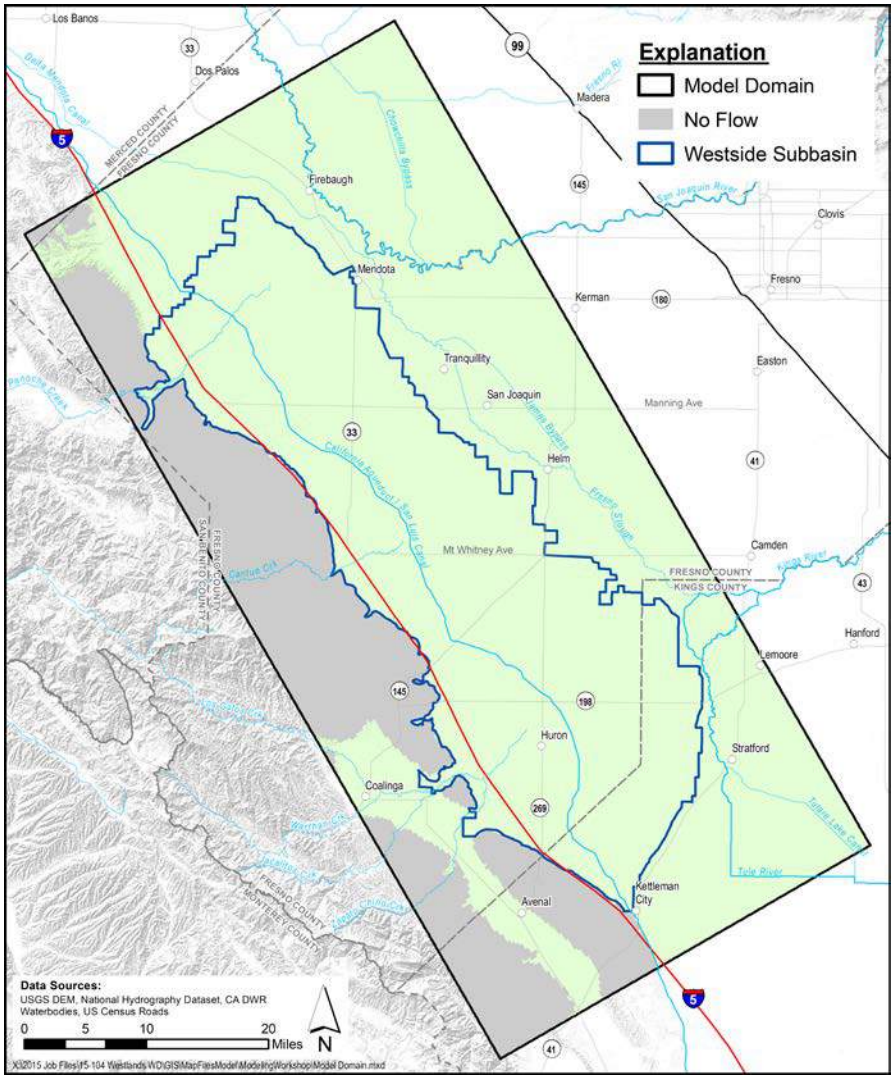
Groundwater Model



- USGS MODFLOW-OWHM
  - MODFLOW Farm Process
- 19 Layer Model
- 312 Rows x 140 Columns
  - ¼ Mile x ¼ Mile Cells
- 28-Year Simulation
  - Monthly Stress Periods

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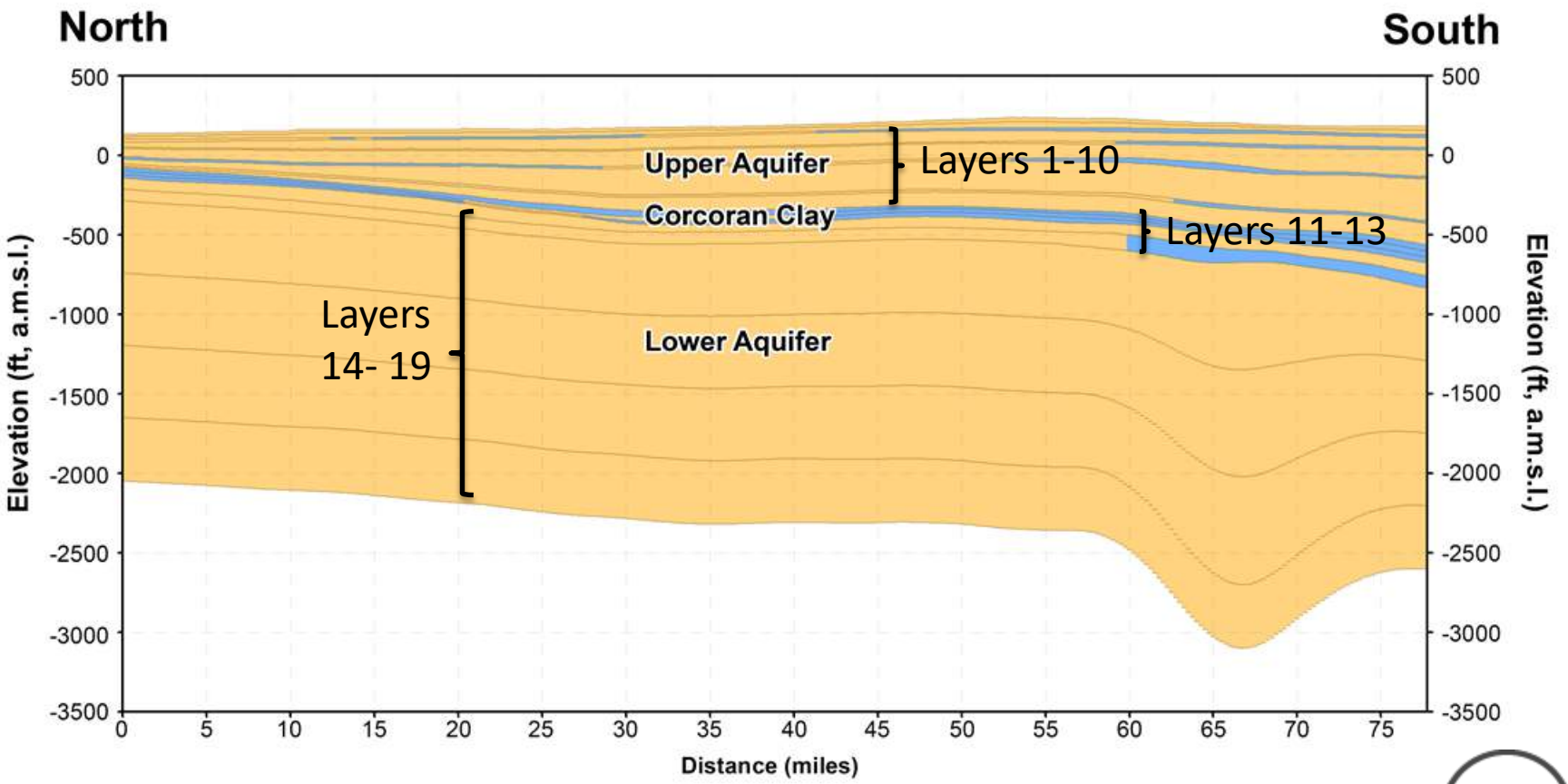
Model Layering



X:\2015 Job Files\15-104 Westlands WD\GIS\MapFiles\Model\ModelingWorkshop\Model Layering.mxd

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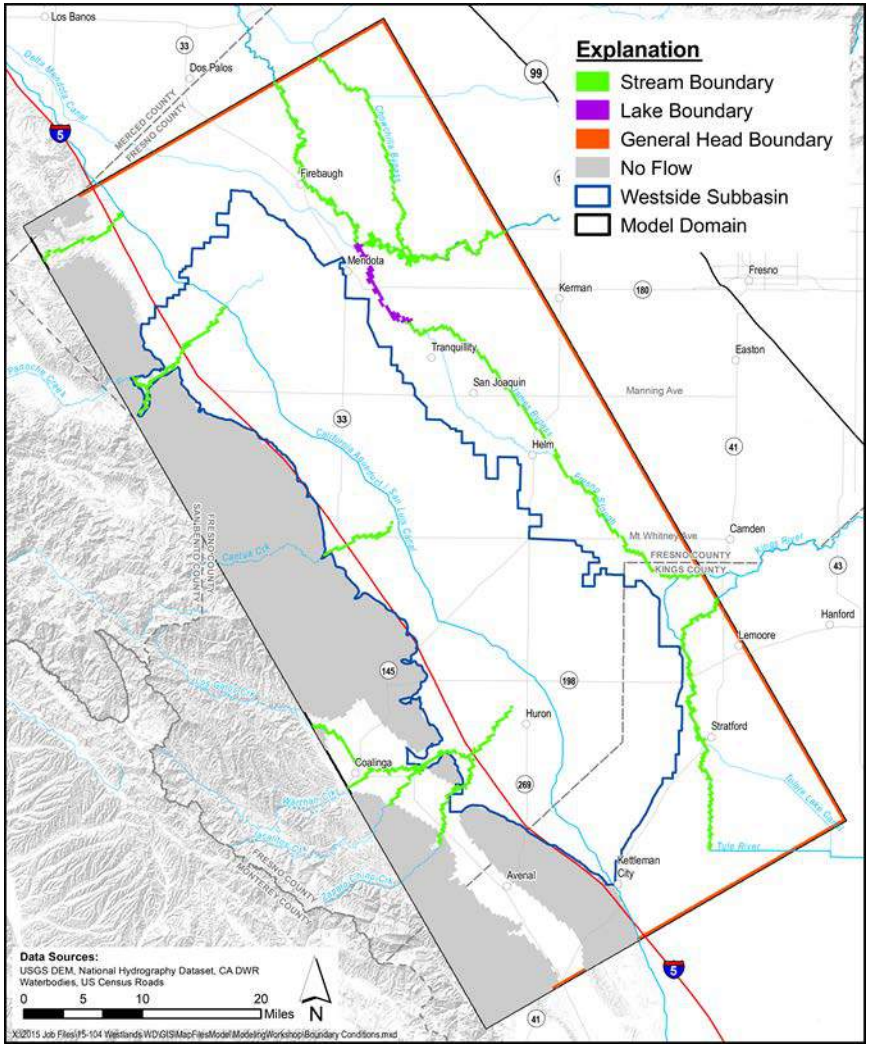
Boundary Conditions



- Edge of Model Domain
  - General Head Boundary
  - Simulates lateral subsurface flow in and out of model domain
- Stream Boundary
  - Simulates interaction between GW and creeks and rivers
- Lake Boundary
  - Simulates interaction between GW and Mendota Pool
- No Flow Boundary
  - Low permeability (western portion of model domain)

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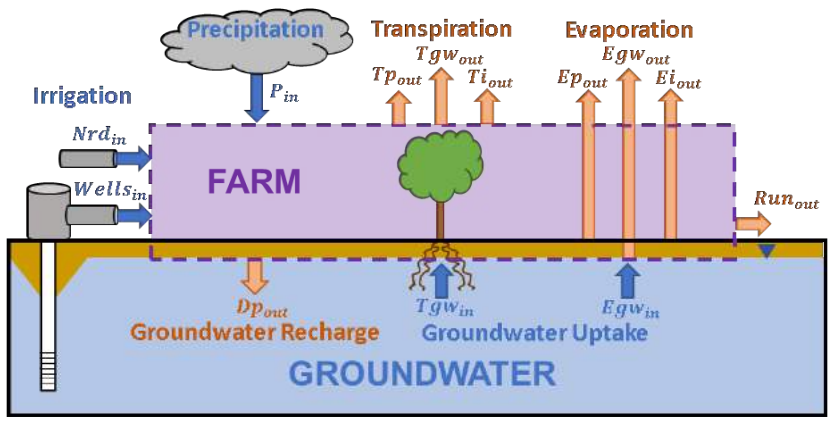
MODFLOW Farm Process

- Supply Constrained Demand
  - Calculates demand for each "Farm" using land use, climatic input and crop parameters
  - Meets demand initially through precipitation, GW uptake and surface water deliveries
  - Deficit made up by groundwater pumping
  - Excess irrigation water and precipitation added to groundwater system via deep percolation



P_{in}	Precipitation into a farm
Nrd_{in}	Non-routed surface water delivery into a farm
$Wells_{in}$	Groundwater pumping delivery into a farm
Egw_{in}	Evaporation from groundwater into a farm
Tgw_{in}	Transpiration from groundwater into a farm
Ei_{out}	Evaporation from irrigation (applied water) out of a farm
Ep_{out}	Evaporation from precipitation out of a farm
Egw_{out}	Evaporation from groundwater out of a farm
Ti_{out}	Transpiration from irrigation (applied water) out of a farm
Tp_{out}	Transpiration from precipitation out of a farm
Tgw_{out}	Transpiration from groundwater out of a farm
Run_{out}	Overland runoff out of a farm
Dp_{out}	Deep percolation out of a farm into groundwater system

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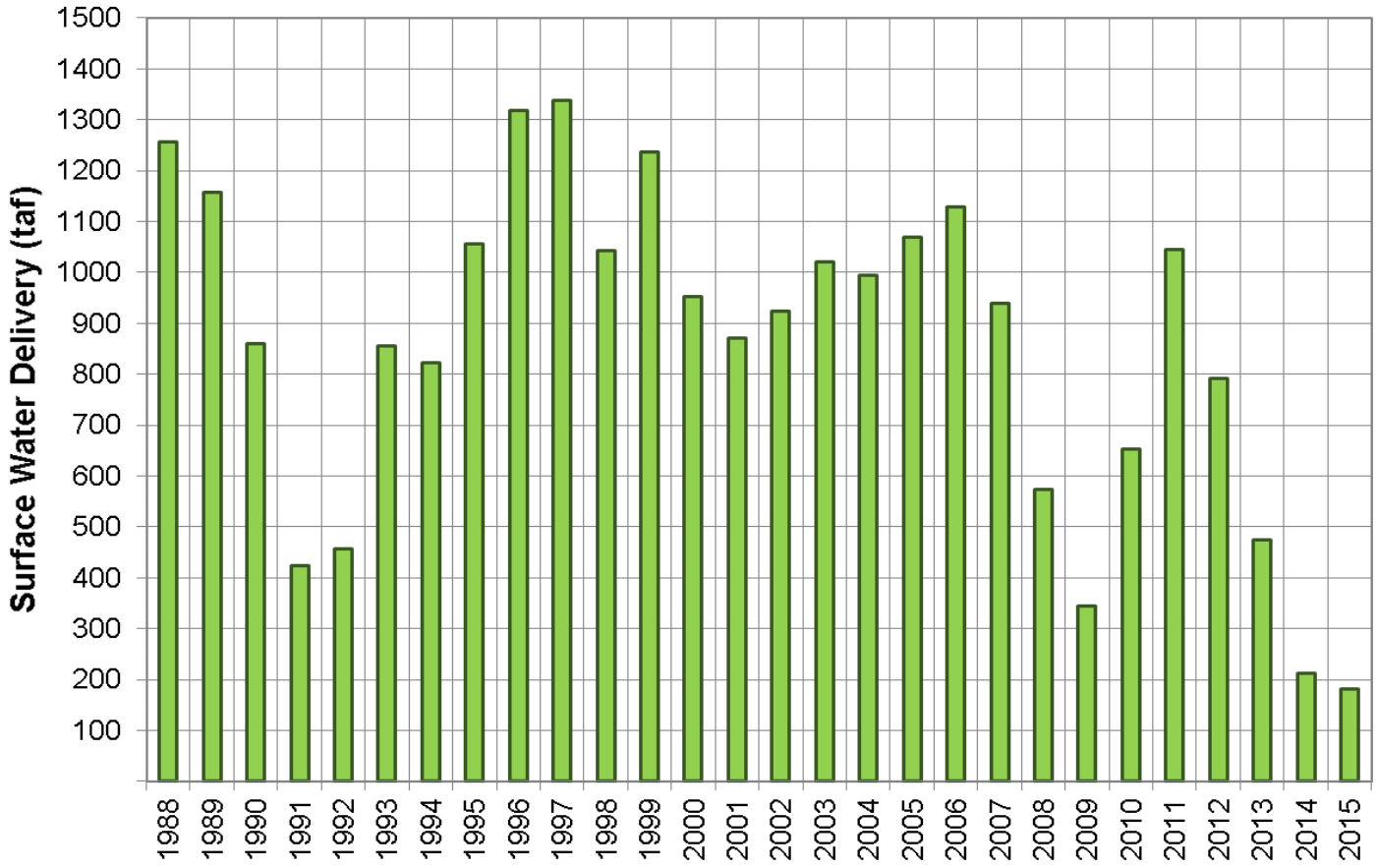
Surface Water Delivery



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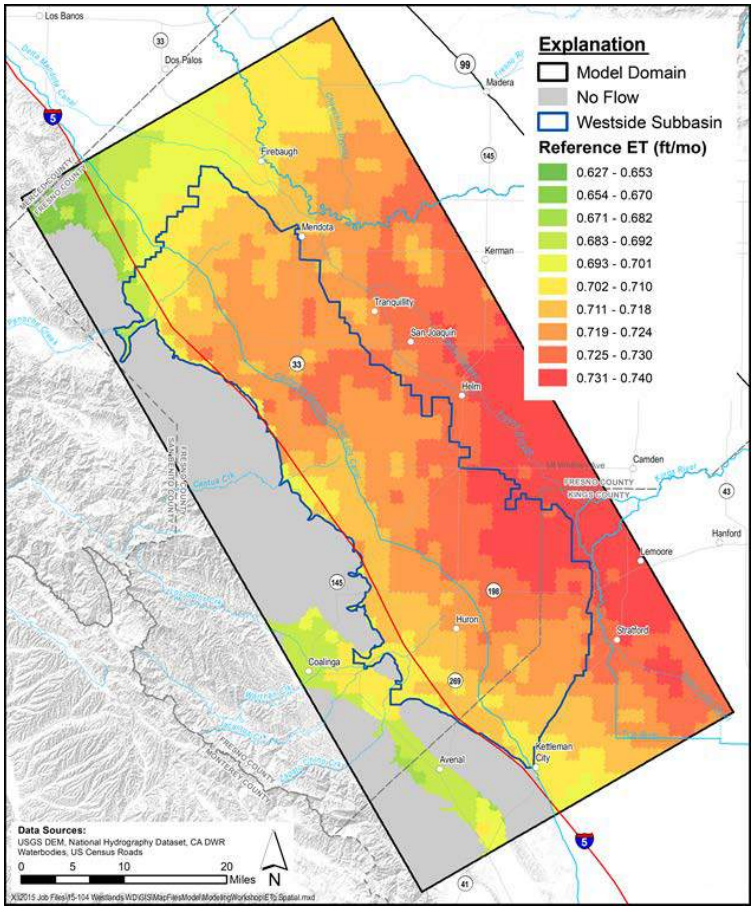
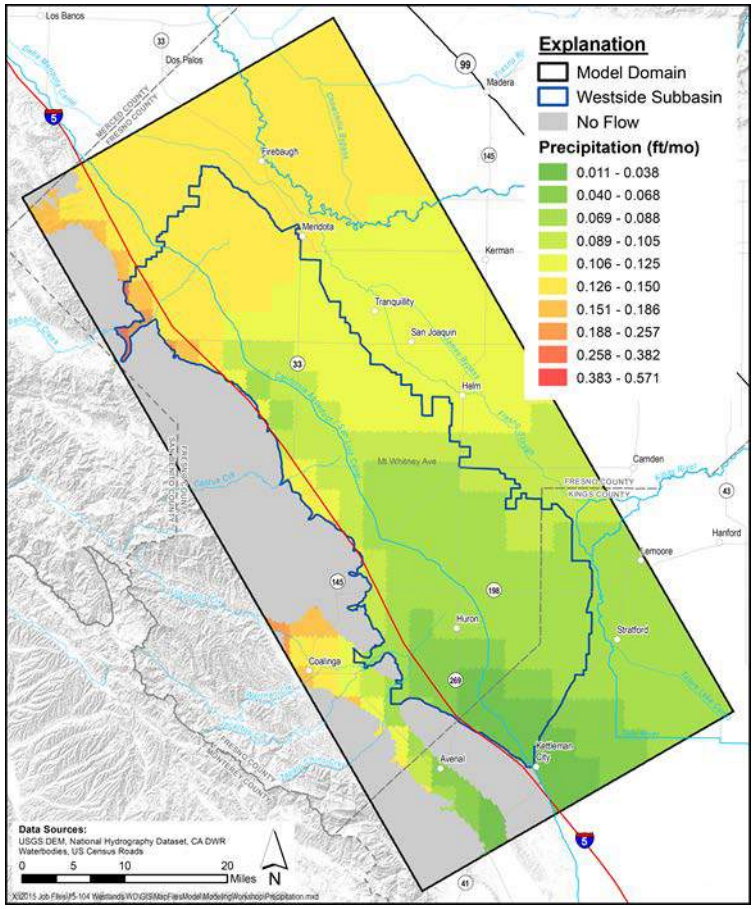
Climatic Inputs





Reference ET: June 2011

Precipitation: February 2011

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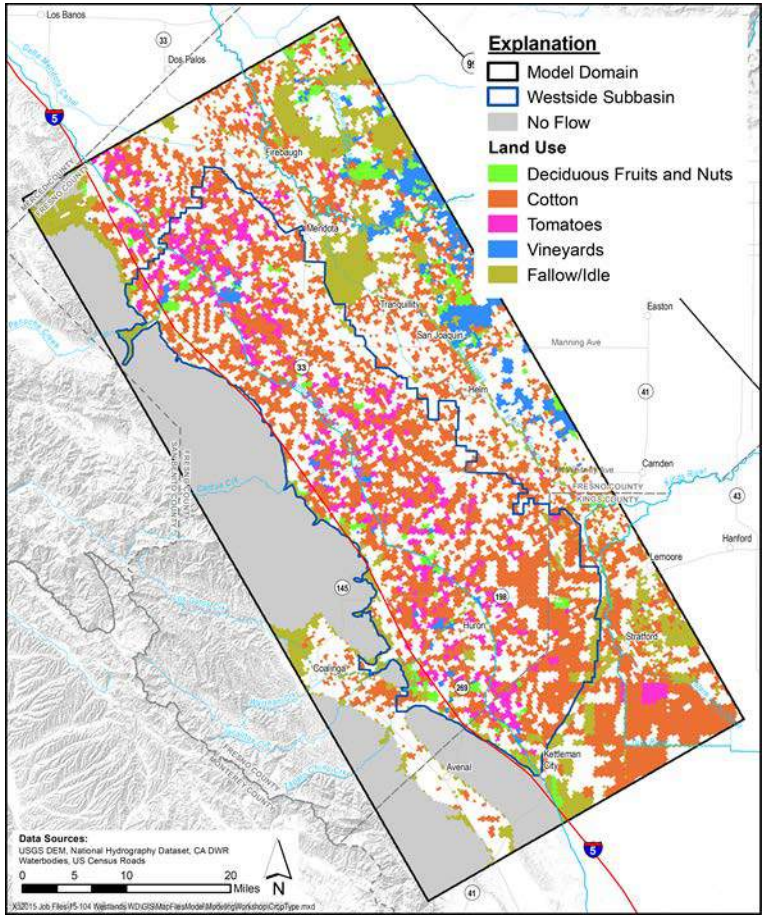
Land Use



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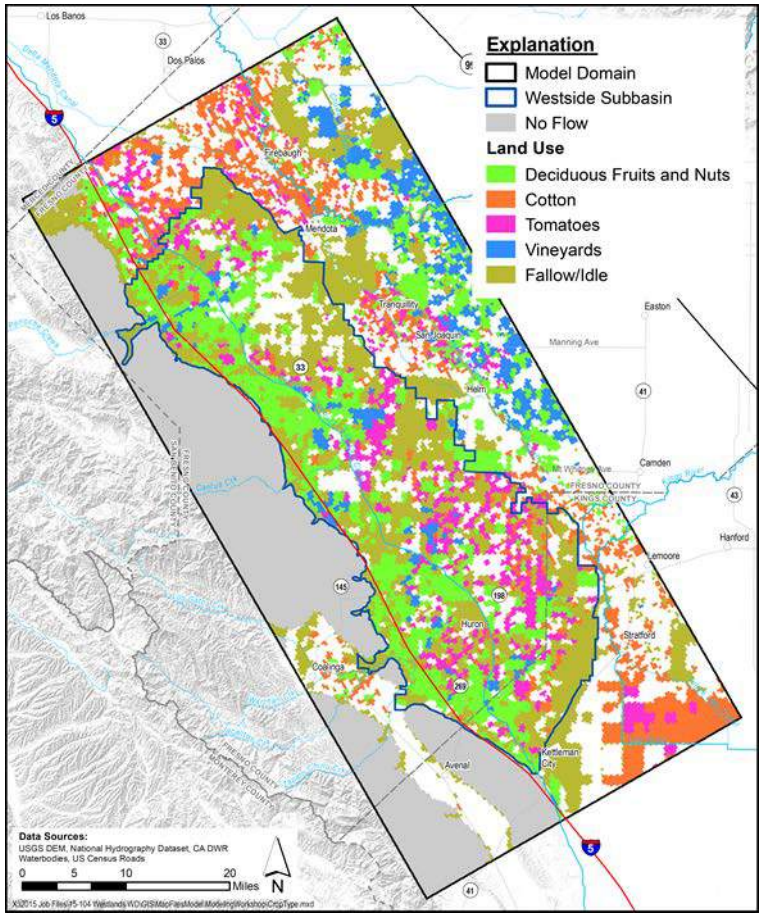

2015

***Crop types omitted for clarity**

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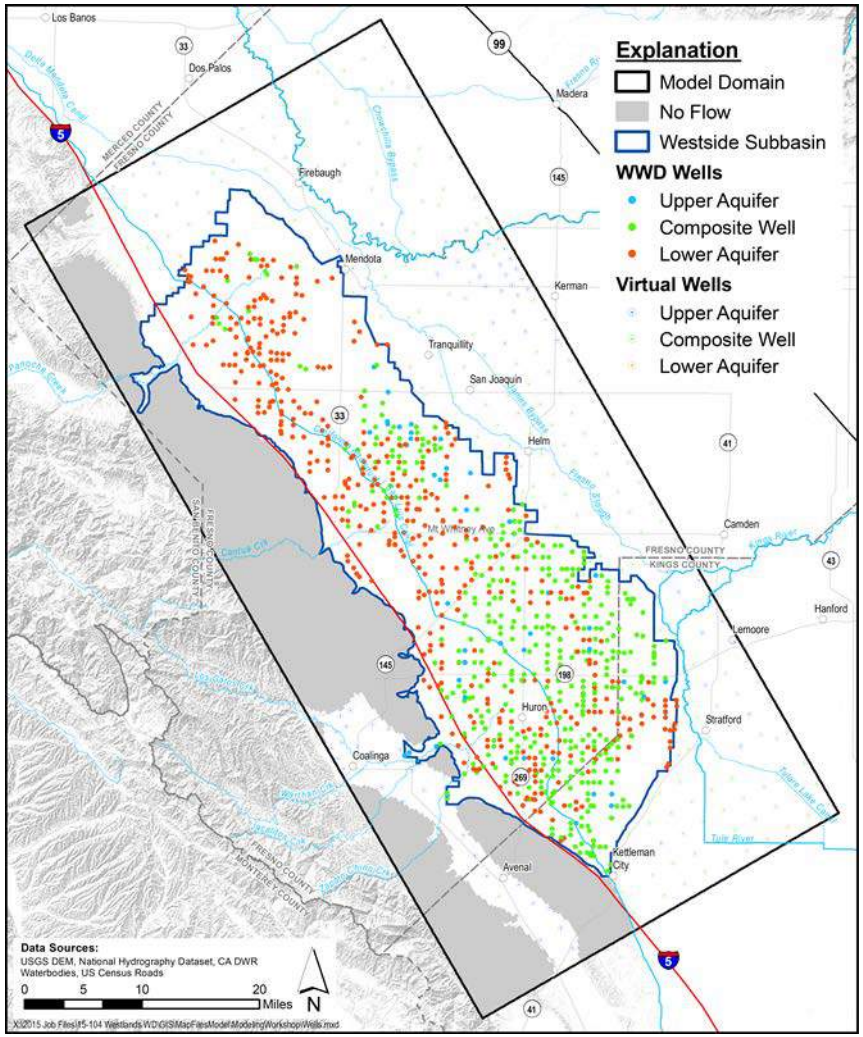
Groundwater Production Wells



- Pumping Rates
  - Pumping rate calculated and distributed in wells within a "Farm" by Farm Process
- Well Construction
  - Based on completion reports within WWD
  - Based on construction within CVHM outside of WWD (Virtual Wells)

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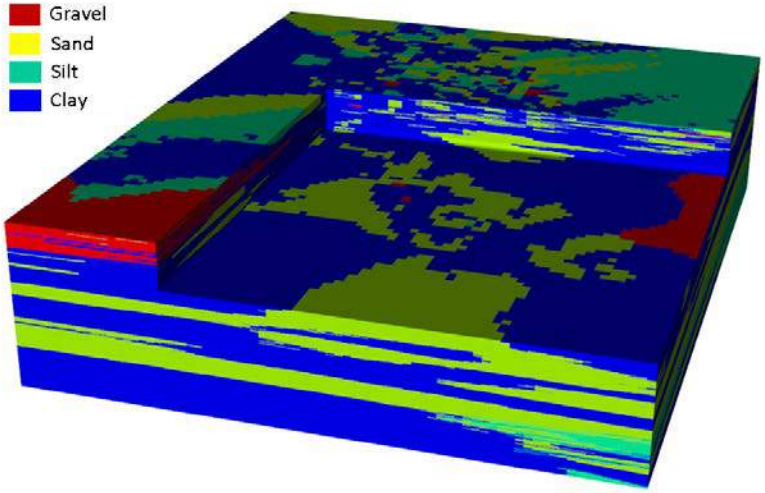
Aquifer Properties

- Indicator Kriging Model
  - Geostatistical model developed from borehole data (well logs and e-logs)
  - Each texture class given numerical value for each hydraulic property and assigned to model grid
  - Limited aquifer test data available
- Used to assign:
  - Hydraulic Conductivity
  - Specific Yield and Porosity
  - Elastic and Inelastic Skeletal Storativity



Geostatistical Model

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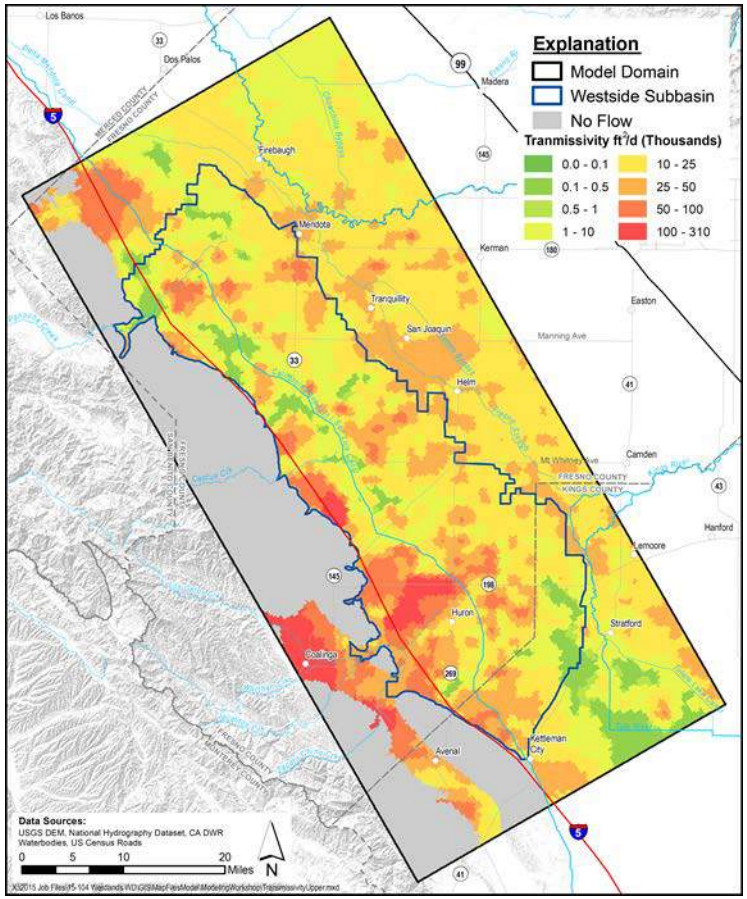
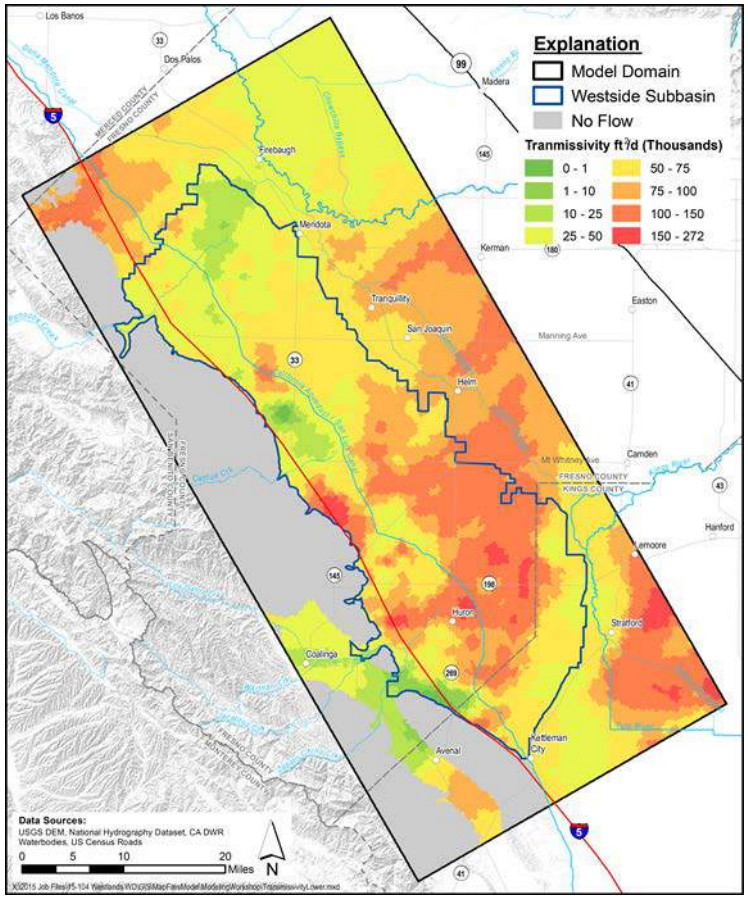
Model Aquifer Transmissivity



Upper Aquifer



Lower Aquifer

Transmissivity

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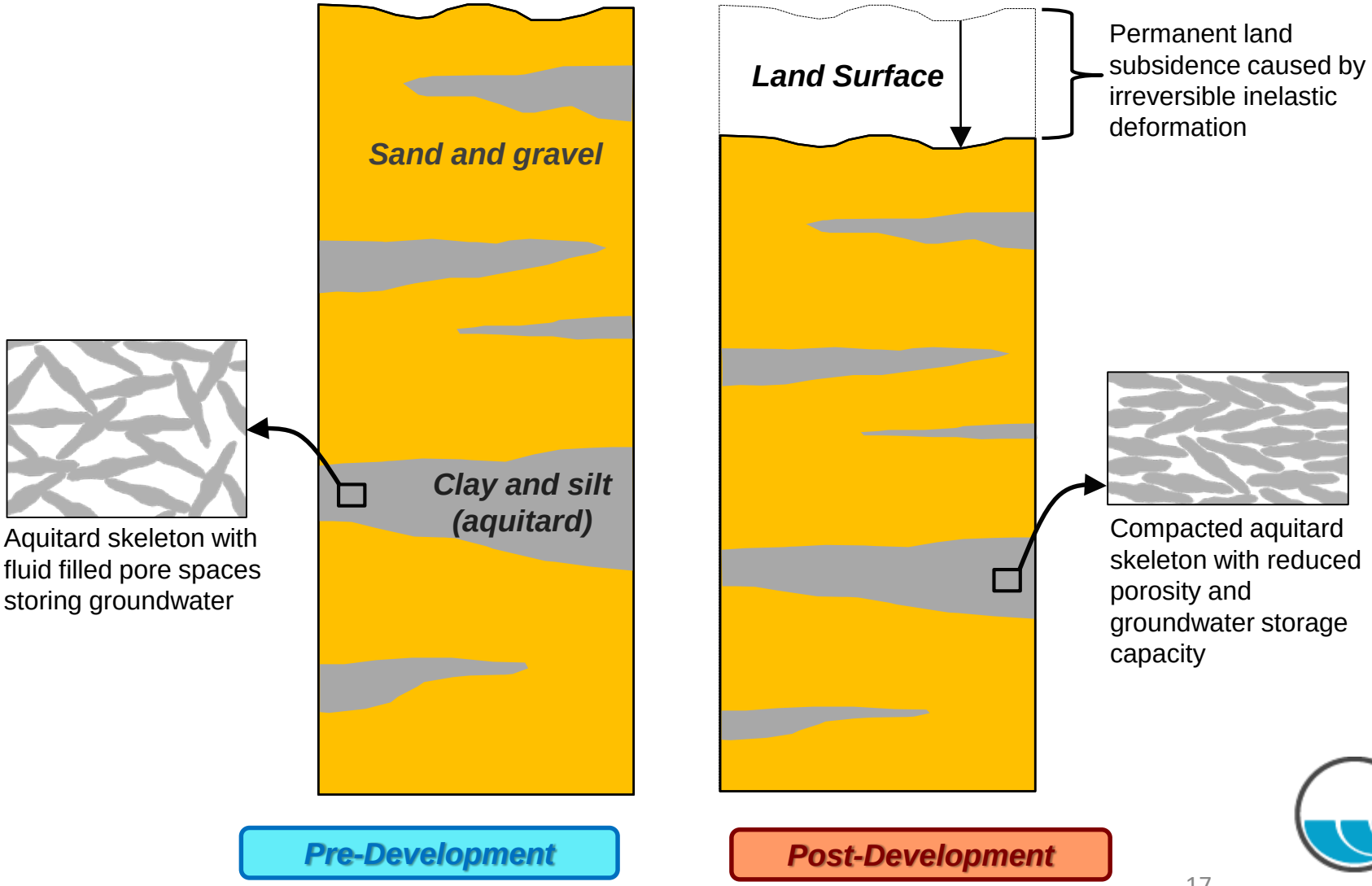
Subsidence



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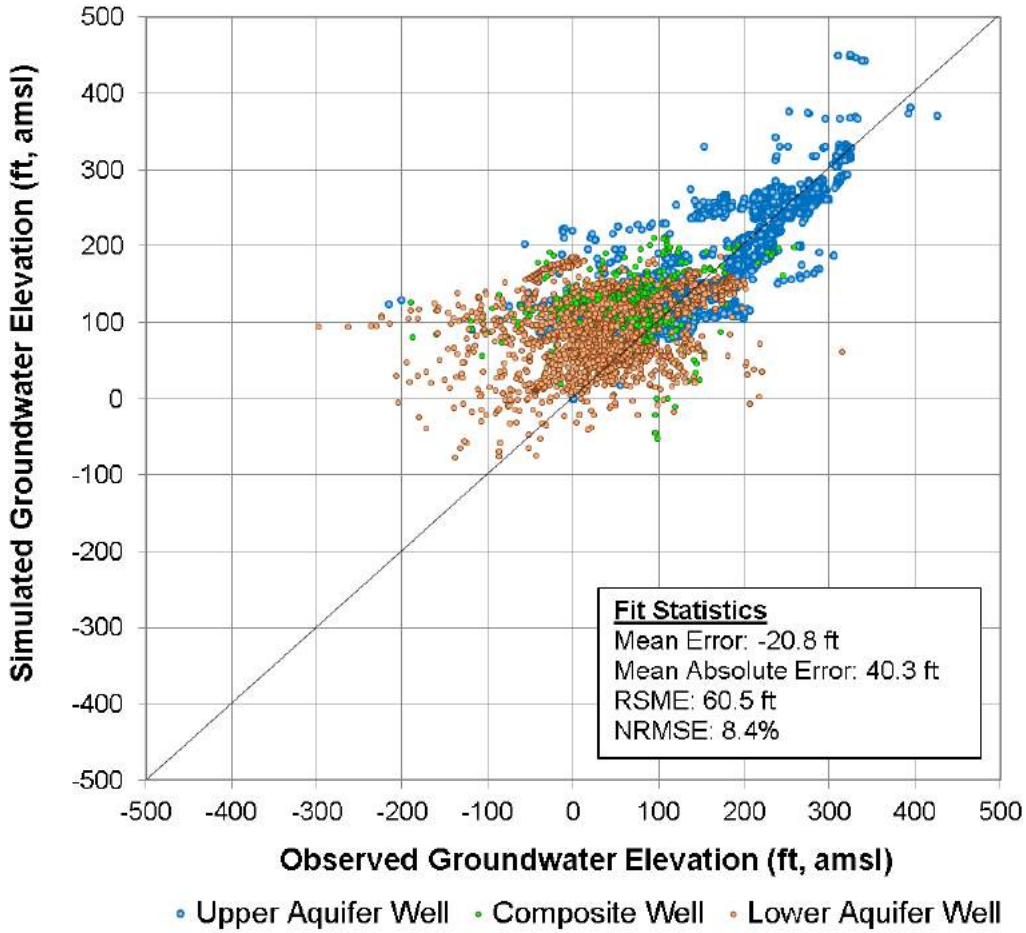
Model Calibration



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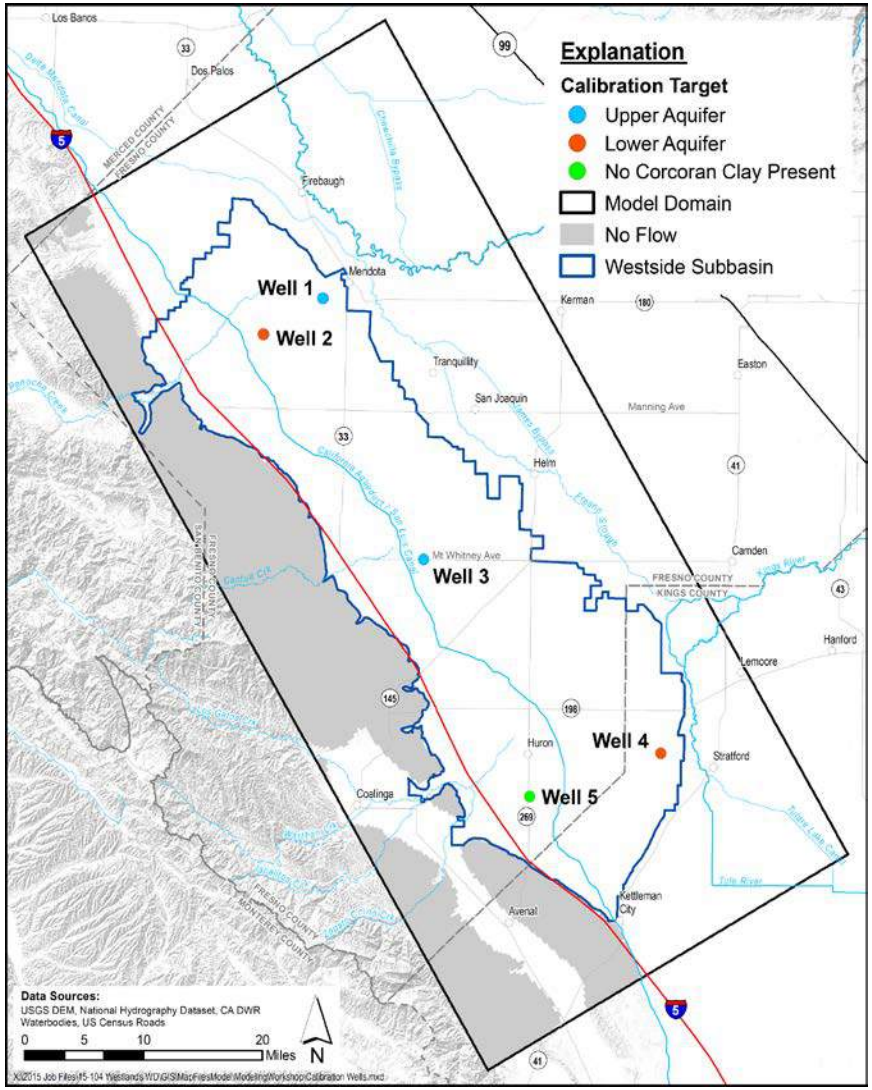
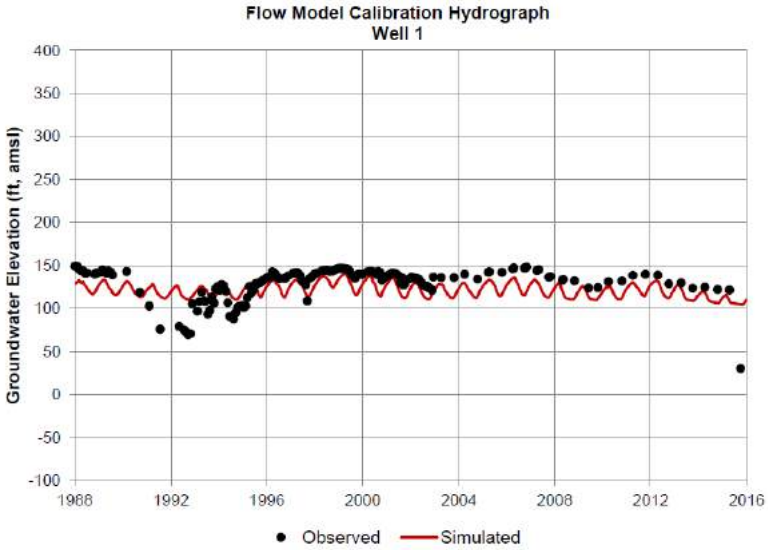
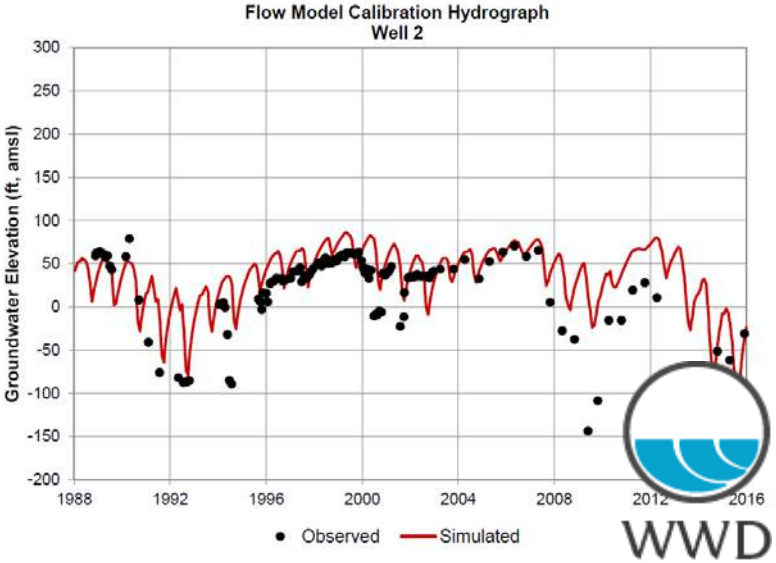
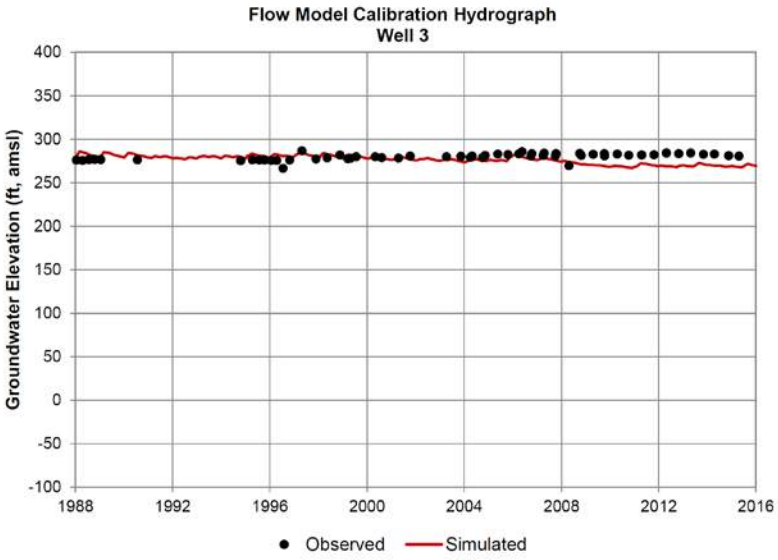
Simulated Groundwater Levels Hydrographs

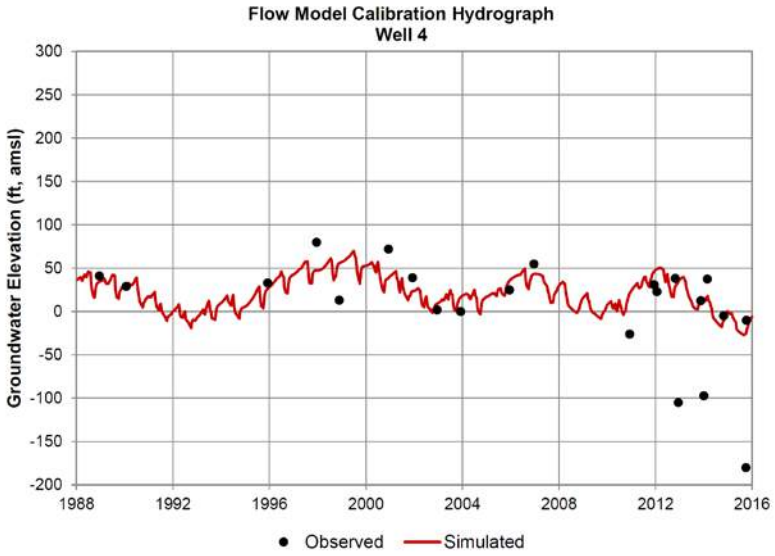


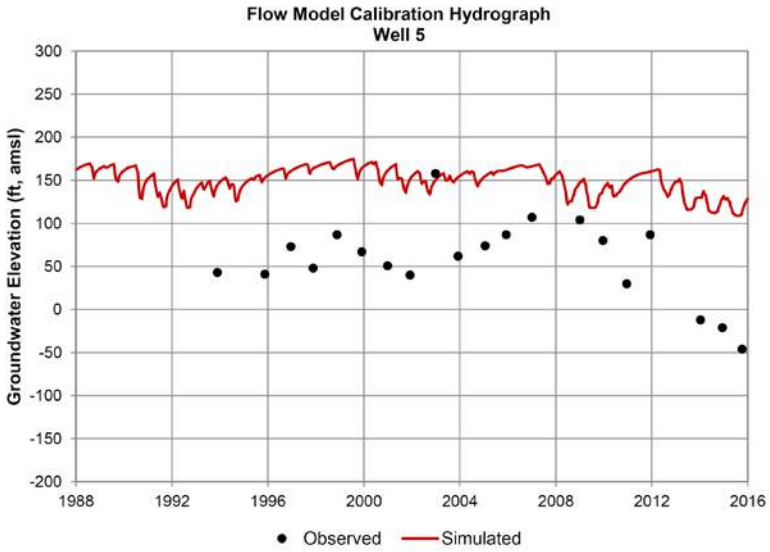




Simulated Groundwater Levels Hydrographs







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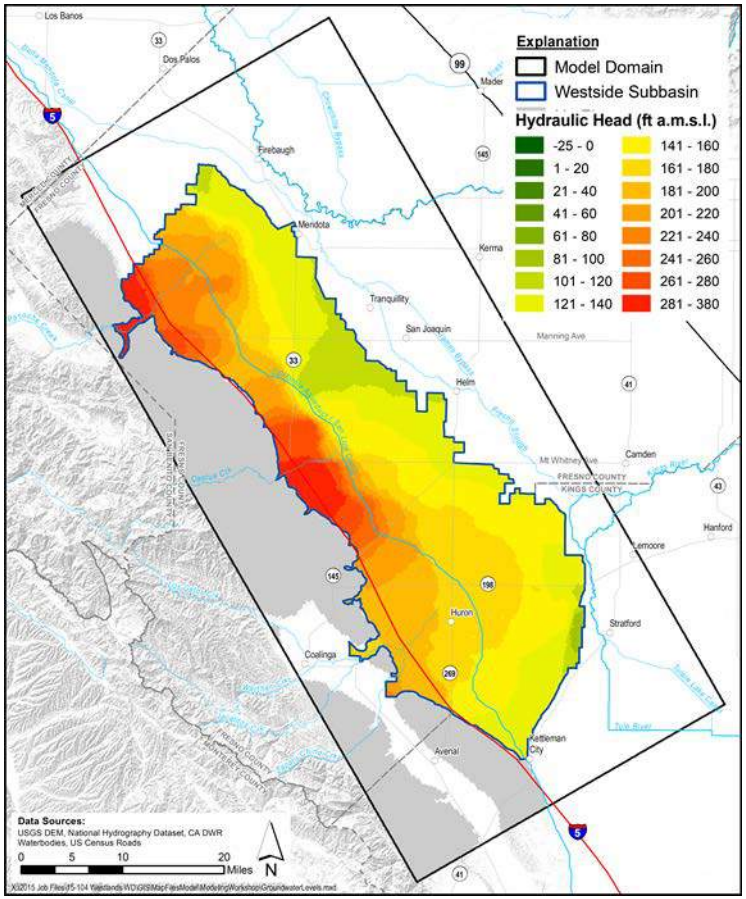
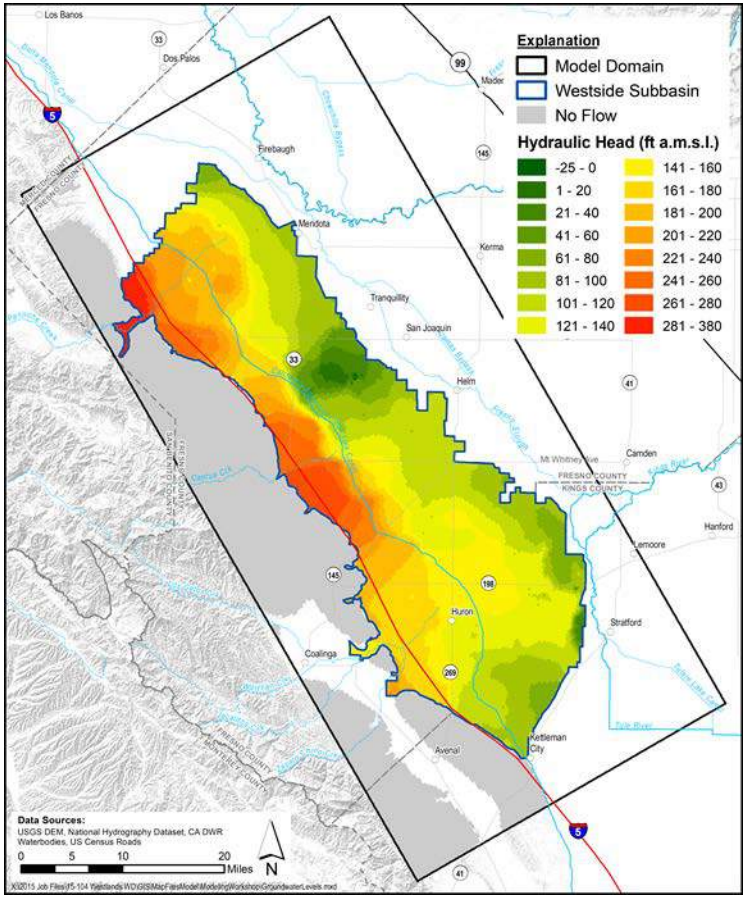
Simulated Groundwater Levels
Upper Aquifer



March 2011



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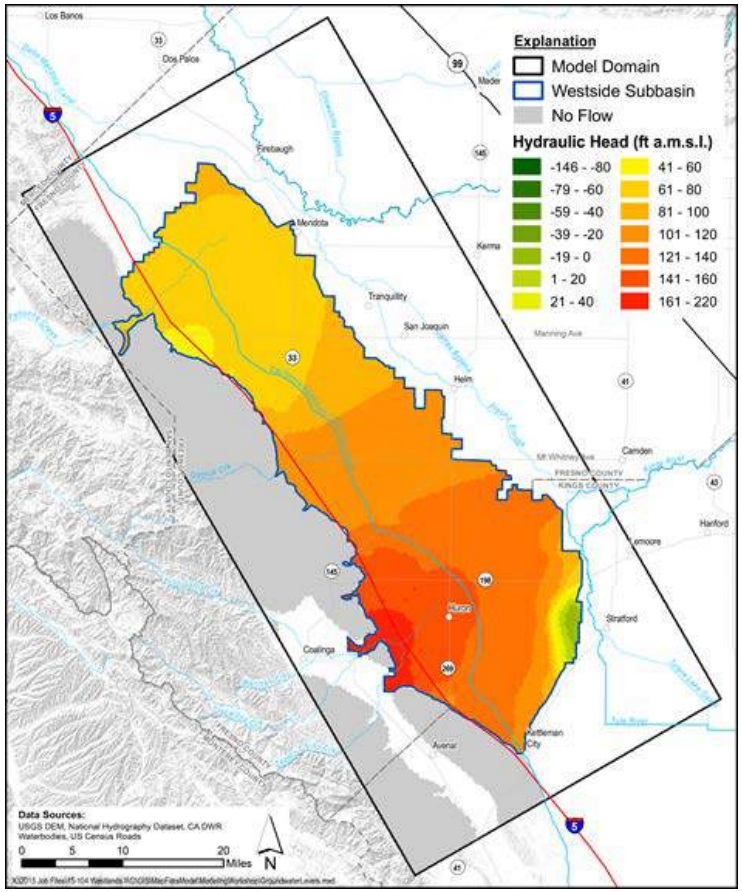
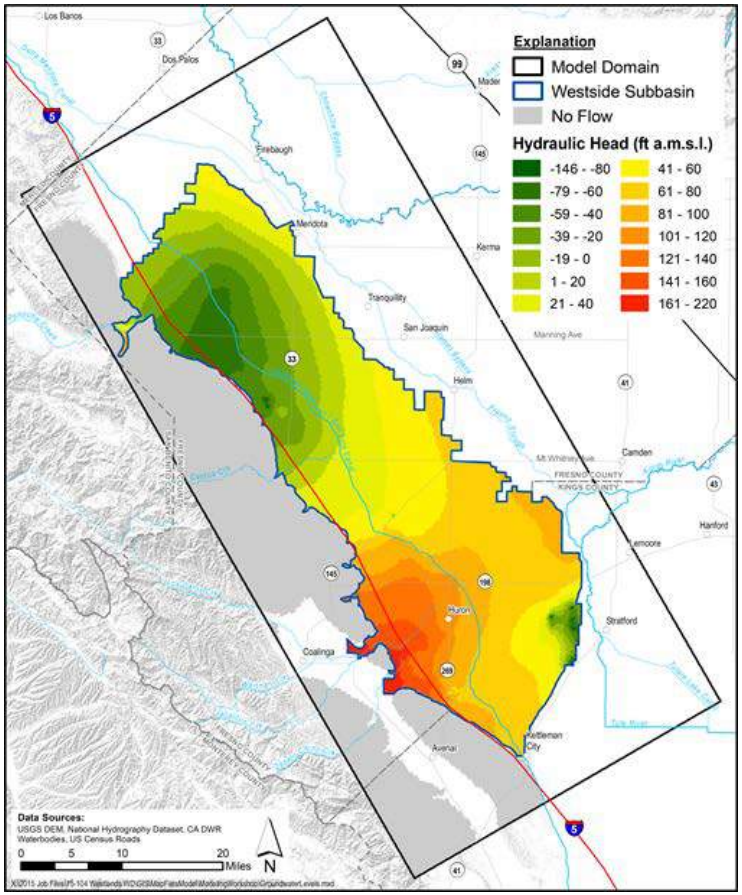
Simulated Groundwater Levels
Lower Aquifer



March 2011



September 2015

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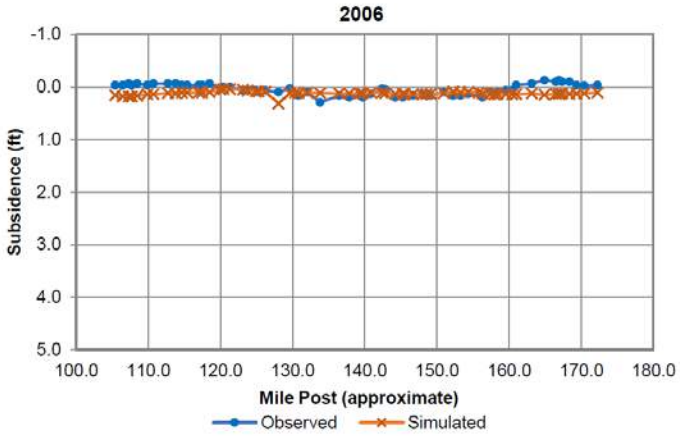
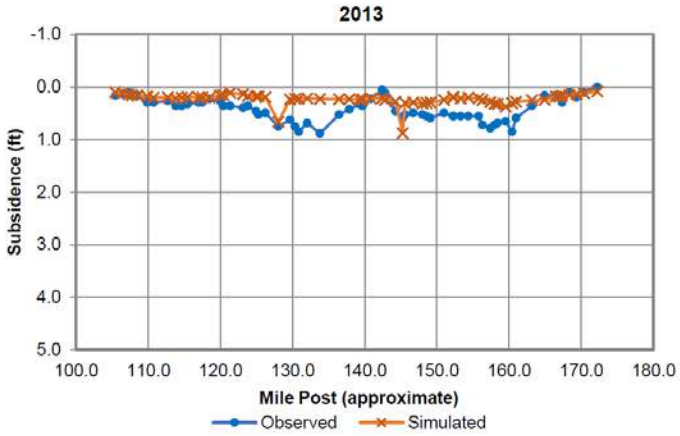
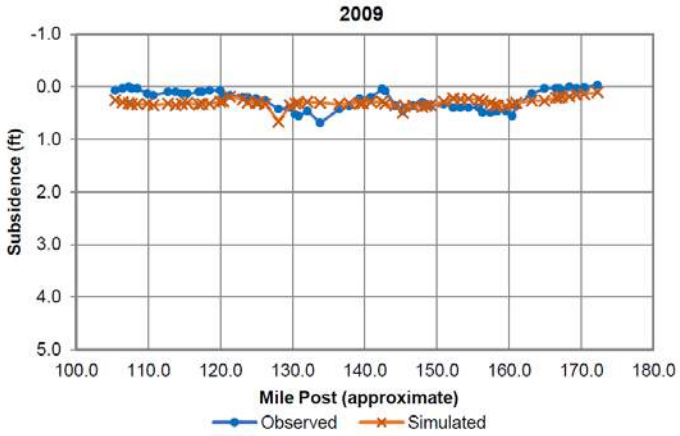
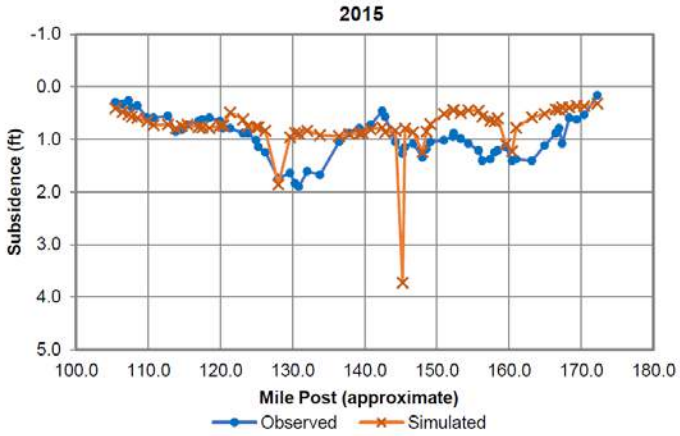
Subsidence Calibration Along San Luis Canal









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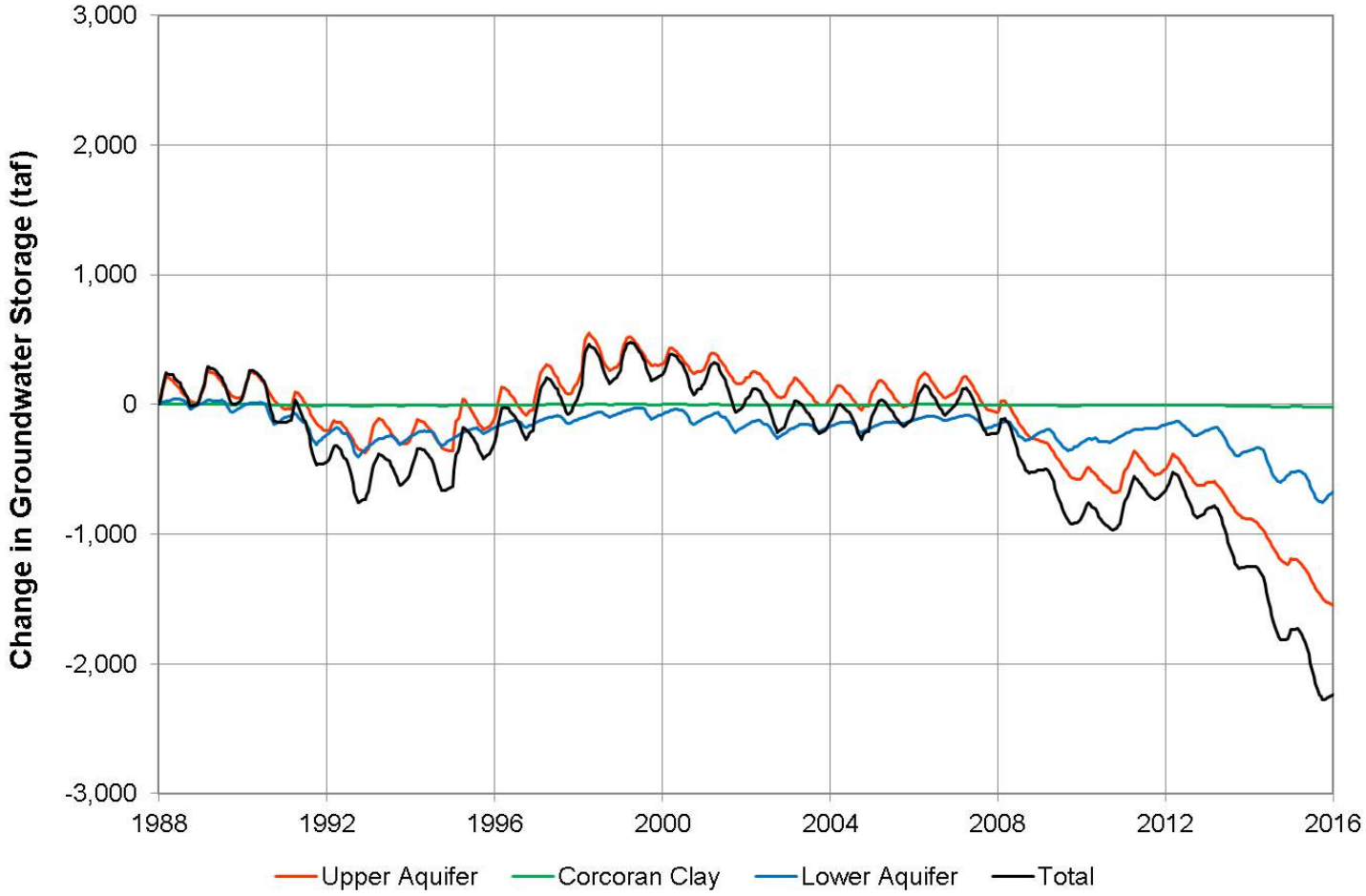
Water Balance: Groundwater Storage



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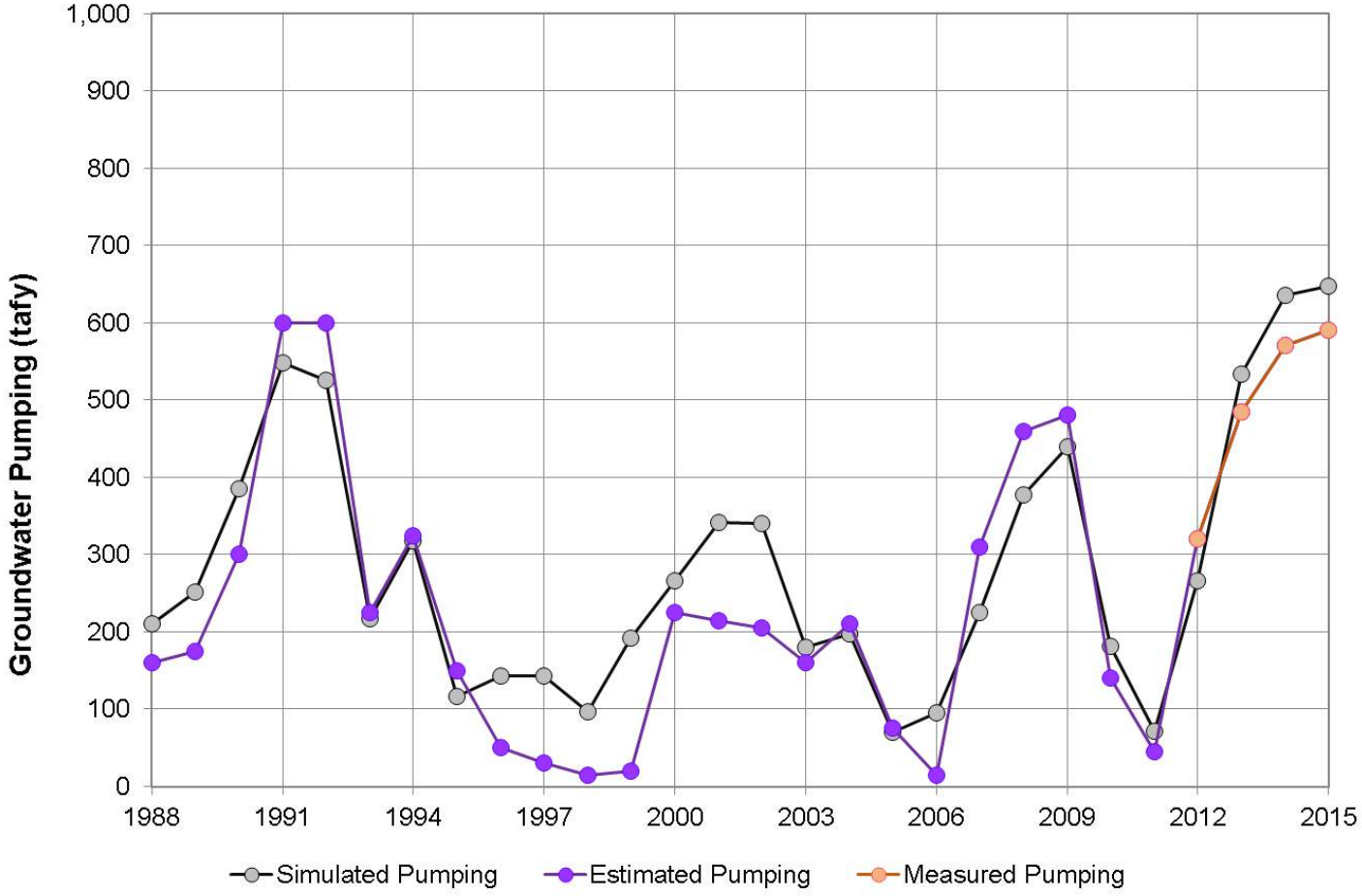
Water Balance Groundwater Pumping



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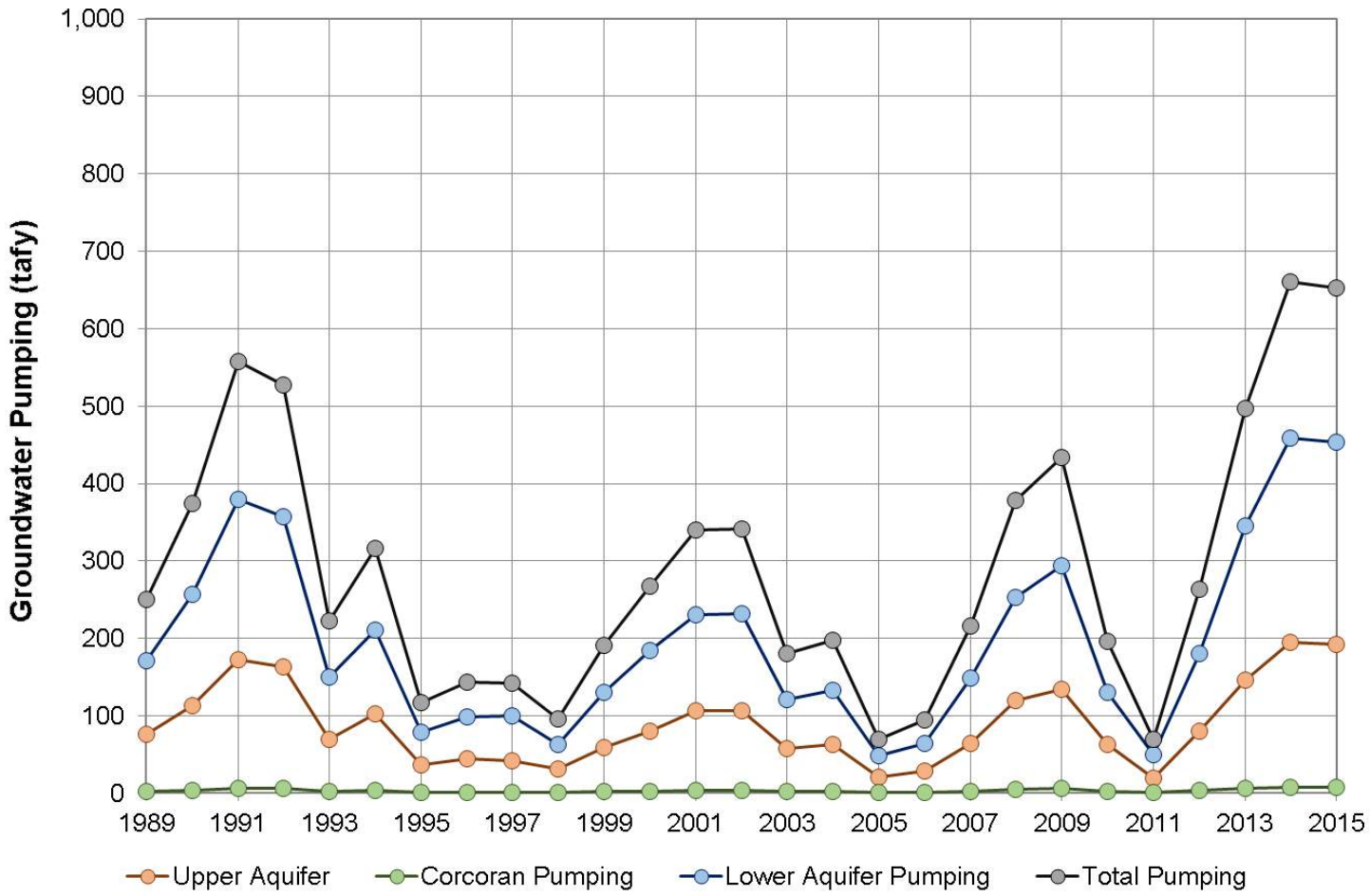
Groundwater Pumping by Aquifer



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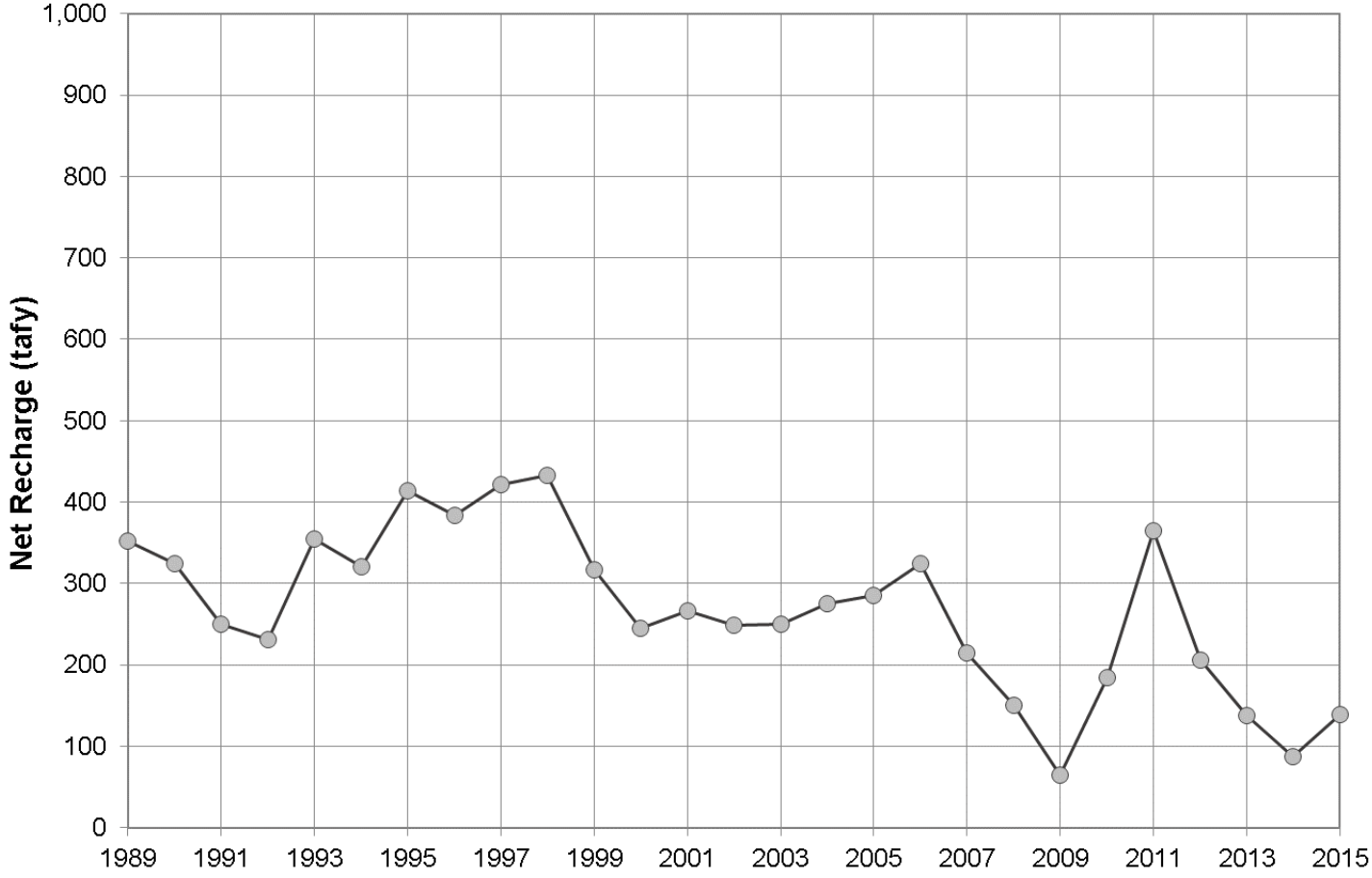
Water Balance Groundwater Recharge



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Groundwater Pumping Potential

Upper Aquifer

- Max- 200 TAF
- Avg-165 TAF
- Min- 130 TAF

Lower Aquifer

- Max- 150 TAF
- Avg-115 TAF
- Min- 80 TAF

Total

- Max- 350 TAF
- Avg- 280 TAF
- Min- 210 TAF

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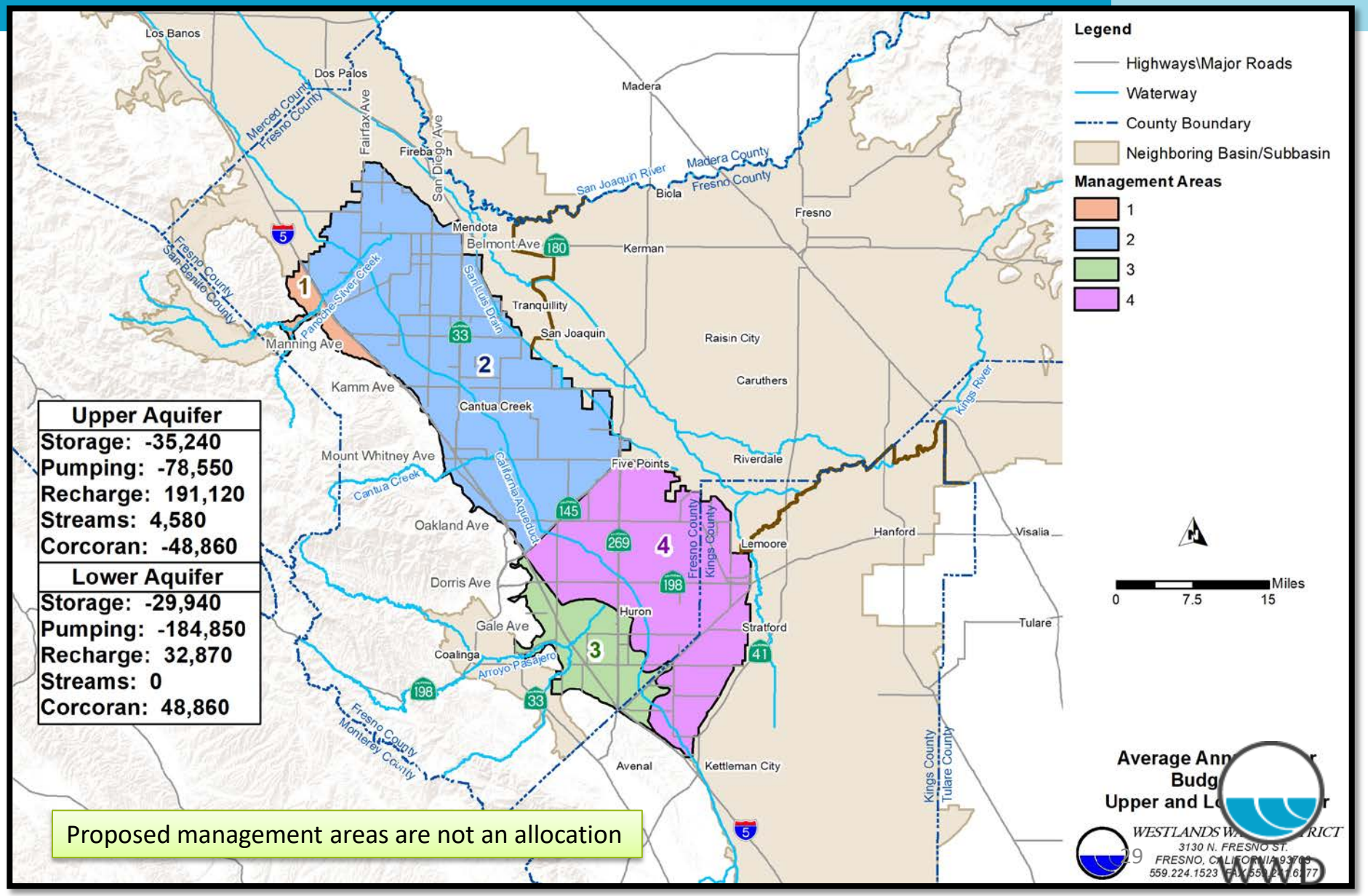
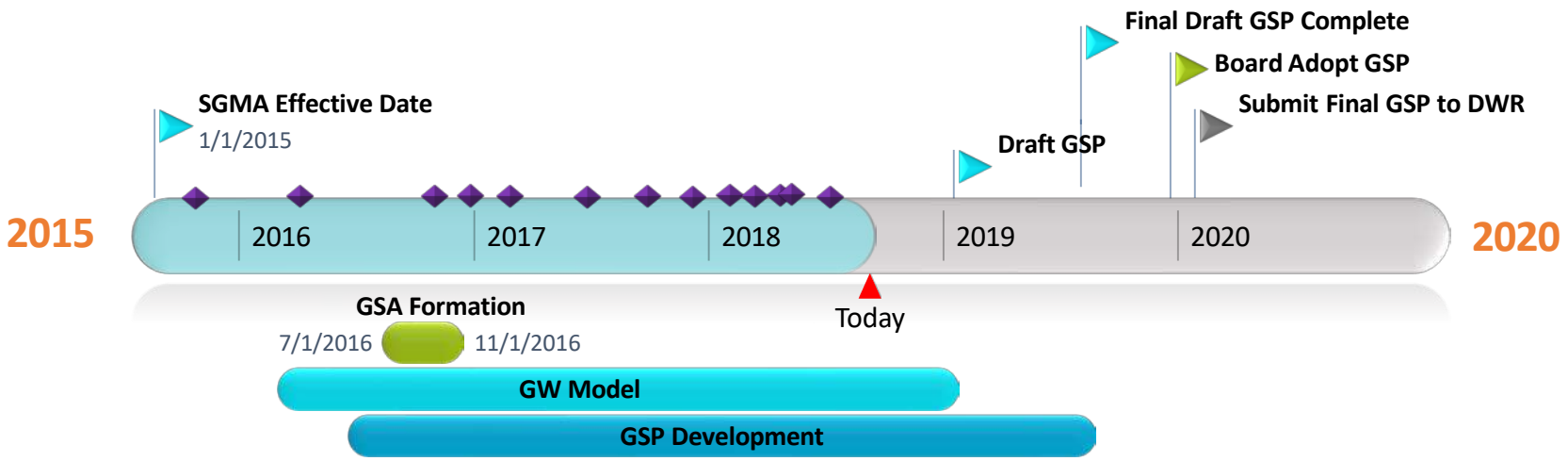
Average Annual Water Budget



SGMA Implementation Timeline



- SGMA workshops & outreach events

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QUESTIONS

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