Item 5B - Sustainable Management Criteria

- Subsidence
- SMC Matrix
- SW Depletion from GW Pumping - Stream Flow Cross Over Analyses

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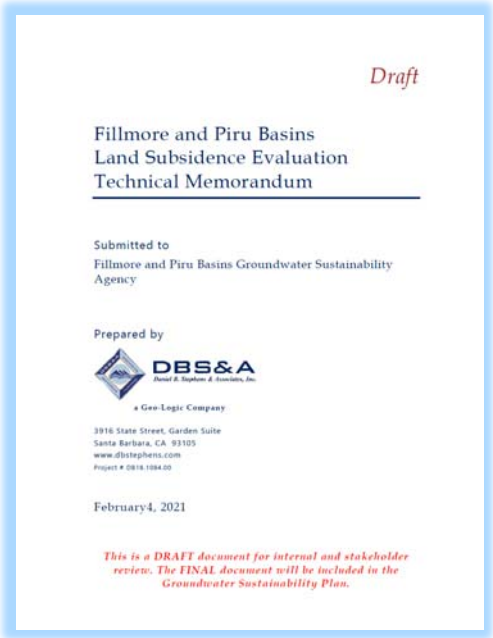
Land Subsidence Evaluation

- Previous investigations and reports;
- Geodetic surveys;
- Interferometric Synthetic Aperture Radar (InSAR) data;
- Subsidence evaluations / potentials.



Draft

Fillmore and Piru Basins
Land Subsidence Evaluation
Technical Memorandum

Submitted to
Fillmore and Piru Basins Groundwater Sustainability Agency

Prepared by

DBS&A
a Geo-Logic Company

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February4, 2021

This is a DRAFT document for internal and stakeholder review. The FINAL document will be included in the Groundwater Sustainability Plan.

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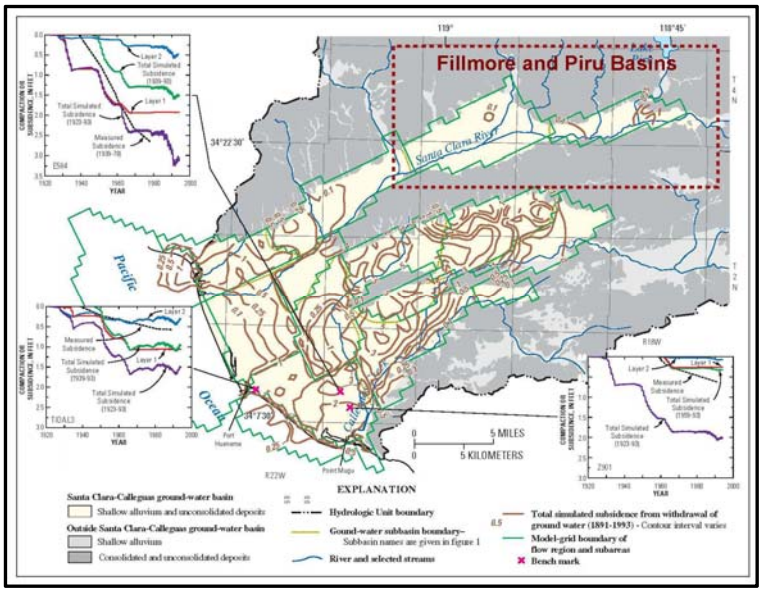
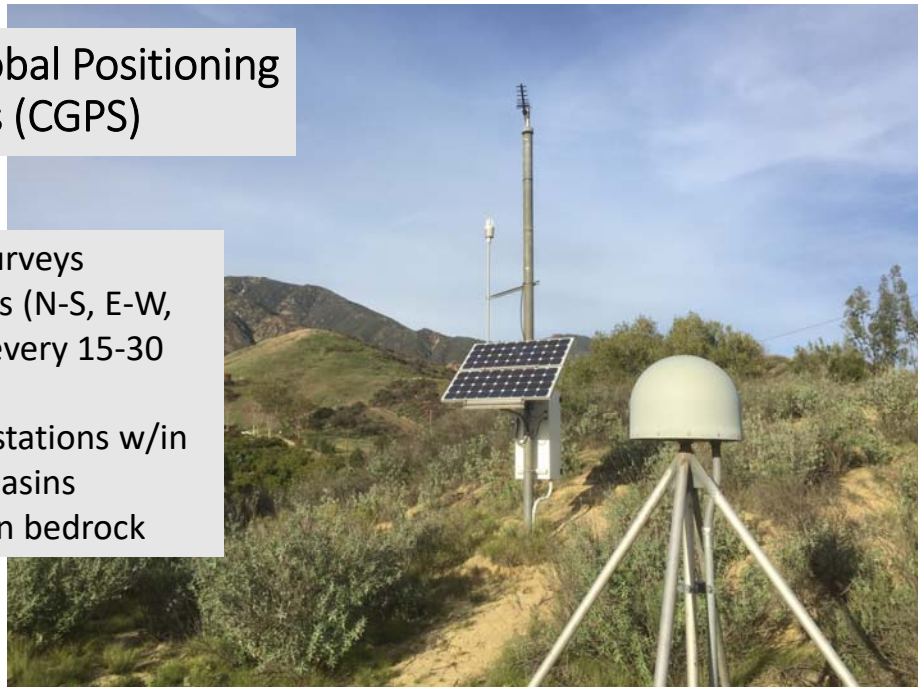


Simulated Subsidence due to Groundwater Withdrawal from 1981 to 1993 (Hanson et al 2003)

Preliminary Draft
Subject to Revision

Continuous Global Positioning Systems (CGPS)

- Geodetic surveys
- 3D positions (N-S, E-W, Elevation) every 15-30 seconds
- Four CGPS stations w/in 5 miles of basins
- Mounted on bedrock



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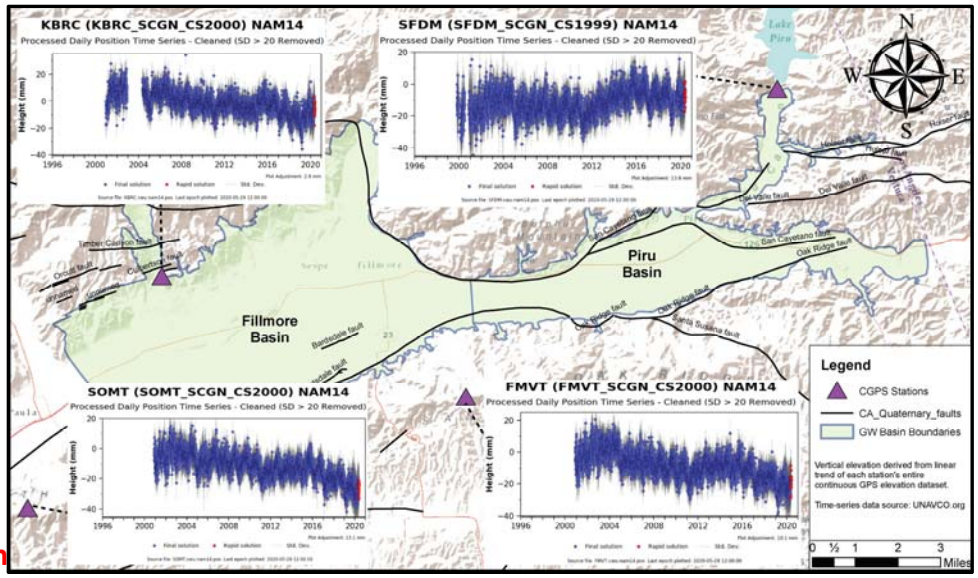
CGPS Locations and Vertical Movement Time-Series (UNAVCO)



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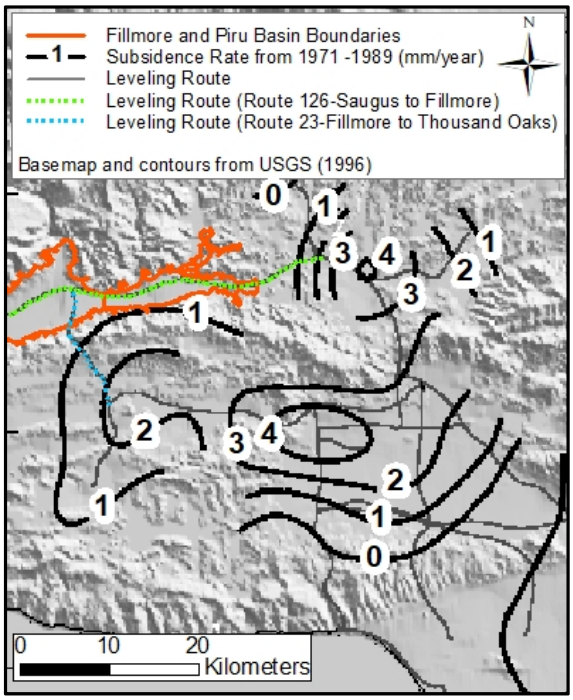
USGS 1994 NGS Leveling Routes and Measured Pre-Seismic Subsidence Rates (mm/year) from 1971 to 1989



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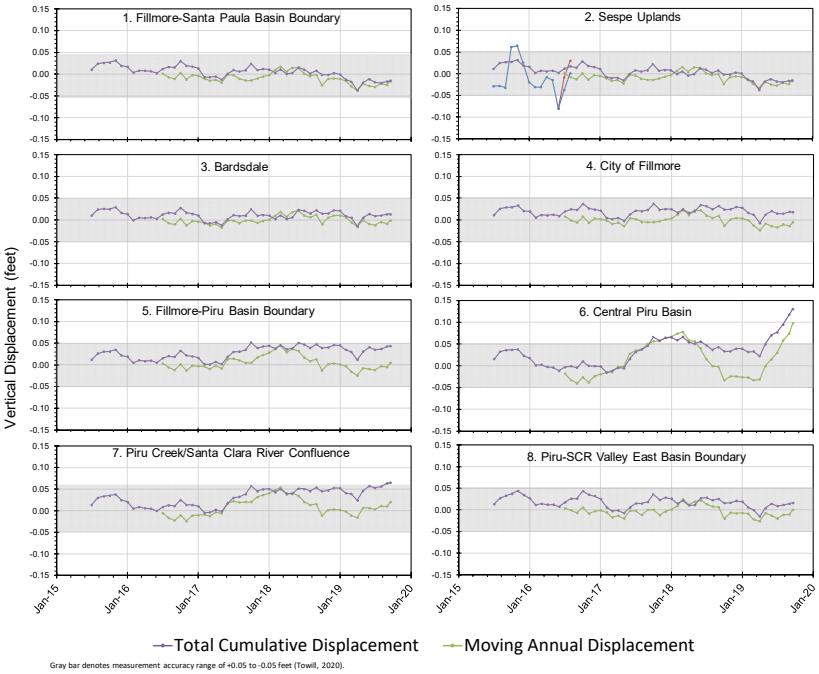
Time-Series Graphs of Annual and Total Land Surface Elevation Changes derived from InSAR



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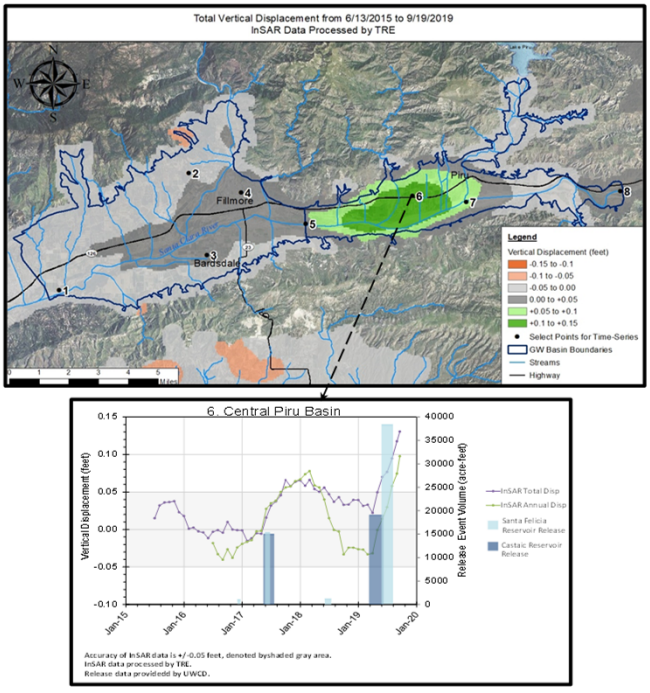
InSAR Data showing Total Vertical Displacement within the Basins.



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Future Subsidence Potential - Representative Wells

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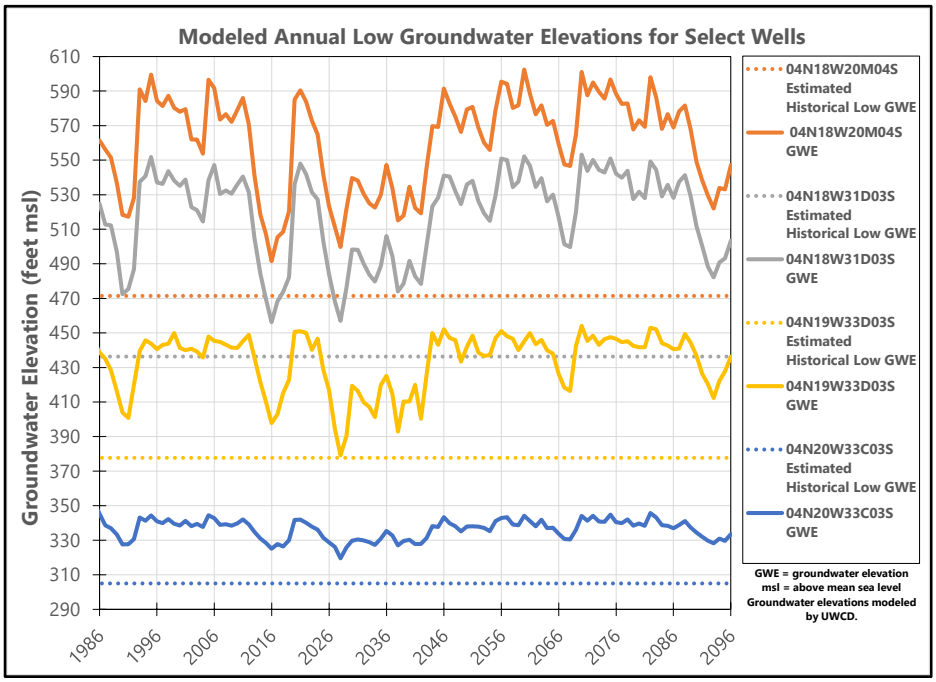
2070CF Modeled Water Levels v. Estimated Historical Low Water Level at Representative Wells



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Difference between Estimated Historical Low Water Levels and 2070CF Modeled Low Water Level

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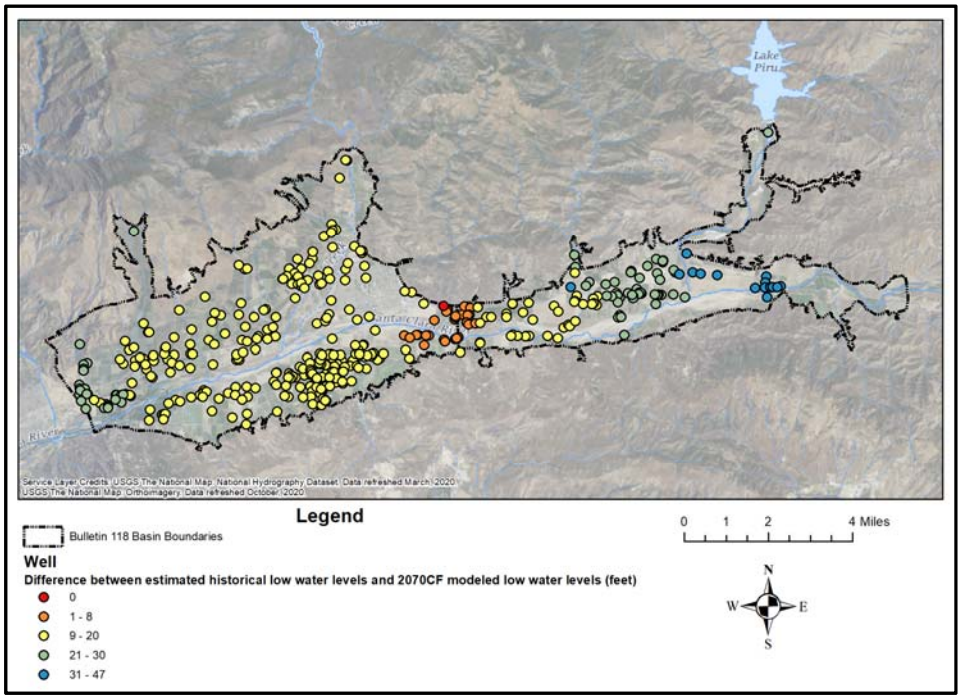

Summary of Subsidence Evaluations

Study / Investigator	Fillmore Basin	Piru Basin	Comments
USGS, 1996	maximum subsidence of 0.03 feet (8 mm, 0.6 mm/yr) near City of Fillmore	maximum subsidence zone up to 0.05 feet (15 mm, ~1 mm/year) around the Town of Piru	1975-1989 study period
Hanson, 2003	maximum value of just over 0.1 feet (0.00098 ft/yr) of subsidence	0.25 feet (0.0024 ft/yr) in the eastern portion of Piru Basin	1891 to 1993 study period
Ventura County, 2013 and 2020	Lies within subsidence hazard zone	Lies within subsidence hazard zone	No technical analyses conducted.
DWR, 2014	Low potential	Insufficient data	
InSAR	Less than +/-0.05 ft	Generally, less than +/-0.05 ft except during periods of artificial recharge, then up to +0.14 ft of rebound in Piru basin	June 2015 – Sept 2019 study period
2070 Climate Change Modeling by UWCD	No subsidence anticipated	No subsidence anticipated	1986 to 2096 model timeframe

Summary of (Inelastic) Subsidence Potential

Basin	Hydro-stratigraphic Setting Susceptibility	Chronic Declines in Groundwater Levels	Geodetic / Extensometer / Tiltmeter Evidence of Subsidence	InSAR Evidence of Subsidence	Subsidence Susceptibility Ranking
Fillmore	Low to Moderate	No	No	No	Low
Piru	Low	No	No	No	Low

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Item 5B - Sustainable Management Criteria

Water Level - Stream Flow Cross Over Analyses

- Updated relationship(s) between WLs in wells near rising GW areas and measured SW flow
- Impact of climate change on SW flows

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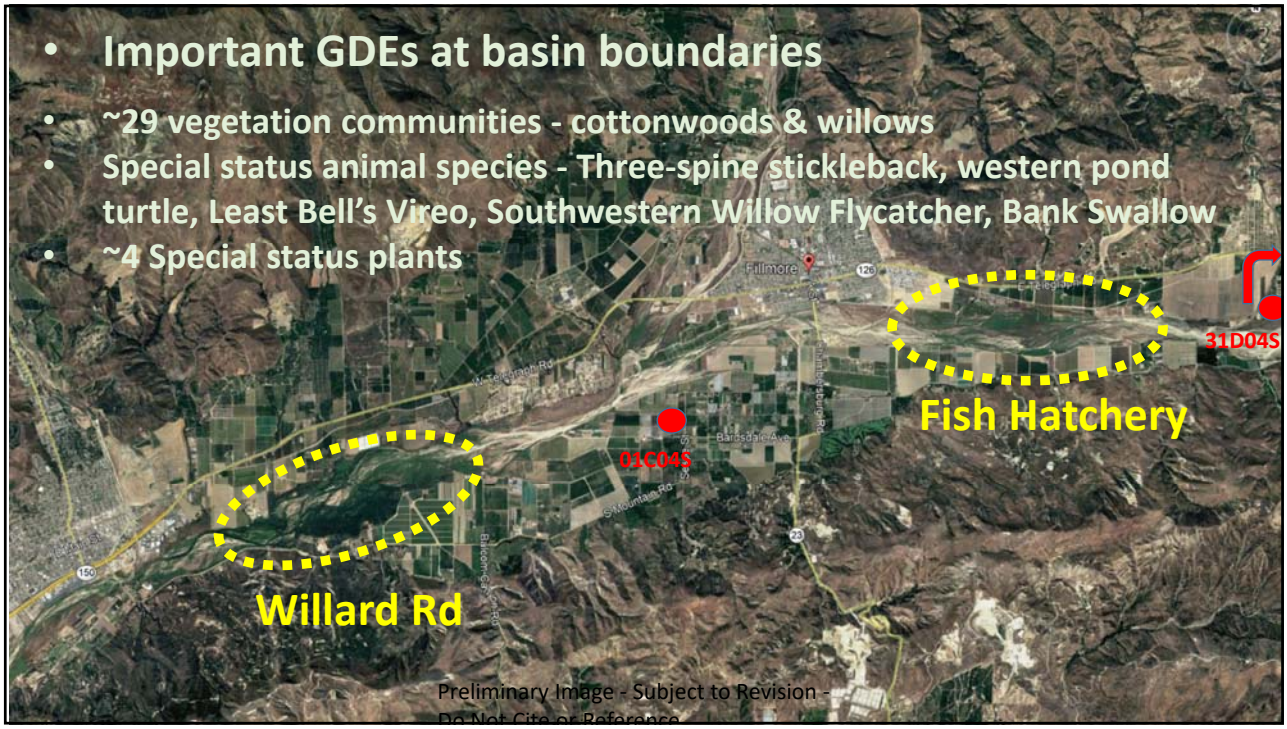
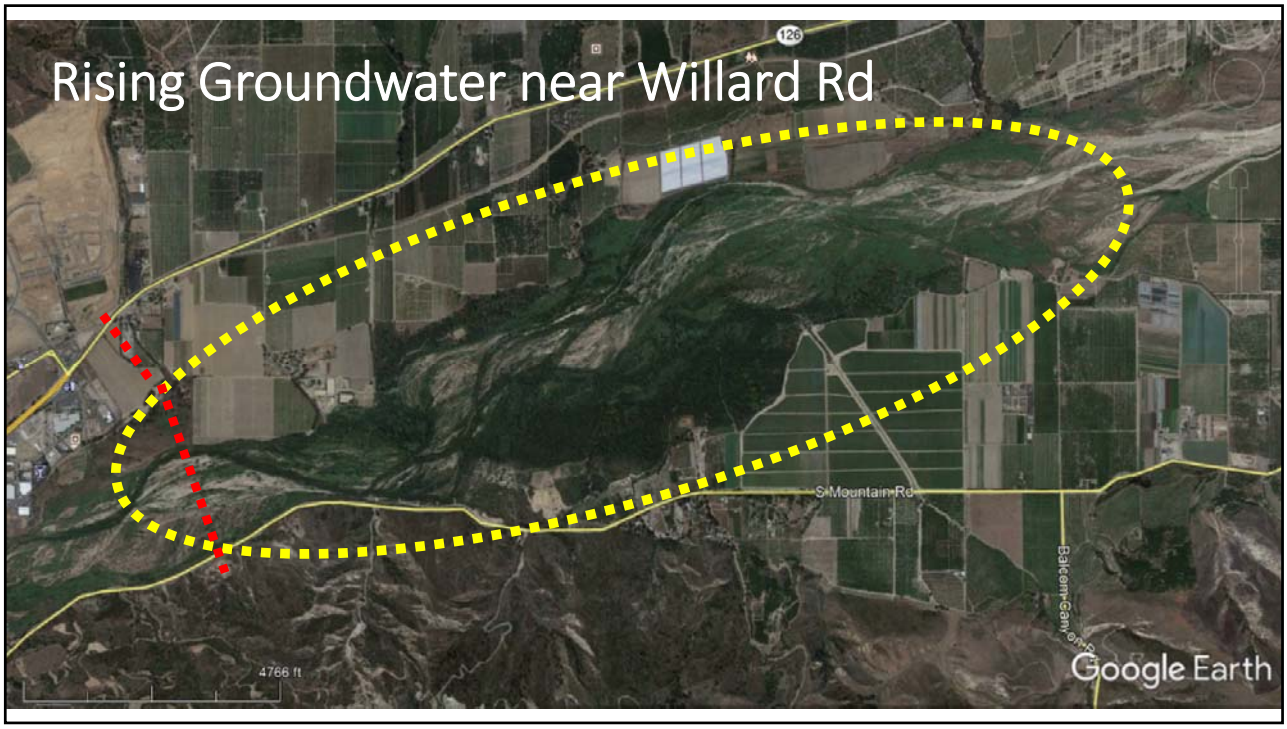
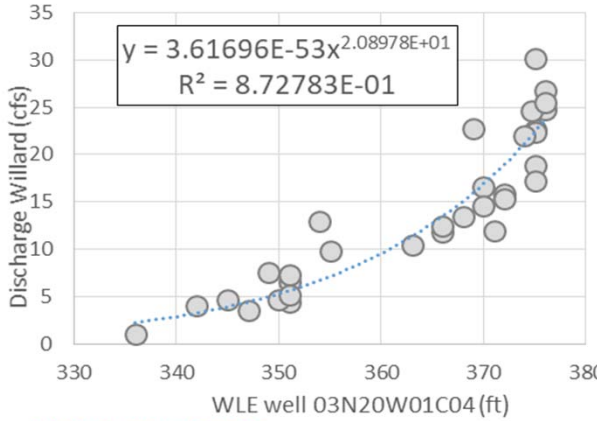

• Important GDEs at basin boundaries
• ~29 vegetation communities - cottonwoods & willows
• Special status animal species - Three-spine stickleback, western pond turtle, Least Bell's Vireo, Southwestern Willow Flycatcher, Bank Swallow
• ~4 Special status plants
Fillmore
31D04S
Fish Hatchery
01C04S
Willard Rd
Preliminary Image - Subject to Revision -
Do Not Cite or Reference

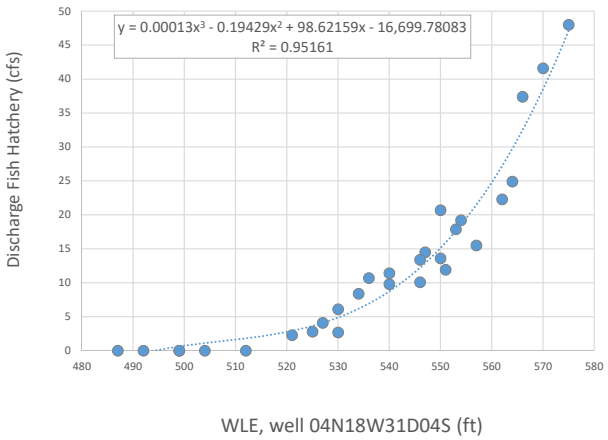

Rising Groundwater near Willard Rd
126
S Mountain Rd
4766 ft
Google Earth

Water Level - Stream Flow Cross Over Analyses

Willard Road



Fish Hatchery



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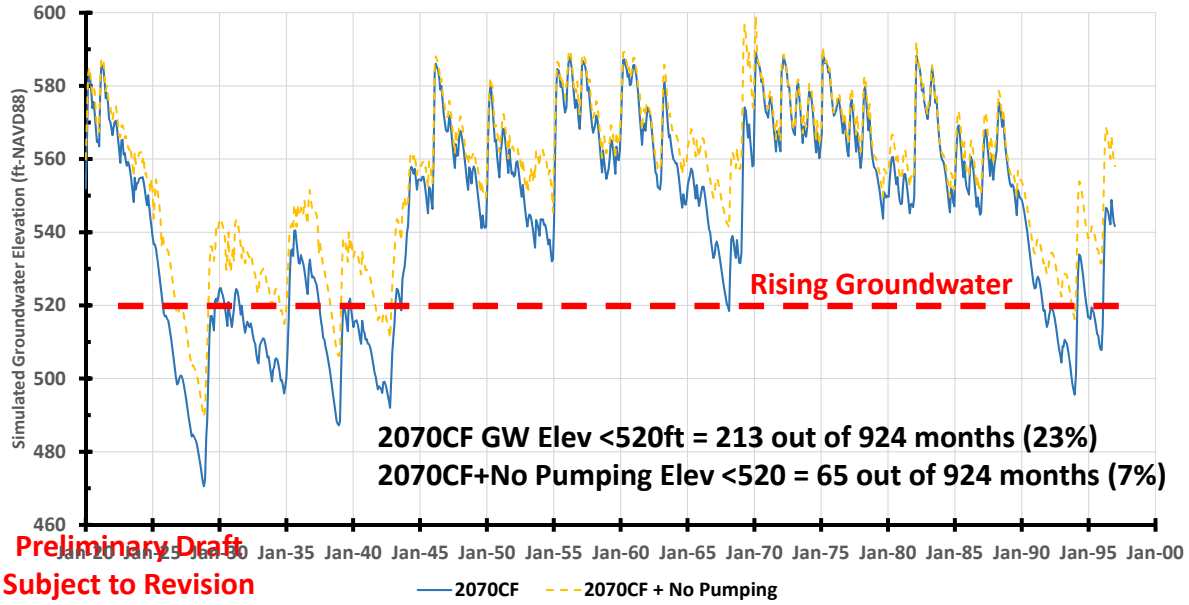
Subject to Revision

Fish Hatchery - 04N18W31D045



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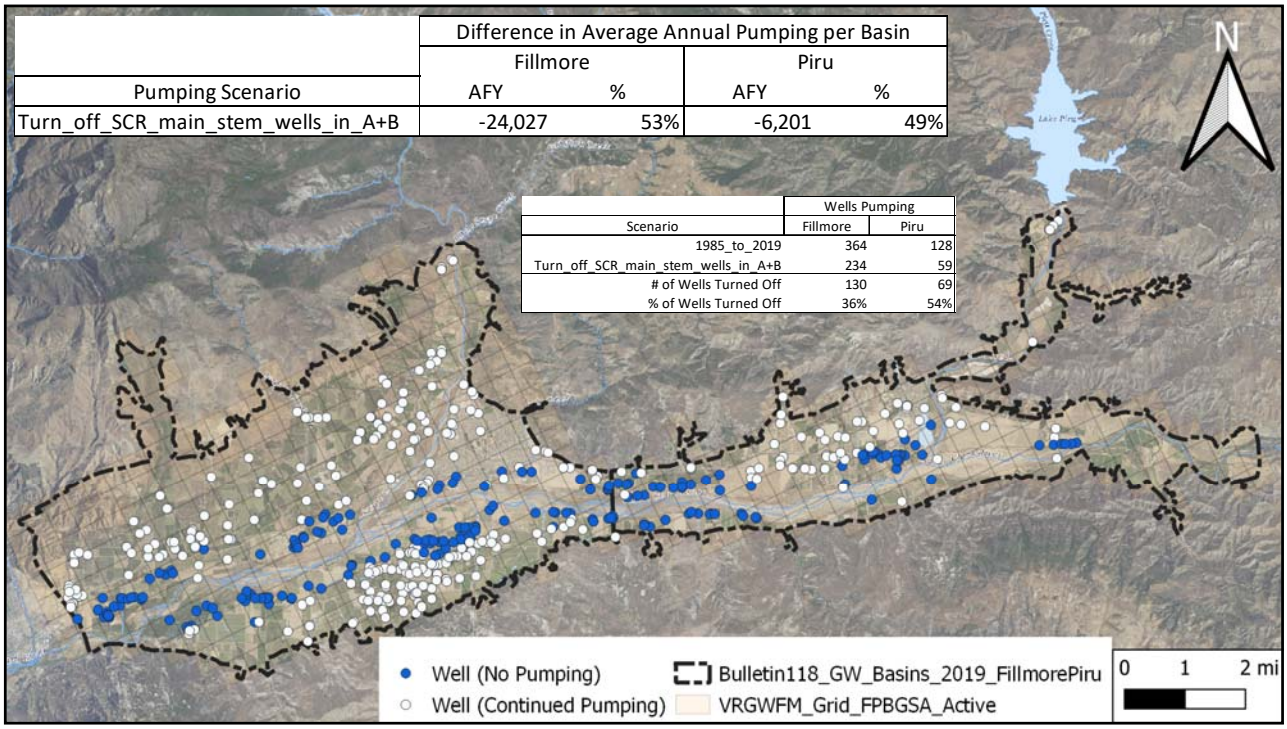
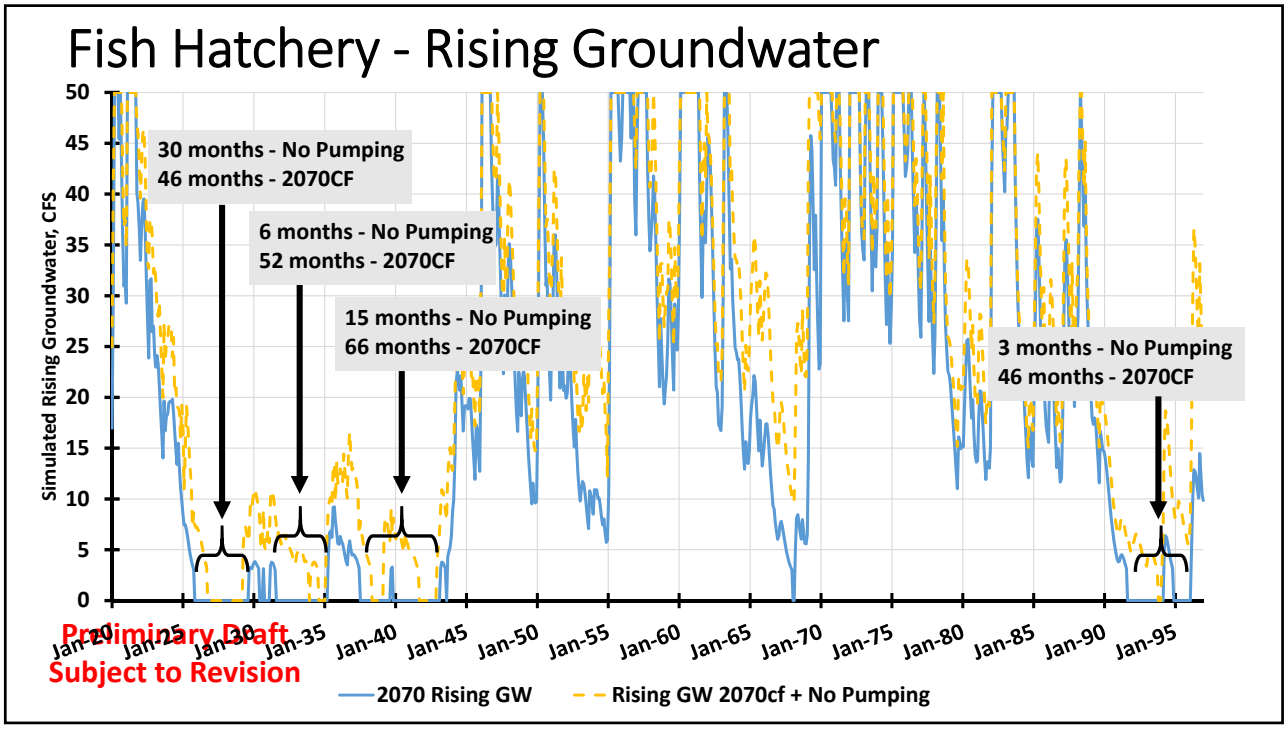

Difference in Average Annual Pumping per Basin
Fillmore
Piru
Pumping Scenario
AFY
%
AFY
%
Turn_off_SCR_main_stem_wells_in_A+B
-24,027
53%
-6,201
49%
Wells Pumping
Scenario
Fillmore
Piru
1985_to_2019
364
128
Turn_off_SCR_main_stem_wells_in_A+B
234
59
# of Wells Turned Off
130
69
% of Wells Turned Off
36%
54%
N
Well (No Pumping)
Well (Continued Pumping)
Bulletin118_GW_Basins_2019_FillmorePiru
VRGWFM_Grid_FPBGSA_Active
0
1
2 mi


Fish Hatchery - Rising Groundwater
Simulated Rising Groundwater, CFS
50
45
40
35
30
25
20
15
10
5
0
30 months - No Pumping
46 months - 2070CF
6 months - No Pumping
52 months - 2070CF
15 months - No Pumping
66 months - 2070CF
3 months - No Pumping
46 months - 2070CF
Jan-20
Jan-25
Jan-30
Jan-35
Jan-40
Jan-45
Jan-50
Jan-55
Jan-60
Jan-65
Jan-70
Jan-75
Jan-80
Jan-85
Jan-90
Jan-95
Preliminary Draft
Subject to Revision
2070 Rising GW
Rising GW 2070cf + No Pumping

Item 5B - Sustainable Management Criteria

Groundwater Level - Rising Groundwater

- Updated relationship(s) between simulated WLs near the Fish Hatchery under the 2070CF conditions
- Impact of groundwater pumping on groundwater levels

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2070CF & 2070CF(No Pumping) Hydrographs - Fish Hatchery

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Item 5B - Sustainable Management Criteria

Minimum Thresholds & Measurable Objectives

- **Updated SMC matrices**

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SMCs - General Framework

- ***Lowering GW Levels*** - no chronic decline in water levels
- ***Reduction of GW Storage*** - no chronic decline in GW storage
- ***Seawater Intrusion*** - not applicable
- ***Degraded Water Quality*** - no regulatory authority over WQ / work with existing agencies with appropriate regulatory authority
- ***Land Subsidence*** - not anticipated during future climate & pumping conditions
- ***Surface Water Depletion*** - no chronic decline in SW flows (rising GW areas)

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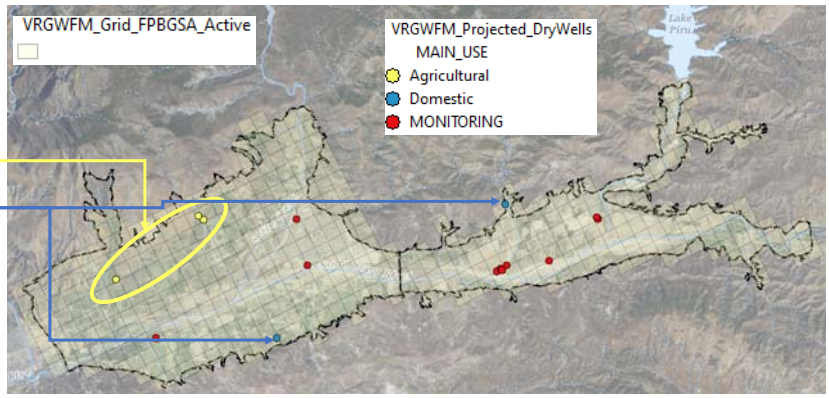
Dry Wells Evaluation (for 2070CF Future Scenario)

***Bottom line:* No production wells are predicted to go dry - Only 3 AG and 2 DOM wells modelled to go dry**

Notes:

- Based on comparison of modelled GW levels vs. bottom of screen...
- Some shallow monitoring wells (with screen <100 ft deep) will go dry during droughts.
- Manually inspected 3 agricultural wells and 2 domestic wells that modelled GW levels indicate would go dry:
  - Unlikely to go dry based on measured GW levels.
- Biases in modelled GW levels tends to underestimate measured GW levels, making this a cautious/conservative evaluation.



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SMC Matrix - TBS

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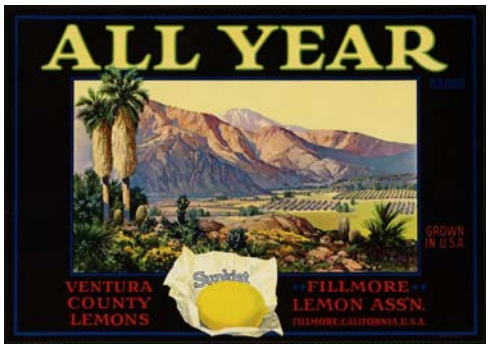
Subject to Revision

Questions?



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