



CUYAMA BASIN GROUNDWATER SUSTAINABILITY AGENCY SPECIAL STANDING ADVISORY COMMITTEE MEETING

Committee Members

Brenton Kelly (Chair)	Jean Gaillard	Karen Adams
Brad DeBranch (Vice Chair)	Joe Haslett	John Caufield
Jake Furstenfeld	Roberta Jaffe	David Lewis

AGENDA

July 25, 2024

Agenda for a meeting of the Cuyama Basin Groundwater Sustainability Agency Standing Advisory Committee meeting to be held on Thursday, July 25, 2024, at 5:00 PM at the **Cuyama Valley Family Resource Center 4689 CA-166, New Cuyama, CA 93254**.

Participate via computer at: <https://rb.gy/c490p> or by going to Microsoft Teams, downloading the free application, then entering Meeting ID: 290 937 651 464 Passcode: z8mi9V, or telephonically at (469) 480-3918, Phone Conference ID: 588 047 246#.

The order in which agenda items are discussed may be changed to accommodate scheduling or other needs of the Committee, the public or meeting participants. Members of the public are encouraged to arrive at the commencement of the meeting to ensure that they are present for Committee discussion of all items in which they are interested.

Teleconference Locations:

4689 CA-166
New Cuyama, CA 93254

1601 Bolthouse Drive Suite 200
Bakersfield, CA 93311

In compliance with the Americans with Disabilities Act, if you need disability-related modifications or accommodations, including auxiliary aids or services, to participate in this meeting, please contact Taylor Blakslee at (661) 477-3385 by 4:00 p.m. on the Wednesday prior to this meeting. The Cuyama Basin Groundwater Sustainability Agency reserves the right to limit each speaker to three (3) minutes per subject or topic.

1. Call to Order (Kelly) (1 min)
2. Roll Call (Kelly) (1 min)
3. Pledge of Allegiance (Kelly) (2 min)
4. Meeting Protocols (Blakslee) (2 min)
5. Public Comment for Items Not on the Agenda | *At this time, the public may address the Committee on any item not appearing on the agenda that is within the subject matter jurisdiction of the Committee.*

ACTION ITEMS

6. Approval of April 25, 2024, Minutes (Kelly) (3 min)
7. Groundwater Sustainability Plan Implementation
 - a) Update on Fault Investigation Study (Strandberg) (30 min)
 - b) Update on Cuyama Basin Water Resources Model (Beck/Van Lienden) (60 min)
 - c) Discuss and Take Appropriate Action on a Monitoring Network Consultant Contract for FY 24-25 (Blakslee) (5 min)
 - d) Discuss and Take Appropriate Action on Data Management System Update Options (Van Lienden) (5 min)

8. Groundwater Sustainability Plan Amendment Components

- a) Update on GSP Component Schedule (Beck/Van Lienden) (5 min)
- b) Discuss and Take Appropriate Action on Project and Management Action Options [**Final Discussion**] (Blakslee/Van Lienden) (30 min)
- c) Discuss and Take Appropriate Action on Glidepath Methodology [**Final Discussion**] (Blakslee/Van Lienden) (30 min)
- d) Discuss and Take Appropriate Action on Basin-Wide Water Management Narrative (Beck/Van Lienden/Dominguez) (10 min)
- e) Discuss and Take Appropriate Action on Updated CMA Boundary, Management Area Criteria, Use of an Operational Boundary and Use of Farm Units [**Final Discussion**] (Blakslee/Van Lienden) (30 min)
- f) Discuss and Take Appropriate Action on Groundwater Allocations [**Final Discussion**] (Blakslee/Van Lienden) (30 min)
- g) Discuss and Take Appropriate Action on Frequency of Changes to Groundwater Allocations [**Final Discussion**] (Blakslee/Van Lienden) (30 min)
- h) Discuss and Take Appropriate Action on GSP Draft Chapters: [Final Discussion] (Beck/Van Lienden) (30 min)
 - i. Chapter 2. Basin Setting
 - ii. Chapter 3. Undesirable Results
 - iii. Chapter 5. Sustainability Management Criteria
 - iv. Chapter 6. Data Management System (DMS)
- i) Discuss and Take Appropriate Action on GSP Amendment Comment Process (Blakslee/Gardiner) (10 min)

REPORT ITEMS

9. Technical Updates

- a. Update on Groundwater Sustainability Plan Activities (Van Lienden) (5 min)
- b. Update on Grant-Funded Projects (Van Lienden) (5 min)
- c. Update on April 2024 Groundwater Conditions Report (Van Lienden) (5 min)

10. Administrative Updates

- a. Report of the Executive Director (Blakslee) (1 min)
- b. Report of the General Counsel (Dominguez) (1 min)
- c. Board of Directors Agenda Review (Blakslee) (3 min)

11. Items for Upcoming Sessions (1 min)

12. Committee Forum (1 min)

13. Correspondence (1 min)

14. Adjourn (7:32 p.m.)

CUYAMA BASIN GROUNDWATER SUSTAINABILITY AGENCY

2024 Board Ad hocs

1	GSP Amendment	Albano Paulding Williams, Das Wooster Yurosek
2	Basin-Wide Water Management Policy	Anselm Bantilan Williams, Deborah Yurosek
3	Central Management Area Policy	Anselm Bantilan Vickery Williams, Deborah Wooster
4	Grant-Funded Items	Albano Vickery Williams, Das Williams, Deborah
5	Unknown Extractors	Anselm Vickery

Tech Forum Participants

Participants	Entity	Representing
Aman Singh Anthony Daus	GSI	Bolthouse / Grimmway
Derek Williams Mack Carlson Bob Abrams Sean Hartman	BBK	Coalition of Landowners for Commonsense Groundwater Solution
Matt Klinchuch	Cuyama Basin Water District	Cuyama Basin Water District
Jeff Shaw John Fio Macy Frost Marco Maneta	EKI	Cuyama Basin Water District
Neil Currie	Cleath-Harris	Grapevine Capital
Matt Young Matt Scrudato	Santa Barbara County Water Agency	Santa Barbara County
Bianca Cabera Steve Johnson Jeff Helsley	Stetson Engineers	Sunrise Olive

Cuyama Basin Groundwater Sustainability Agency Standing Advisory Committee Special Meeting

April 25, 2024

Draft Meetings Minutes

PRESENT:

Kelly, Brenton – Chair
DeBranch, Brad – Vice Chair
Adams, Karen
Gaillard, Jean
Haslett, Joe
Jaffe, Roberta
Lewis, Dave

Beck, Jim – Executive Director
Blakslee, Taylor – Assistant Executive Director
Dominguez, Alex – Legal Counsel
Van Lienden, Brian – Woodard & Curran

ABSENT:

Furstenfeld, Jake

1. Call to Order

Cuyama Basin Groundwater Sustainability Agency (CBGSA) Standing Advisory Committee (SAC) Chair Kelly called the meeting to order at 5:01 p.m.

2. Roll Call

Mr. Blakslee called roll of the Committee (shown above).

3. Pledge of Allegiance

Chair Kelly led the pledge of allegiance.

4. Meeting Protocol

Assistant Executive Director Taylor Blakslee provided direction on the meeting protocols in facilitating a remote meeting.

5. Approval of Minutes

Chair Kelly opened the floor for comments on the February 29, 2024, CBGSA SAC meeting minutes.

MOTION

Committee Member Adams made a motion to approve the February 29, 2024, CBGSA SAC meeting minutes with the noted corrections. The motion was seconded by Committee Member Jaffe, a roll call vote was made, and the motion passed.

AYES: Adams, Caufield, DeBranch, Gaillard, Haslett, Jaffe, Kelly, Lewis
 NOES: None
 ABSTAIN: None
 ABSENT: Furstenfeld

6. Public Comment

Nothing to report.

Chair Kelly noted that an email to CBGSA stakeholders went out on April 23, 2024, informing and encouraging individuals to report dry wells.

7. Groundwater Sustainability Plan Implementation

a. Discuss and Take Appropriate Action on DMS

Mr. Van Lienden provided an overview of potential data management system (DMS) improvements, which is included in the SAC packet, and tech forum feedback.

Committee Member Adams asked about a pumping portal to track allocations. Mr. Van Lienden responded that pending Board direction this option is technically feasible. Mr. Blakslee commented that an allocation tracking system has been previously considered by the Board and they have elected to continue to use the current reporting system for now.

Chair Kelly asked Legal Counsel Alex Dominguez if there are ways to track data without breaching data privacy concerns. Mr. Dominguez replied we have faced a similar situation in other basins and while there are certain protections for public utilities information, if a landowner is over their allocation it would be disclosed. Committee Member Jaffe asked how that information is shared, and Mr. Blakslee replied the Board will receive a report for the previous year's allocation against the usage for each landowner.

Committee Member DeBranch commented that these opportunities are currently grant-funded and implementing programs with grant funds is great, but the Cuyama Basin Groundwater Sustainability Agency (CBGSA) will ultimately be responsible to decide whether to fund program on a long-term basis.

b. Discuss and Take Appropriate Action on Website Update Options

Mr. Blakslee provided an overview of the Cuyama Basin Groundwater Sustainability Plan website update options. Committee Member DeBranch commented it would be helpful to reorganize the website.

8. Groundwater Sustainability Plan Amendment Components

a. Update on GSP Components Schedule

Mr. Blakslee provided an overview of the GSP components Schedule which is provided in the SAC packet. He highlighted several changes to the schedule and said we are still on schedule, but all the slack has been used.

Stakeholder Adam Lovgren asked about the July model update release and asked for clarification on which definition of safe yield or sustainable yield the glidepath will be using. Legal Counsel Alex Dominguez replied the sustainable yield is more common to the Sustainable Groundwater Management Act (SGMA) while the term safe yield typically is used in adjudications.

b. Authorize 90-Day Notice to Cities and Counties for an Amendment to the GSP and Set a Public Hearing on November 6, 2024

Legal Counsel Alex Domingues provided an overview of the 90-Day Notice to Cities and Counties for an amendment to the GSP and set a public hearing on November 6, 2024. He added that the CBGSA is required to send a letter to cities and counties outlining the GSP amendment process.

c. Discuss and Take Appropriate Action on Project and Management Action Options

Mr. Beck provided an overview of the project and management action options which is included in the SAC packet including the addition of two new projects for consideration.

Mr. Van Lienden provided an overview of the flow meter recalibration program and rangeland and forest management project.

Committee Member Caufield asked if an assessment has been done to determine the potential results of the rangeland project. Mr. Van Lienden responded no it has not. Committee Member Caufield added it is important for Committee members understand the potential impact before approving a project.

Committee Member Gaillard commented that controlled burning would likely occur in protected land, and suggested staff consider vegetation management as opposed to prescribed burns. He noted there are many invasive species that could be managed and suggested to avoid forest management and focus on vegetation management in the Cuyama Valley.

Committee Member Lewis expressed concerns with the cost of a potential meter calibration program. Chair Kelly asked if the program is a part of current GSA policy that would be a cost shared by the GSA or landowners. Mr. Beck replied no cost estimates are available at this time.

Stakeholder Adam Lovegren asked if flow meter calibration could be funded retroactively by a grant. Mr. Blakslee replied there could be grant programs to assist in funding, but staff is not currently aware of any.

Committee Member Jaffe commented that she agrees with the staff recommendation to not include rangeland and forest management as project in the GSP, but does agree with Committee member Gaillard's comments to focus on invasive species and water intensive plants in the valley. Committee Member Adams agreed with this as well.

Stakeholder Ann Myhre suggested keeping the project language broad and open to vegetation management rather than listing a specific approach.

d. Discuss and Take Appropriate Action on Basin-Wide Water Management (*Continued Discussion*)

Mr. Beck provided an overview of the basin-wide water management options which is provided in the SAC packet. He reviewed points of discussion from the last Board meeting in March 2024.

He reported that staff developed maps for SAC and Board review based on feedback in February and March 2024 to consider reviewing water budgets based on physical features and modeling data. Mr. Beck added that these areas do not identify subbasins but potential areas to consider water management policy in.

Committee Member Caufield commented he is not opposed to the areas on the map, and asked if the faults or land use are deciding the management areas. Chair Kelly replied we are just talking about irrigated lands.

Committee Member Jaffe commented we have always been looking at these three areas and how different they are in terms of land use and geology. She said we have also talked a lot about data gaps, and there are currently county approved exploratory oil wells being drilled in the county. She said the well will be drilled 11,000 feet deep and we can learn a lot about the basin if this happens.

Committee Member Haslett commented on one of the differences you experience the further west you go in the basin is the source of water and geography. He said it is important to consider this attribute when trying to manage the basin as a whole. Mr. Beck asked if Mr. Haslett would like the Board to consider bifurcating the western region and Mr. Haslett replied yes based on geographical differences.

Mr. Van Lienden commented that staff has land use data for all areas but we are focusing on irrigated lands and Land IQ will also be verifying these areas and refining existing data.

Committee Member Debranch commented that this item and maps might be premature and we ought to consider some other items before we develop management areas. He added he does not understand how you can have multiple water budgets if everything is connected.

Stakeholder Lynn Carlisle asked for an update on the current fault investigation. Mr. Van Lienden replied we will review fault investigation findings in a later agenda item. She said if you go forward on managing different areas, you will need strong justifications on the boundaries and it is important to base that off of technical studies.

Committee Member Adams asked if a vote to accept the four areas is made, when would the opportunity to revise management areas occur. Mr. Blakelee replied that a concurrence to consider water budgets in the four areas would result in Woodard & Curran developing budget numbers for the four outlined areas for further technical examination of water management is required for those areas.

Committee Member Gaillard said he would like to see three budgets, central parts and all surrounding areas. He said you have to look at the entire central area, rather than the CMA and surrounding areas.

Committee Member Haslett commented he disagrees with the premise of the whole motion, and said the central management area is the issue, and no other management areas need to be created. He said water use in the other areas is not the issue, the central management areas is, and he only agrees with managing water in the Central Management Area.

Committee Member Gaillard commented that he is in favor of one management area and revisiting other areas every five years.

Committee Member Adams said she agreed with one management area as well, since no data was introduced that showed the other areas are interconnected.

Chair Kelly said he would like to see water budgets for all four areas.

Committee Member Caufield said he would like to see the data for either three or four areas.

Committee Member Jaffe said she would like to see the data for the four areas and is interested in keeping the east and west regions separated.

Vice Chair DeBranch said he was not in favor of multiple budgets and recommended the basin be treated as a whole.

Committee Member Lewis said he lives in the CMA, and it is obvious a handful of pumpers have caused a lot of the problems in the CMA and did not provide a recommendation for this item.

e. Discuss and Take Appropriate on GSP Draft Chapter

Mr. Van Lienden provided an overview of the GSP draft chapters. He reported that if approved these chapters would be included in the draft GSP in September and in the final for the public hearing in November 2024.

Chair Kelly asked if this is the final version or if comments or edits can be made. Mr. Blakslee replied yes edits can be made to the chapters.

Committee Member Jaffe asked if there was an update on Interconnected surface water areas, she also said Chapter 3 needs some fact checking and needs to be updated. Mr. Van Lienden replied staff will ensure these changes are corrected.

Mr. Beck said you can make a motion to approve the chapters with the recommended corrections. Chair Kelly commented it is hard to approve a chapter without an update made to the items being listed for correction.

Committee Member Jaffe noted that the GDE section needs to be reexamined.

The SAC elected not to vote on Chapters 3 or 5 due to several errors in the draft chapter.

9. Technical Updates

a. Update on Fault Investigation Study

Mr. Van Lienden provided an overview of the fault investigation study which is included in the SAC packet.

Chair Kelly asked if additional well data could be obtained from the new monitoring well and Mr. Van Lienden replied staff could potentially get more information from the driller and incorporate into the analysis.

Committee Member Lewis asked for the information to be simplified for stakeholder review.

Mr. Van Lienden commented that the information being presented is preliminary and an update will be provided in July 2024.

Stakeholder Lynn Carlisle commented that the fault investigation is related to previous efforts to try and change the basin boundaries and is helpful to determining the permeability of the faults.

b. Update on Water Resources Model

Mr. Van Lienden provided an update on the water resources model which is provided in the SAC

packet.

Stakeholder Adam Lovgren commented that staff should consider a different model for smaller field sizes to make it more accurate.

Stakeholder Lynn Carlisle asked how rainfall is being accounted for in the model, and Mr. Van Lienden replied it take into account all water coming into and being used within the basin.

Committee Member Haslett asked if the data being shown is just for the CMA or the entire basin. Mr. Van Lienden replied the data being shown is for the entire basin.

c. Update on Groundwater Sustainability Plan Activities

Mr. Van Lienden provided an overview of the GSP activities which is provided in the SAC packet.

Micah Eggleton commented that the wrong version of GSP chapter 3 was inadvertently distributed and a correct version will be shared in the Board packet.

d. Update on Grant-Funded Projects

Mr. Van Lienden provided an overview of the grant-funded projects which is provided in the SAC packet.

Committee Member Lewis commented it would be nice to have local roads displayed on the maps.

10. Administrative Updates

a. Report of the Executive Director

Mr. Blakslee reported that a dry well reporting notice was emailed on April 23, 2024. He also reported on the upcoming Fiscal Year 2024-2025 groundwater extraction fee hearing, and the July 2024 public workshop.

Committee Member Lewis asked what reporting a dry well will do. Mr. Blakelee replied it triggers an investigation and helps the GSA identify if the well is experiencing an outage due to water levels or mechanical functions.

Stakeholder Lynn Carlisle commented that the California Department of Water Resources (DWR) has set up a reporting system and is trying to develop programs to help dry wells. She asked if the reports are being submitted to DWR's My Dry Well system. Mr. Blakelee replied yes, the report would be uploaded to the DWR system but no reports have been received to-date.

b. Report of the General Counsel

Nothing to report.

c. Board of Directors Agenda Review

Mr. Blakslee provided an overview of the Board of Directors Agenda which is included in the SAC Packet.

11. Items for Upcoming Sessions

Nothing to report.

Committee Member Jaffe asked if there is a policy for new wells or replacement wells. Mr. Blakslee replied there is a policy for both new wells and replacement wells and each has a form that must be filled out.

12. Committee Forum

Nothing to report.

13. Public Comment

Nothing to report.

14. Correspondence

Nothing to report.

15. Adjourn

Chair Kelly adjourned the meeting at 8:44 p.m.

STANDING ADVISORY COMMITTEE OF THE
CUYAMA BASIN GROUNDWATER SUSTAINABILITY AGENCY

Chair Kelly: _____

ATTEST:

Vice Chair DeBranch: _____



TO: Standing Advisory Committee
Agenda Item No. 7a

FROM: Jim Strandberg, Woodard & Curran

DATE: July 25, 2024

SUBJECT: Update on Fault Investigation Study

Recommended Motion

None – information only.

Discussion

An update on the fault investigation study is provided as Attachment 1.

Cuyama Basin Groundwater Sustainability Agency

Update on Fault Investigation

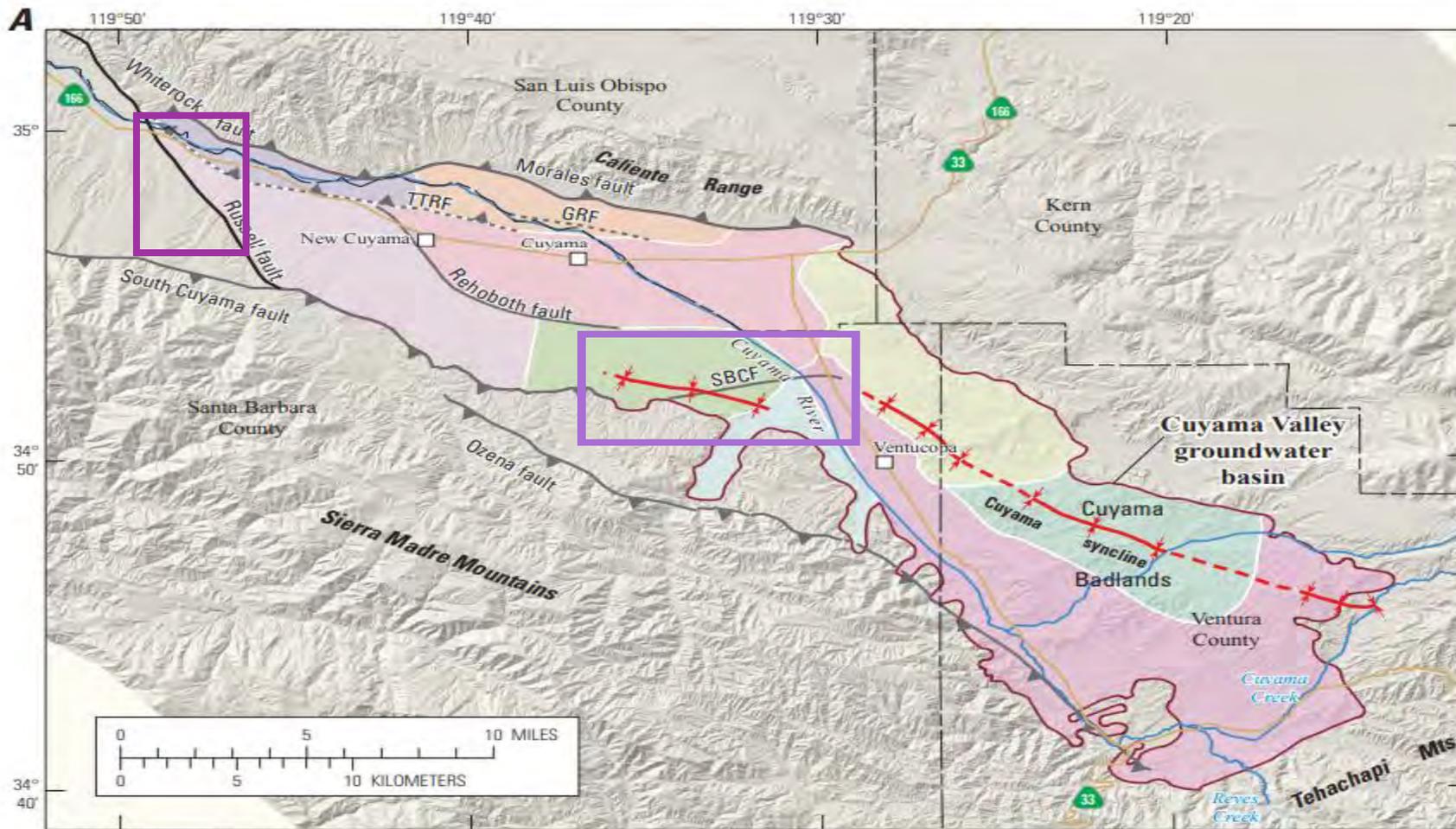
July 25, 2024



Update on Streamlined Groundwater-Fault Interaction Investigation

- Santa Barbara Canyon and Russell Fault Zones
- Investigation Components Include:
 - Evaluate available water level and WQ data in investigation areas
 - Interpret AEM data and oil & gas geophysical logs
 - Conduct surface geophysical surveys
 - Construct a new monitoring well near SBC Fault (i.e., MW-H with funding covered by current grant agreement)
 - Sample groundwater and conduct geochemical analyses
 - Groundwater flow calculations and modelling

Update on Streamlined Groundwater-Fault Interaction Investigation



Shaded relief base created from 30-m digital elevation model from USGS National Elevation Dataset (NED); North America Vertical Datum 1983 (NAVD83). Hydrology sourced from 1:24,000-scale National Hydrography Dataset, 1974-2009. Place names sourced from USGS Geographic Names Information System 1974-2009. Albers Projection, NAD83

Groundwater hydrologic subregions and related geologic structures; B, simplified Cuyama major groundwater regions; and C, groups of landscape water-balance subregions for 1943–2010 in Cuyama Valley, California (USGS, 2015)

Cuyama groundwater basin subregions (table 1)

- Caliente/Northern-Main (CNMZ)
- Central Sierra Madre Foothills (CSMFH)
- Northeast Ventucopa Uplands (NEVU)
- Northwestern Sierra Madre Foothills (NSMFH)
- Northern Ventucopa Uplands (NVU)
- Southern Sierra Madre Foothills (SSMFH)
- Southern Ventucopa Uplands (SVU)
- Southern-Main (SMZ)
- Western-Main (WMZ)

See table 1 for subregion designation

- Normal fault
- Thrust fault
- Thrust fault, concealed
- Syncline
- Syncline, concealed

GRF, Graveyard fault;
SBCF, Santa Barbara Canyon fault;
TTRF, Turkey Trap Ridge fault



Groundwater-Fault Interaction Investigation – Geophysical Surveys

- **Field Surveys**
 - SBC Fault survey in mid-February
 - Russell Fault survey in late March
- **Survey Method**
 - 2D electrical resistivity (ER) and induced polarization
 - Two transects (lines) across each fault > 3,000 feet in length to investigate 600 to 800 feet in depth
 - Transects were linear over fairly level ground
 - Data processing using industry standard software

Groundwater-Fault Interaction Investigation – Geophysical Surveys - SBCF Fault



- Transects crossed the buried fault location inferred by the USGS.
- Line 1 was in the ROW of SR 33. Well MW-H provided a control point.
- Line 2 was in the Cuyama River channel among vegetation.

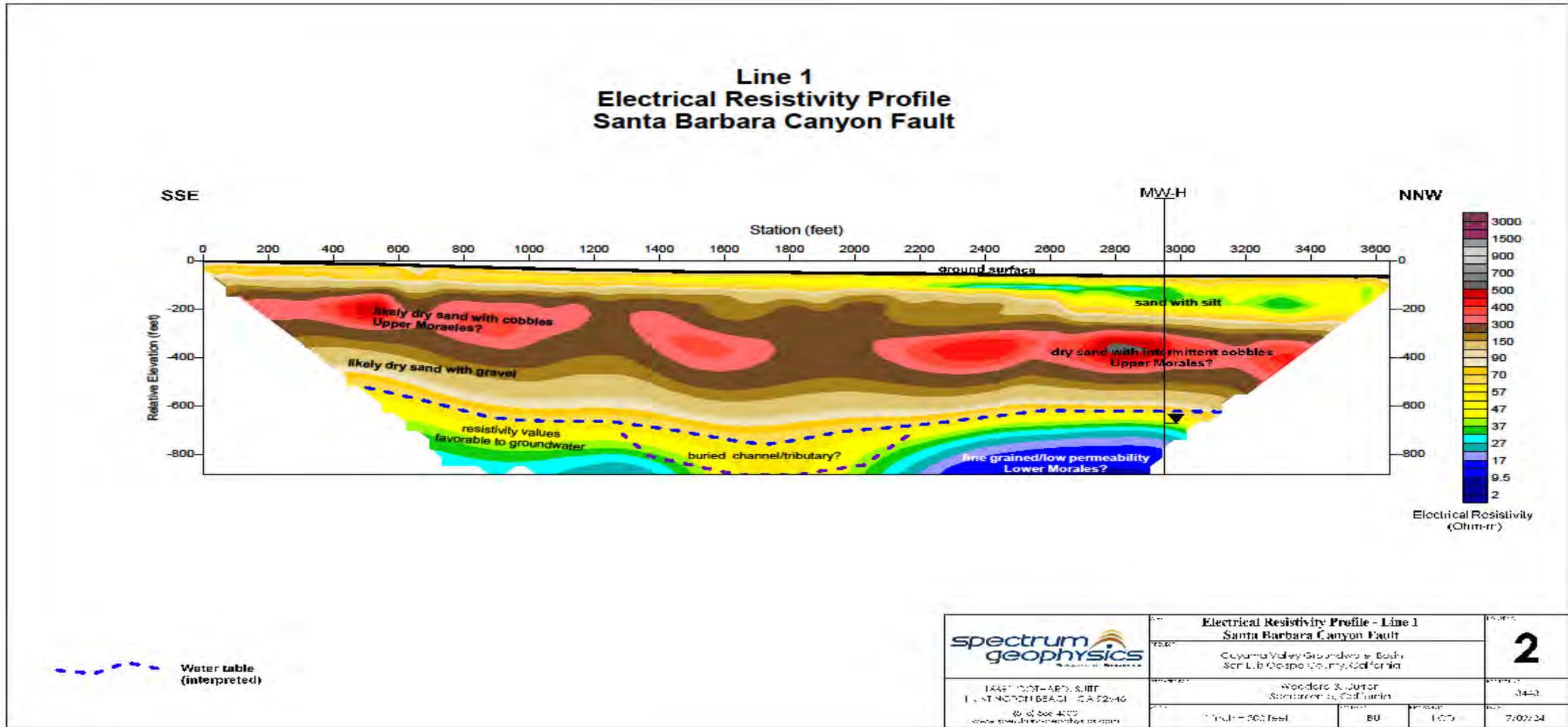
Groundwater-Fault Interaction Investigation – Geophysical Surveys - SBC Fault

Line 1

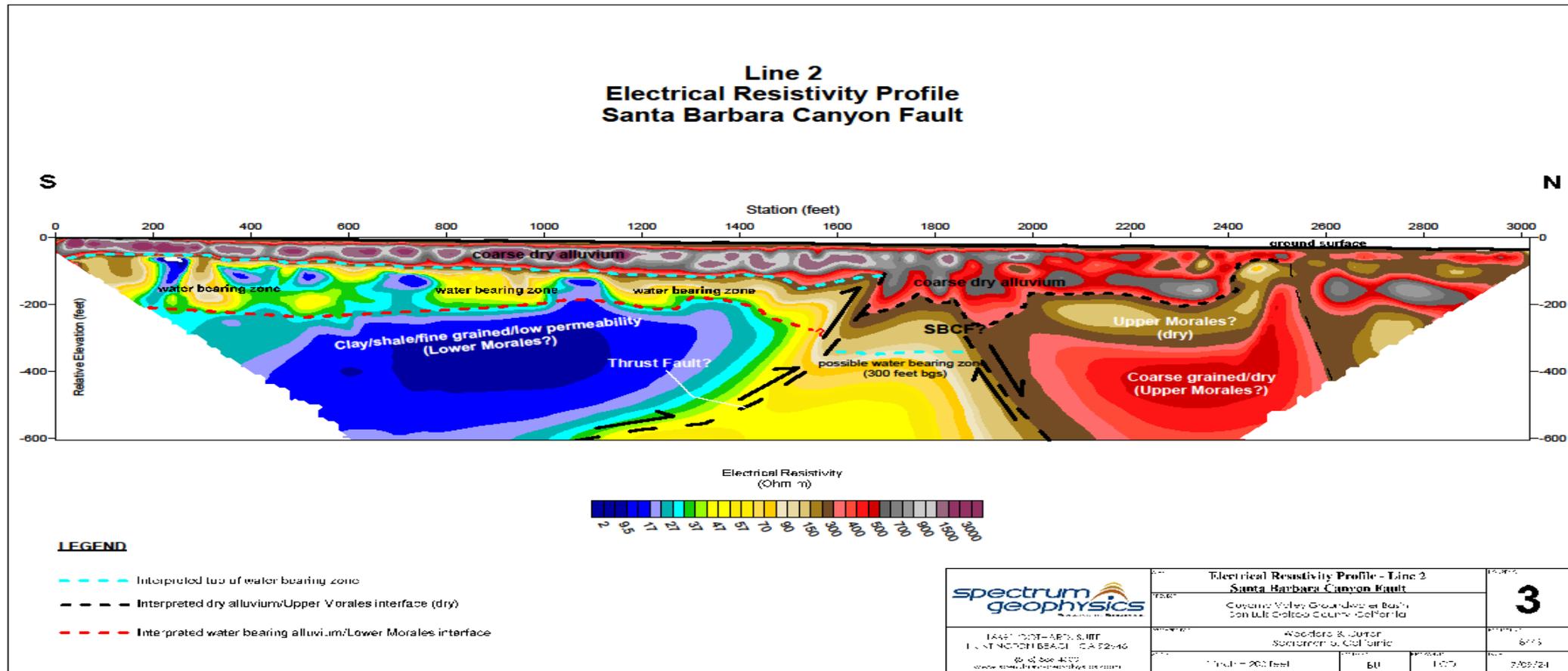


Line 2





- Relatively laterally continuous lithology across the profile.
- Fault mapped by the USGS is not present.
- Depth to water is about 600 feet bgs.



- Abrupt lateral changes in resistivity indicate faults or fault splays (i.e., fault zone).
- Survey identified the SBC Fault and an unknown thrust fault to the south.
- Groundwater south of the thrust fault is about 50 to 100 feet bgs.
- Depth to water drops in the fault zone and is greater than about 600 feet bgs to the north.



-  Electrical Resistivity Transect
-  Concealed fault mapped by the USGS



***Note: Not all below ground utilities or features may be represented on this map.

spectrum geophysics
 geophysical solutions
 8218 LANIER-IRM BLVD, #12
 HOLLYWOOD, CA 91505
 phone: (619) 806-4500
 spectrumgeophysics.com

Geophysical Survey Location Map
 Cuyama Valley Groundwater Basin
 SBCF
 San Luis Obispo County, California
 Woodard & Curran
 Sacramento, California



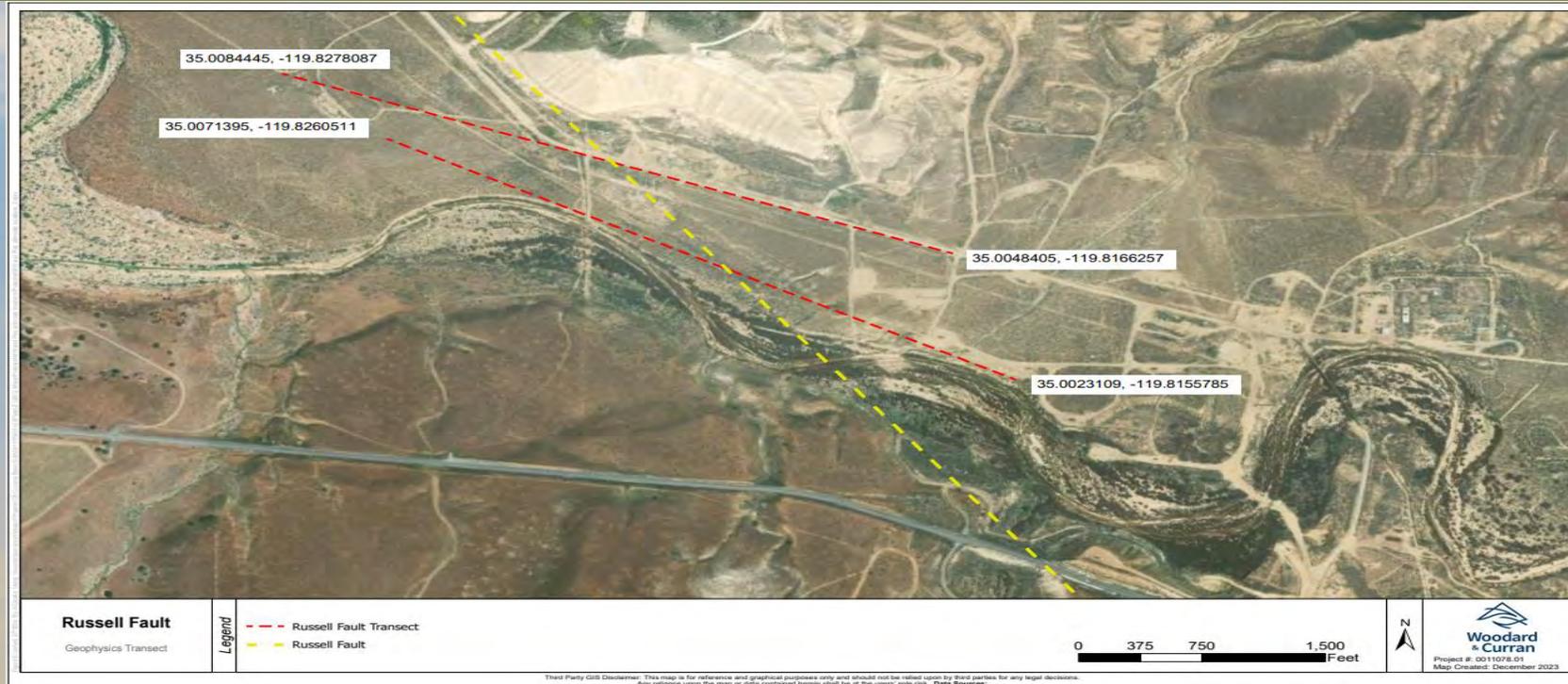
1

BM 43

1 inch = approx 300 ft | BAU | BAU | 7/9/24



Groundwater-Fault Interaction Investigation – Geophysical Surveys – Russell Fault



- Few options for linear transects to avoid bedrock outcrops, deeply incised and meandering Cuyama River channel, and oil field operations.
- Line 1 adjacent to dirt road crosses barbed wire fence and into dense vegetation.
- Line 2 in relatively flat area close to river between two oil wells.

Groundwater-Fault Interaction Investigation – Geophysical Surveys – Russell Fault

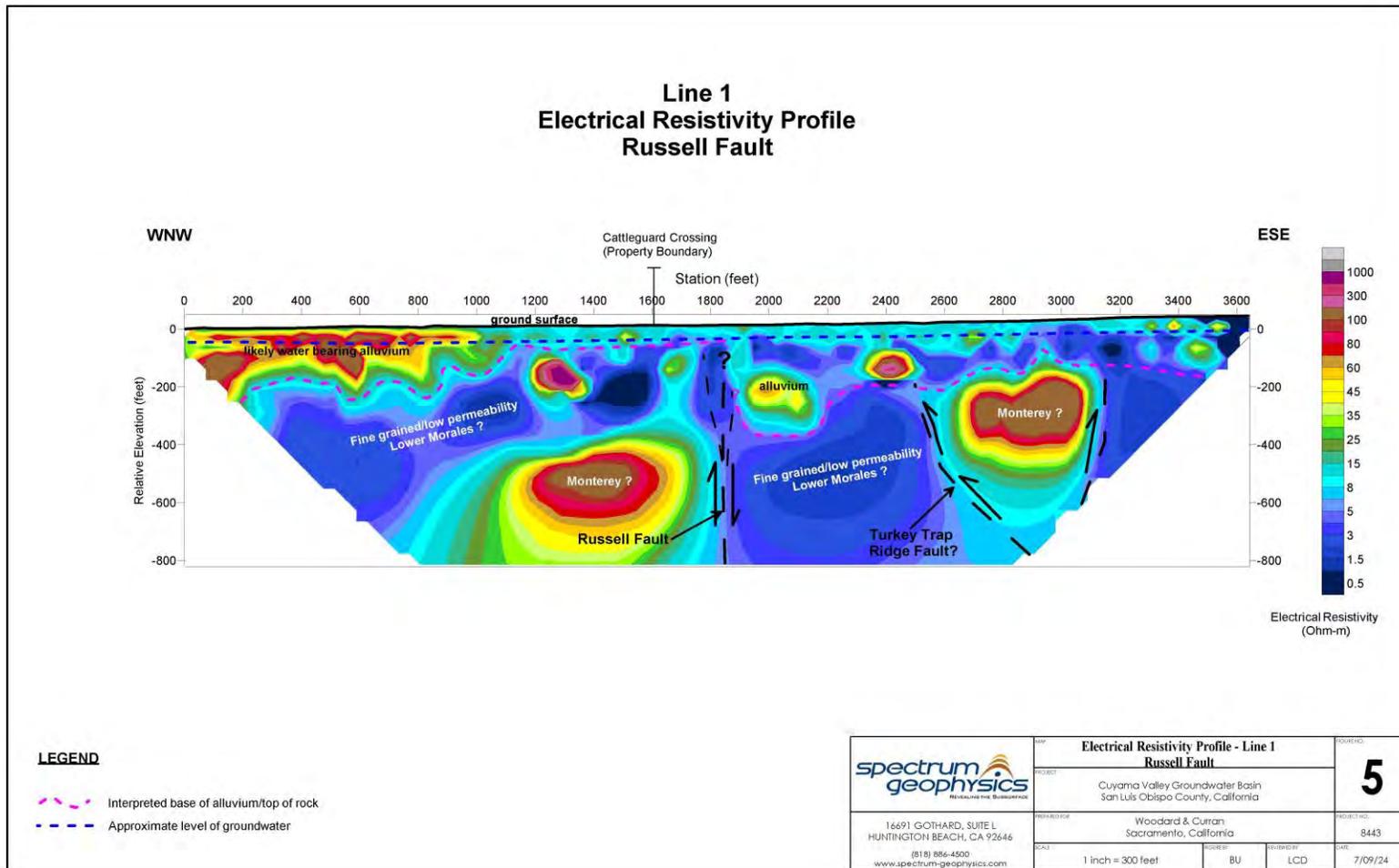
Line 1



Line 2

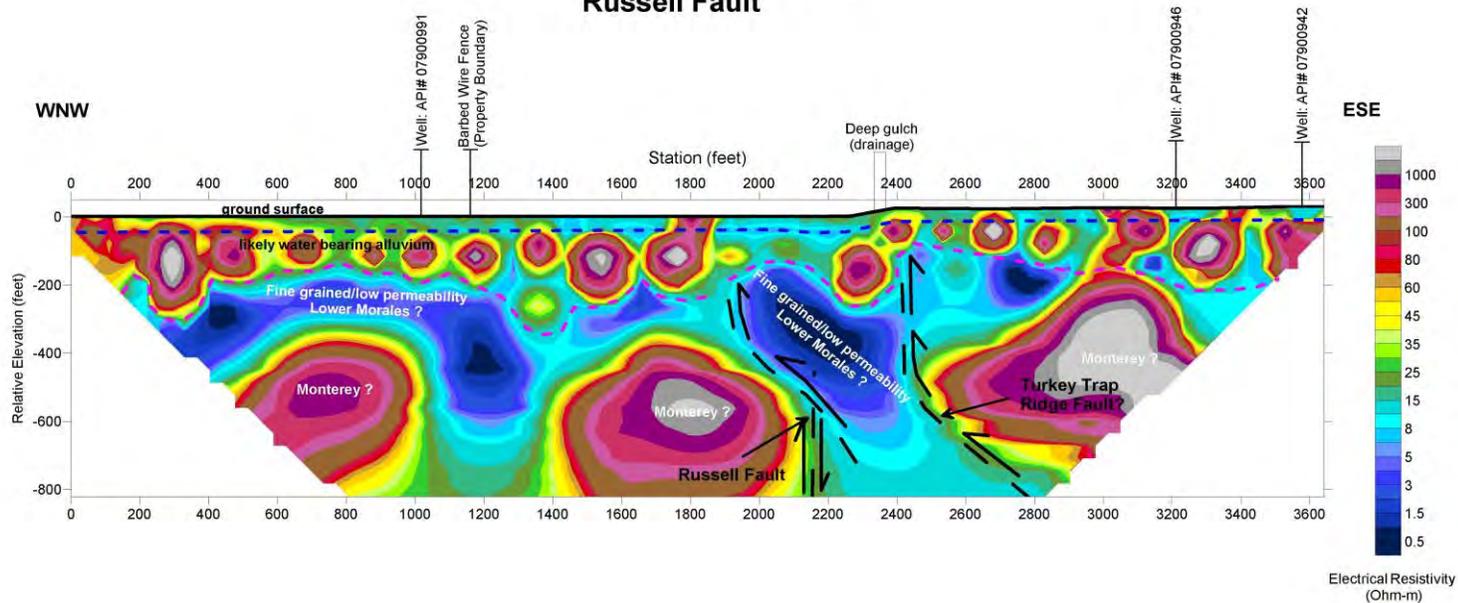


Groundwater-Fault Interaction Investigation – Geophysical Surveys – Russell Fault



- Abrupt lateral changes in resistivity indicate faults/fault plays (fault zone). Complex.
- A vertical anomaly interpreted to be the Russell Fault.
- Another, likely younger, apparent east-dipping thrust fault east of the Russell Fault is interpreted to be the Turkey Trap Ridge Fault.
- Faults are buried by about 100 feet or more.
- Groundwater appears to be approx. 50 feet bgs across the profile.
- Extent of saturated alluvium is greater in the eastern portion of the profile.

Line 2 Electrical Resistivity Profile Russell Fault

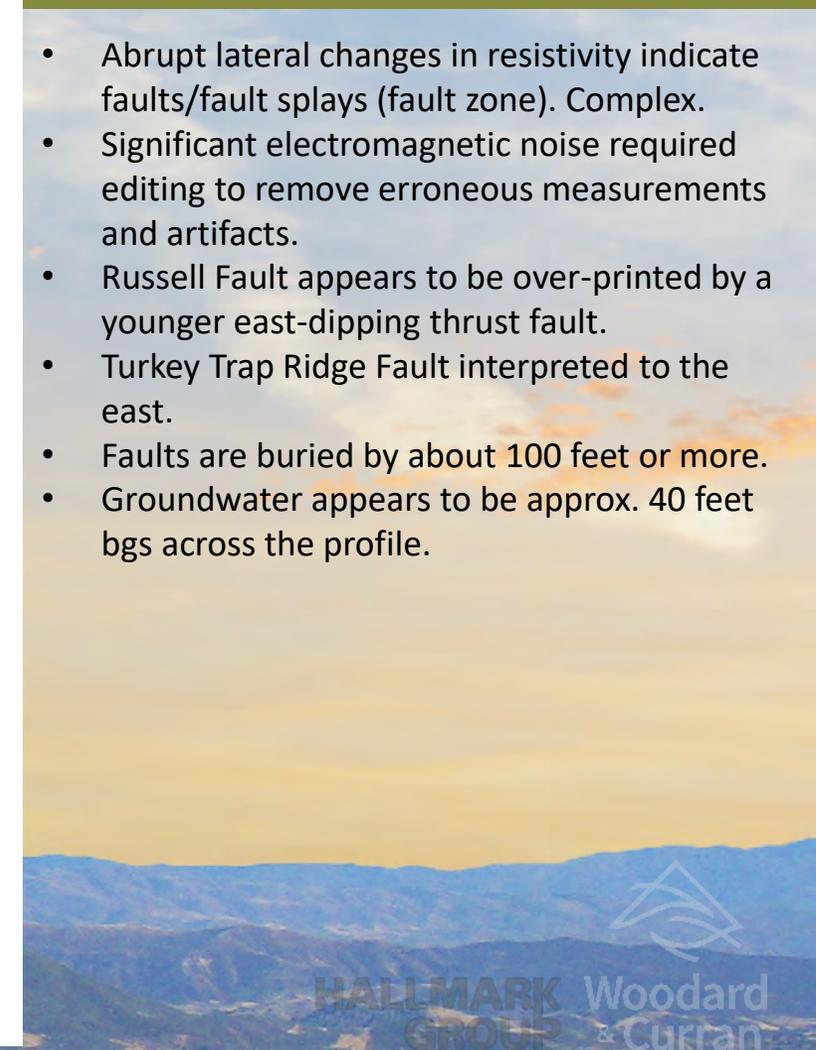


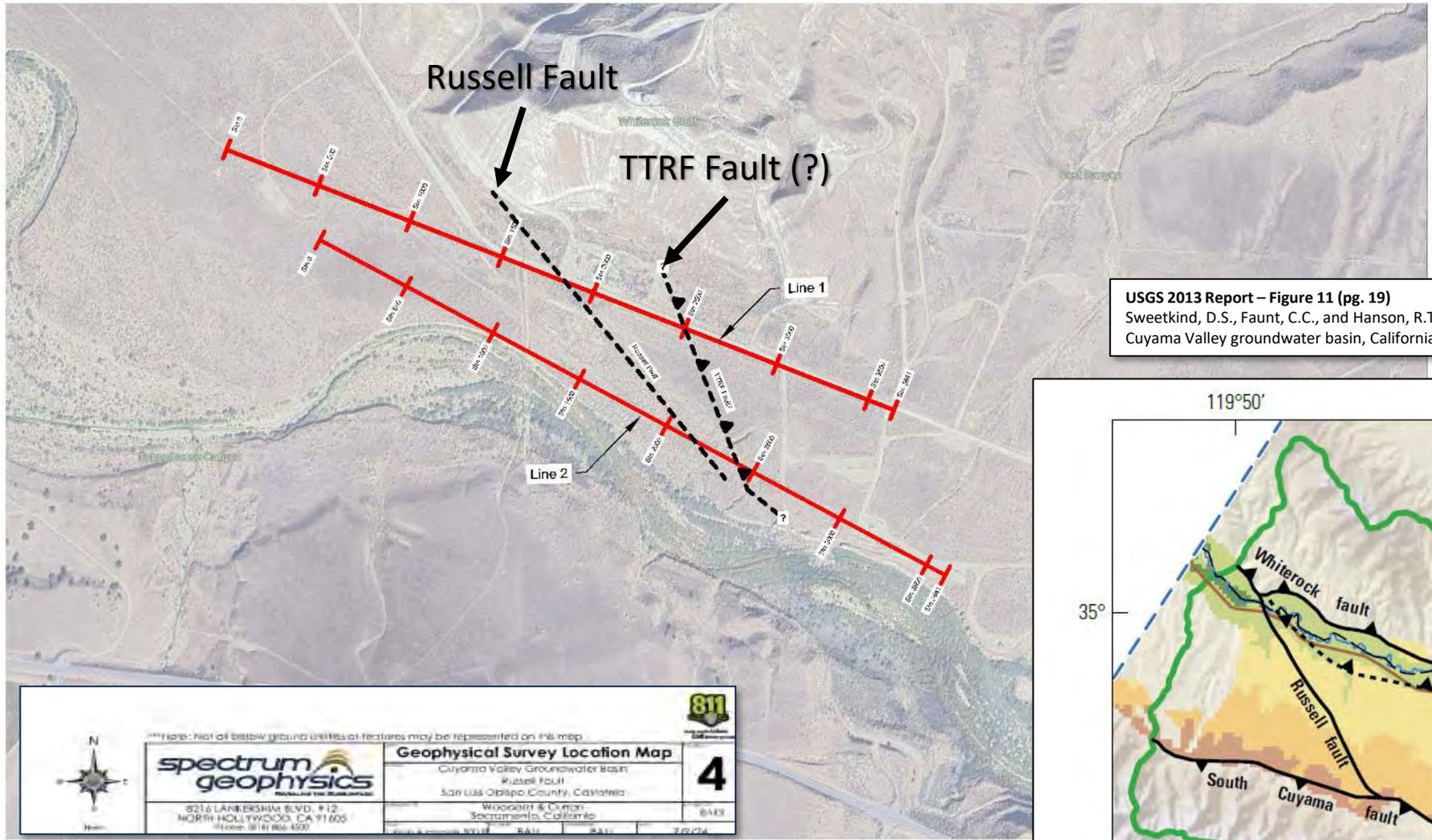
LEGEND

- - - - - Interpreted base of alluvium/top of rock
- - - - - Likely level of groundwater

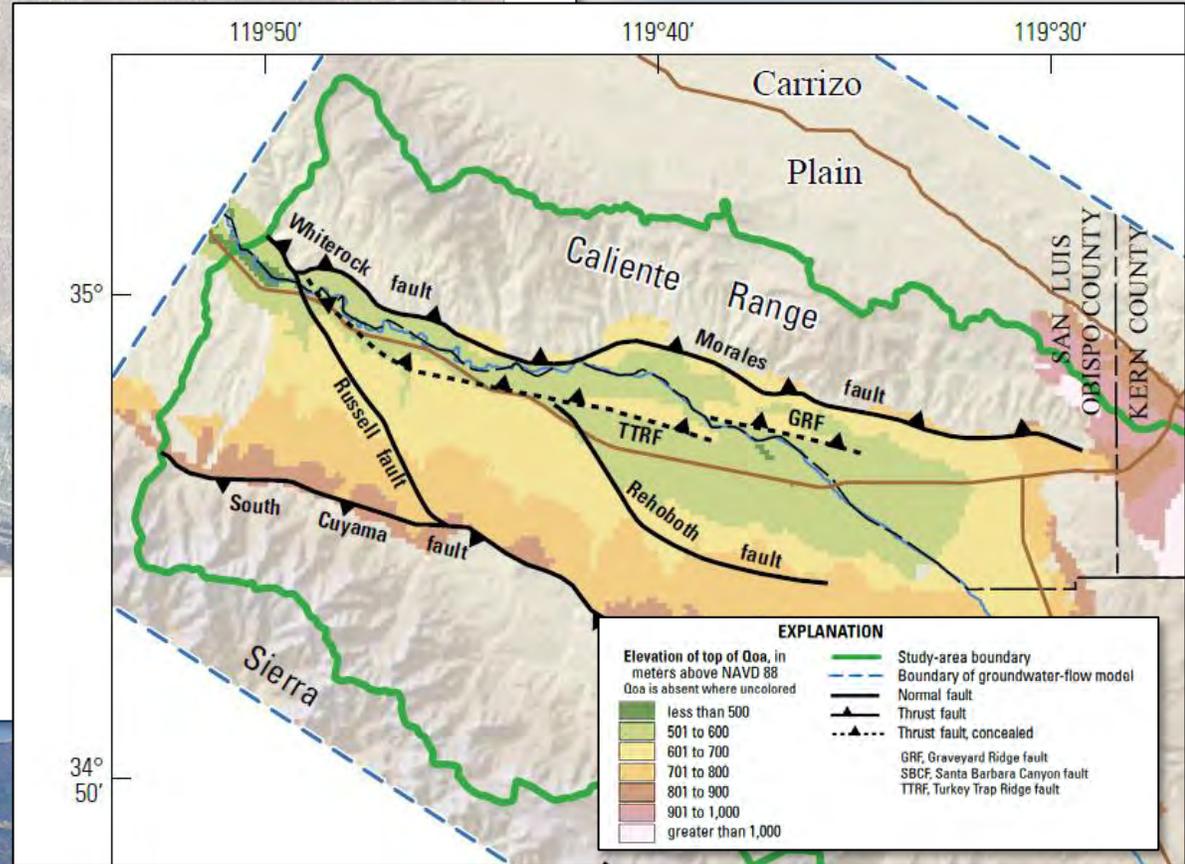
	Electrical Resistivity Profile - Line 2 Russell Fault		PROJECT NO. 6
	PROJECT Cuyama Valley Groundwater Basin San Luis Obispo County, California		
16691 GOTHARD, SUITE L HUNTINGTON BEACH, CA 92646 (818) 886-4500 www.spectrum-geophysics.com	PREPARED FOR Woodard & Curran Sacramento, California	PROJECT NO. 8443	
SCALE 1 inch = 300 feet	DRAWN BY BU	REVIEWED BY LCD	DATE 7/09/24

- Abrupt lateral changes in resistivity indicate faults/fault splays (fault zone). Complex.
- Significant electromagnetic noise required editing to remove erroneous measurements and artifacts.
- Russell Fault appears to be over-printed by a younger east-dipping thrust fault.
- Turkey Trap Ridge Fault interpreted to the east.
- Faults are buried by about 100 feet or more.
- Groundwater appears to be approx. 40 feet bgs across the profile.





USGS 2013 Report – Figure 11 (pg. 19)
 Sweetkind, D.S., Faunt, C.C., and Hanson, R.T., 2013, Construction of 3-D geologic framework and textural models for Cuyama Valley groundwater basin, California: U.S. Geological Survey Scientific Investigations Report 2013–5127, 46 p.



— Electrical Resistivity Transect
 - - - Fault

EXPLANATION

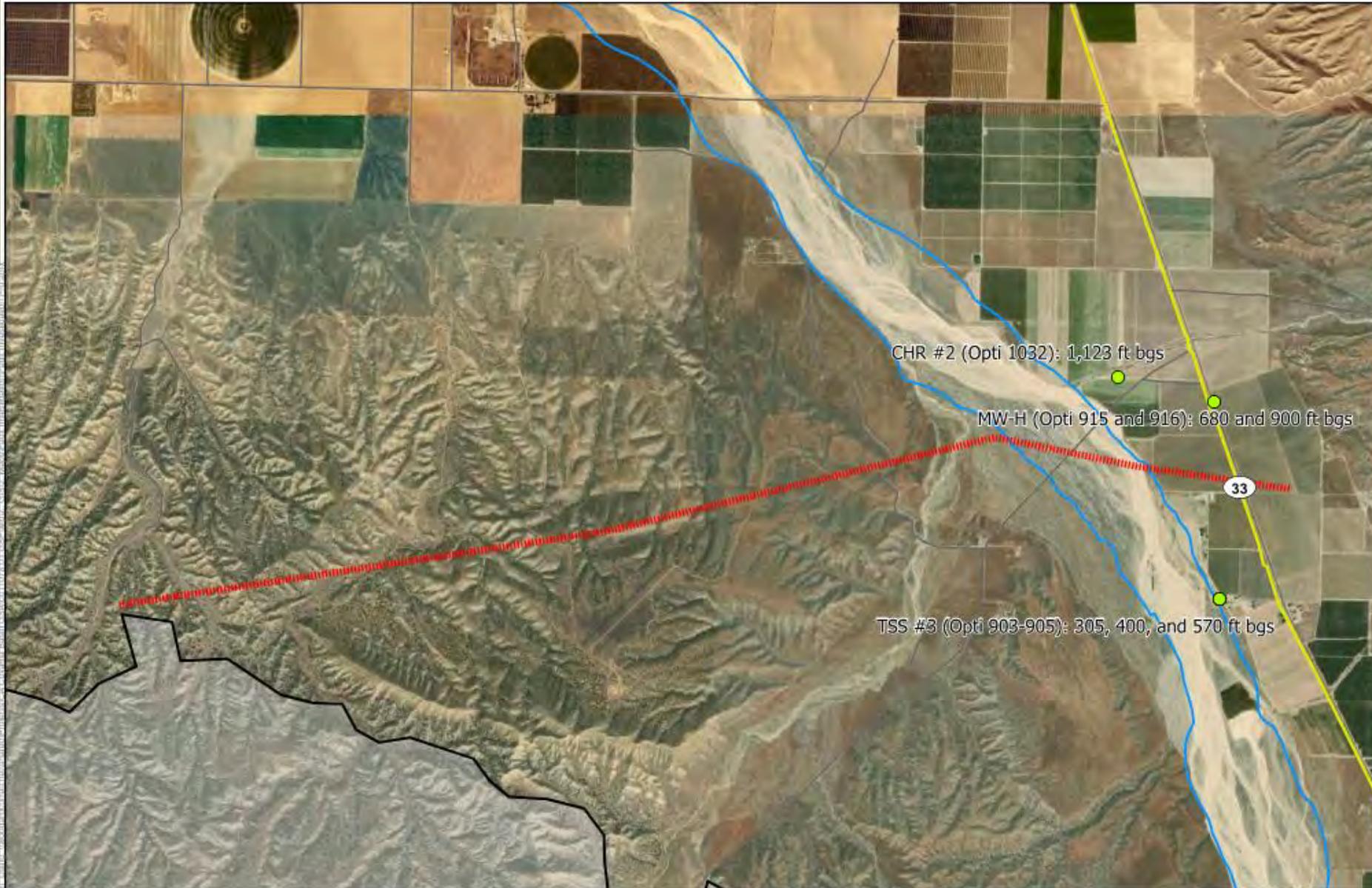
Elevation of top of Oqa, in meters above NAVD 88
 Oqa is absent where uncolored

- less than 500
- 501 to 600
- 601 to 700
- 701 to 800
- 801 to 900
- 901 to 1,000
- greater than 1,000

- Study-area boundary
- Boundary of groundwater-flow model
- Normal fault
- Thrust fault
- Thrust fault, concealed
- GRF, Graveyard Ridge fault
- SBCF, Santa Barbara Canyon fault
- TTRF, Turkey Trap Ridge fault

Groundwater-Fault Interaction Investigation – Water Quality

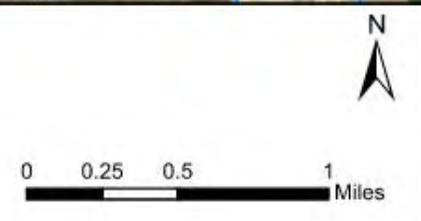
- **SBC Fault/Fault Zone**
 - TSS #3 wells 903-905 were sampled in 2021; sampled 904 in 2024.
 - Kern Ridge Growers well CHR2 was sampled in 2024.
 - Stiff diagrams to display the data.
- **Russell Fault/TTRF System**
 - TSS #1 wells 900-902 were sampled in 2021; sampled 901 & 902 in 2024.
 - North Fork Ranch well NF-20 was sampled in 2020.
 - Stiff diagrams to display the data.



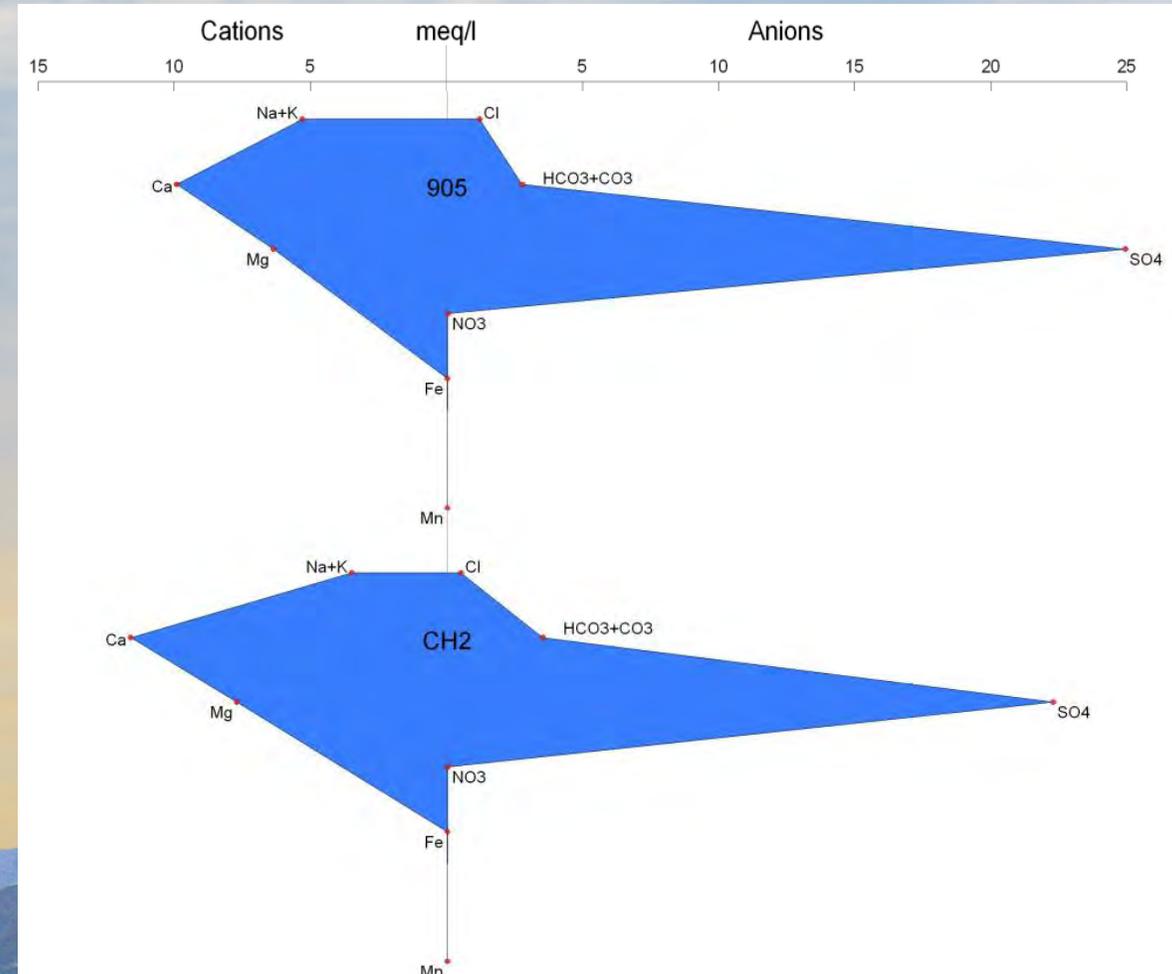
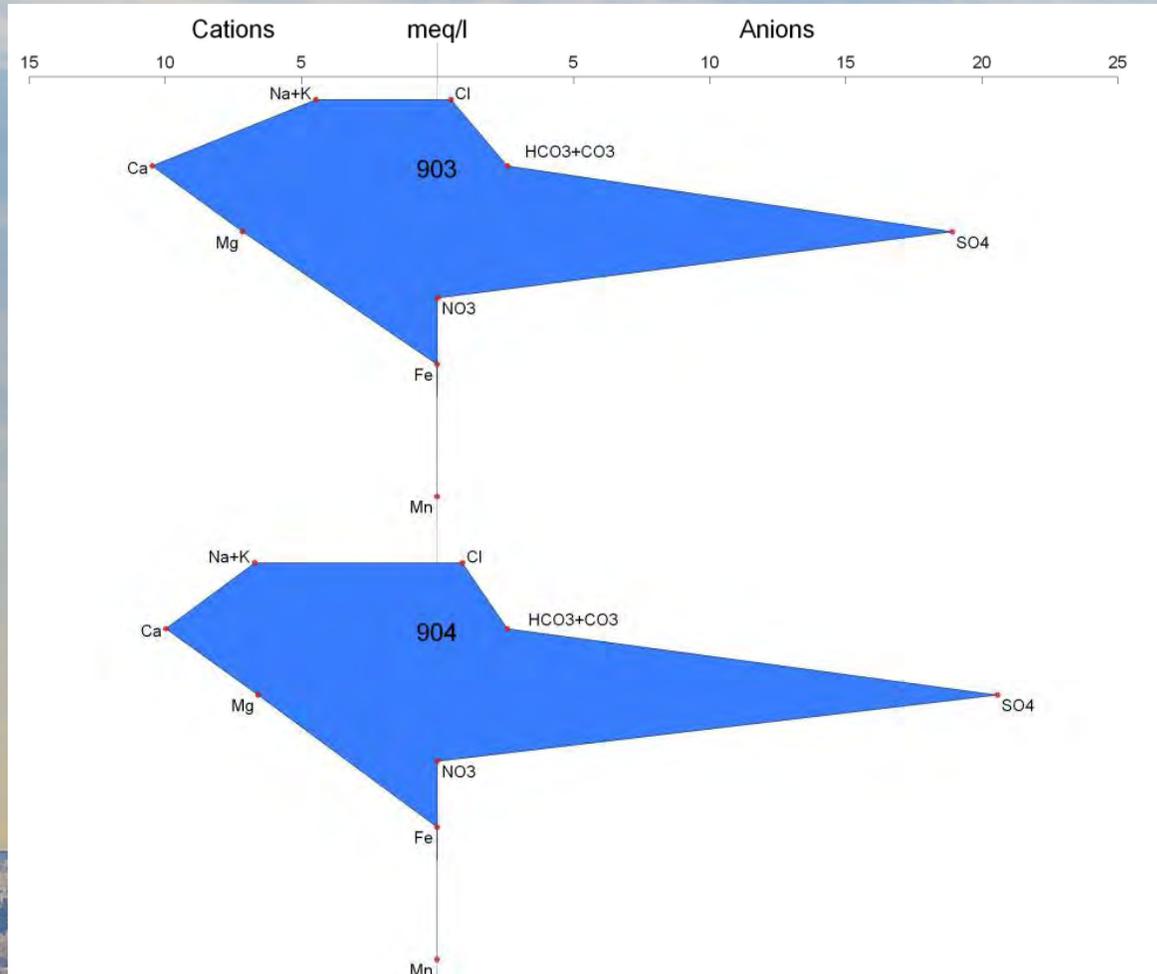
**Wells Near
Santa Barbara Canyon Fault
with Groundwater Quality Data**
Cuyama Basin
Map Created: March 2023



- Legend**
- Highways
 - Local Roads
 - SBC Fault
 - Cuyama River
 - Wells with Water Quality Data and Total Depth



Groundwater-Fault Interaction Investigation – Water Quality – SBC Fault





**Wells Near
Russell Fault
with Groundwater Quality Data**

Map Created: July 2024

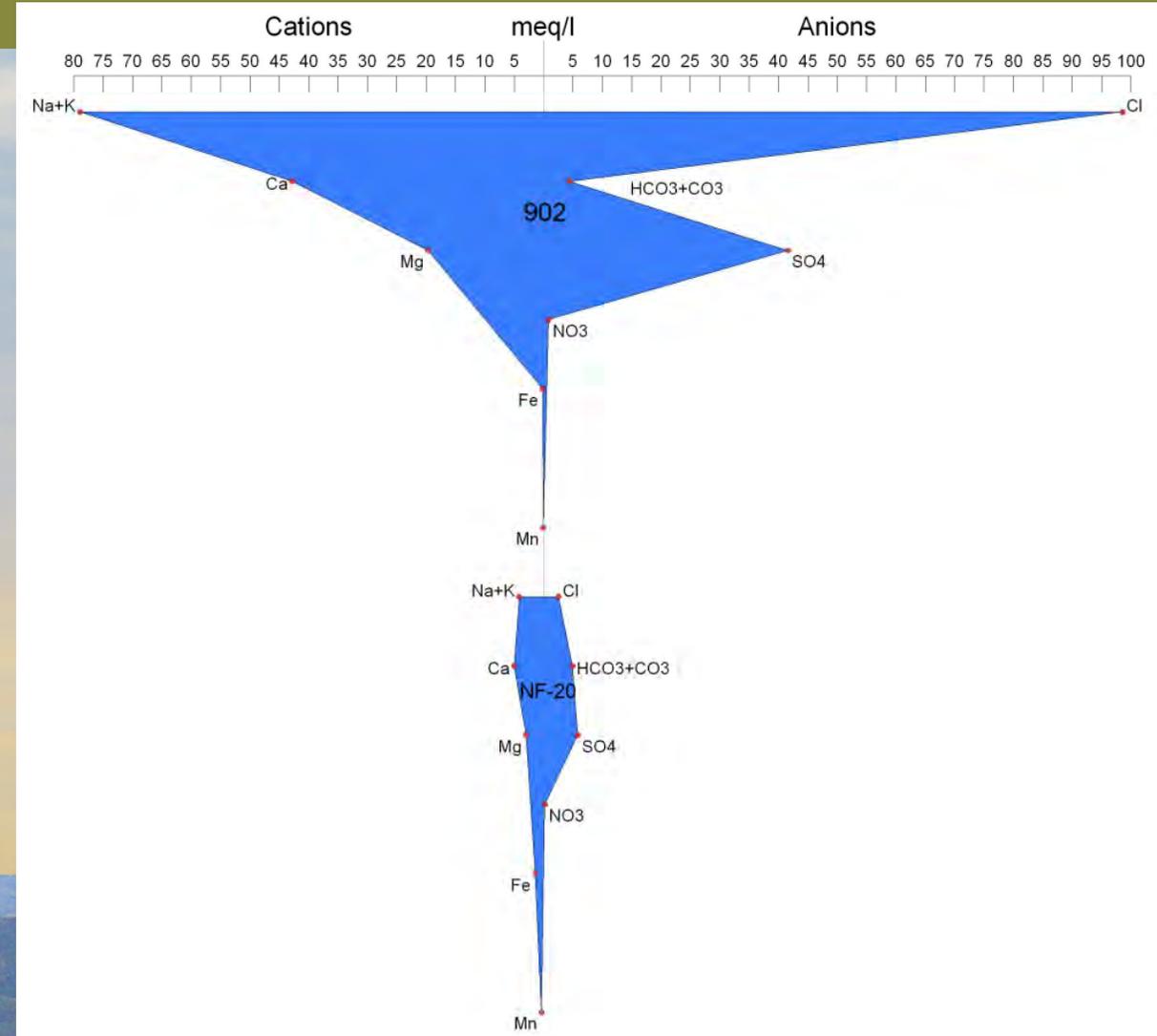
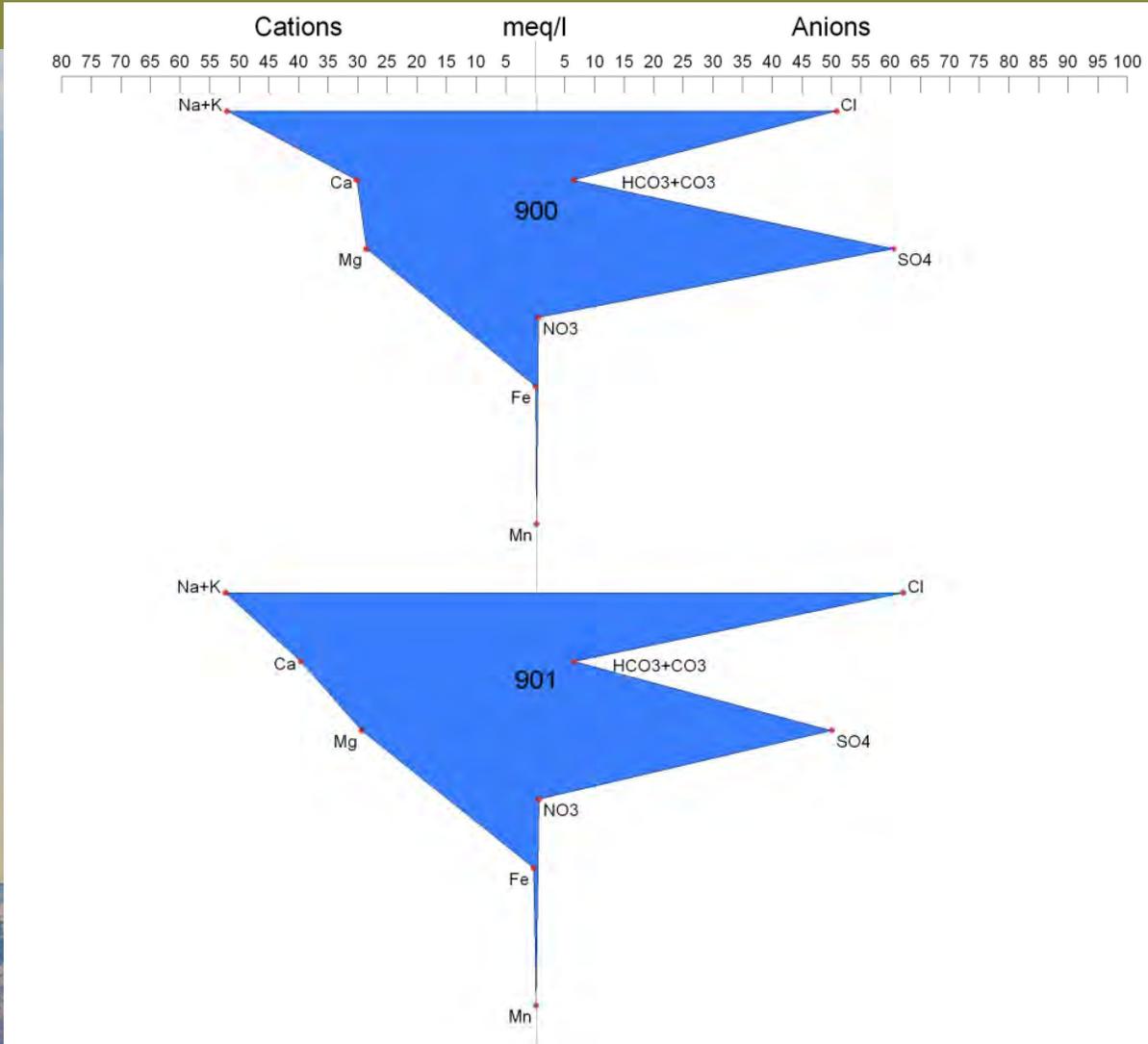


Legend

- Highways
- Local Roads
- Cuyama River
- Russell Fault
- Cuyama Basin
- Wells with Water Quality Data and Total Depth



Groundwater-Fault Interaction Investigation – Water Quality – Russell Fault



Groundwater-Fault Interaction Investigation – Groundwater Flow – SBC and Russell Faults

Simulated flow based on previous and current versions of the model:

Santa Barbara Canyon Fault

- v0.20: 2,400 AFY
- V0.30: 3,300 AFY
 - Includes ~500 AFY from Santa Barbara Canyon

Russell Fault

- v0.20: 200 AFY
- V0.30: 190 AFY

Groundwater-Fault Interaction Investigation - Conclusions

Geophysical Survey

- SBC and Russell Fault systems are more complex than previously reported.
- The older buried faults are over-printed by younger thrust faults.

Santa Barbara Canyon Fault System

- Identified beneath the Cuyama River but not to the northeast as mapped.
- Fault system creates an abrupt transition in the depth to water from about 50 to 100 feet bgs to the south and greater than 600 feet bgs to the north.
- Groundwater quality is similar south and north of the fault system at depths of 265 to 1,100 feet bgs.
- Flow across the fault appears to be approx. 3,300 AFY

Russell Fault System

- Fault system does not affect depth to water on either side.
- Groundwater quality immediately east of the fault system is significantly more saline than to the west.
- Flow across the fault appears to be minimal.



TO: Standing Advisory Committee
Agenda Item No. 7a

FROM: Brian Van Lienden / Jim Beck

DATE: July 25, 2024

SUBJECT: Update on Water Resources Model

Recommended Motion

None – information only.

Discussion

An presentation on the Water Resources Model is provided as Attachment 1.

Cuyama Basin Groundwater Sustainability Agency

Update on CBWRM Model Refinement

July 25, 2024



Agenda

- Briefing on the CBWRM model upgrade
- Review model results
- Update on Sustainable Yield Analysis
- Update on Management Area Extent

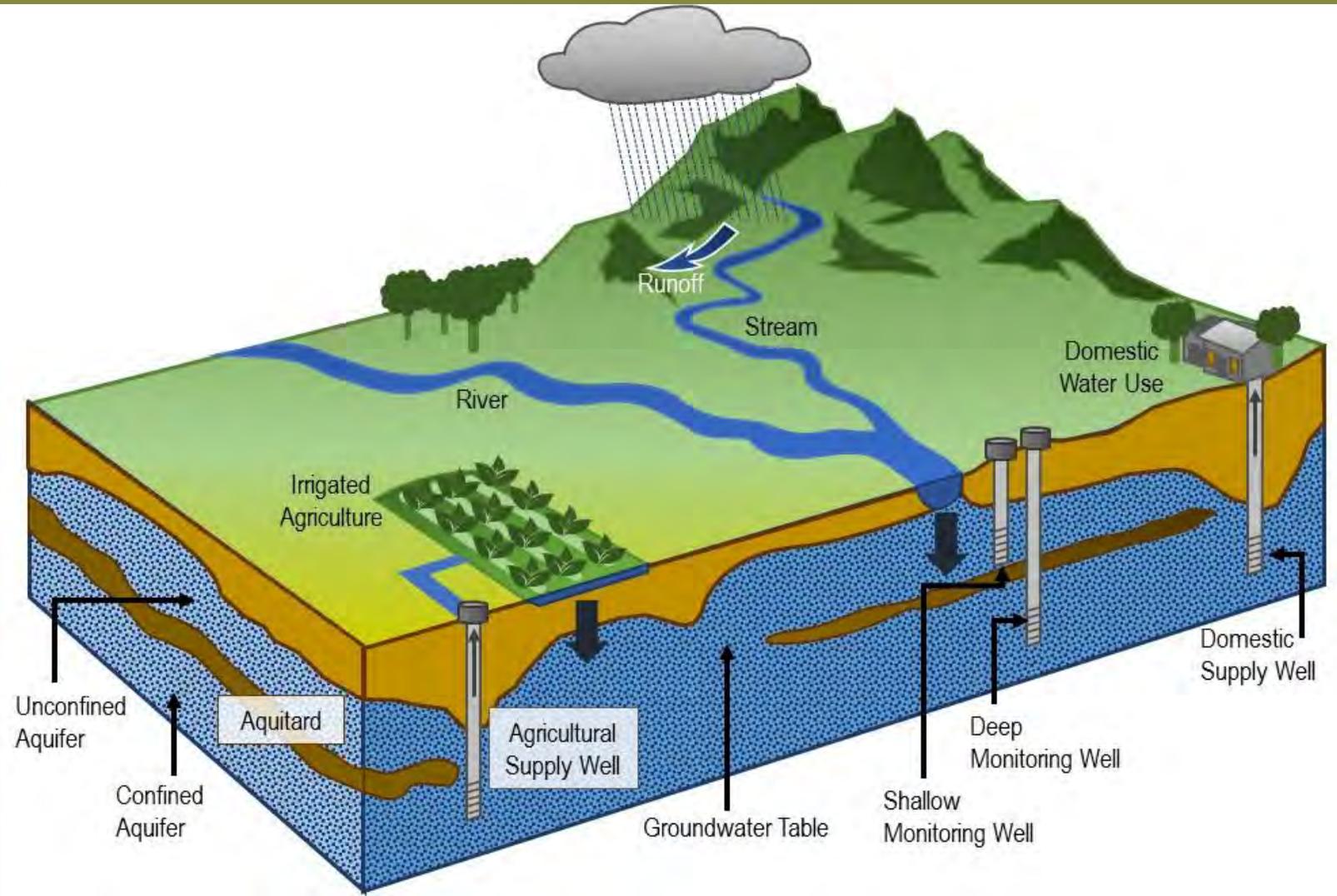
Key Outcomes

- The updated model incorporates significant new data that was previously unavailable
- Projected basin-wide pumping (38,500 AFY) and groundwater storage deficit (14,100 AFY) are both lower than previous estimates
- Central Management Area is reduced by approx. 700 acres (3% reduction)
- Basin-wide sustainable yield is estimated to be 17,800 AFY
- Pumping cap in current Central Management Area plus Farming Units is 10,500 AF
- Approach to uncertainty analysis for the updated model will be similar to that of the GSP.



Components of the Cuyama Basin Water Resources Model

- Groundwater aquifers
- Agricultural and domestic pumping
- Percolation
- Surface water interaction



Model Development and Application History

- **CBWRM was originally developed for the 2020 GSP (v0.10)**
 - This version was used to develop water budget and sustainability estimates contained in the 2020 GSP
 - Applied for water year 2020 and 2021 Annual Reports
- **July 2022 Update (v0.20)**
 - Incorporated updated data available at that time
 - Applied for water year 2022 and 2023 Annual Reports
 - Used to develop CMA allocation tables for 2023 and 2024
- **July 2024 Update (v0.30)**
 - Incorporates additional data updates that are now available

Newly available information

- **Geology:**
 - AEM
 - Fault investigation
 - Well log data from the newly installed monitoring wells
- **Land use:**
 - Updated land use data from LandIQ and local landowners
- **Pumping:**
 - Reported pumping for 2022 and 2023
 - Detailed information about the well location and service areas as a result of the well survey and pumping reports
- **Recalibration:**
 - Groundwater level and streamflow measurements from CBGSA monitoring program

CBWRM Model Update

- Revised model layering by incorporating AEM, fault investigation, and other geologic data.
- Revised the land surface component to align simulated pumping with the reported pumping values for 2022 and 2023 and incorporate non-irrigated land use types.
- Estimates of Non-irrigated parcels based on recent idle acreage
- Refined pumping wells and service areas.
- Recalibrated the model using data through WY 2023.
- Updated historical and future conditions budgets, and estimate sustainable yield.

Other available data not incorporated in the model

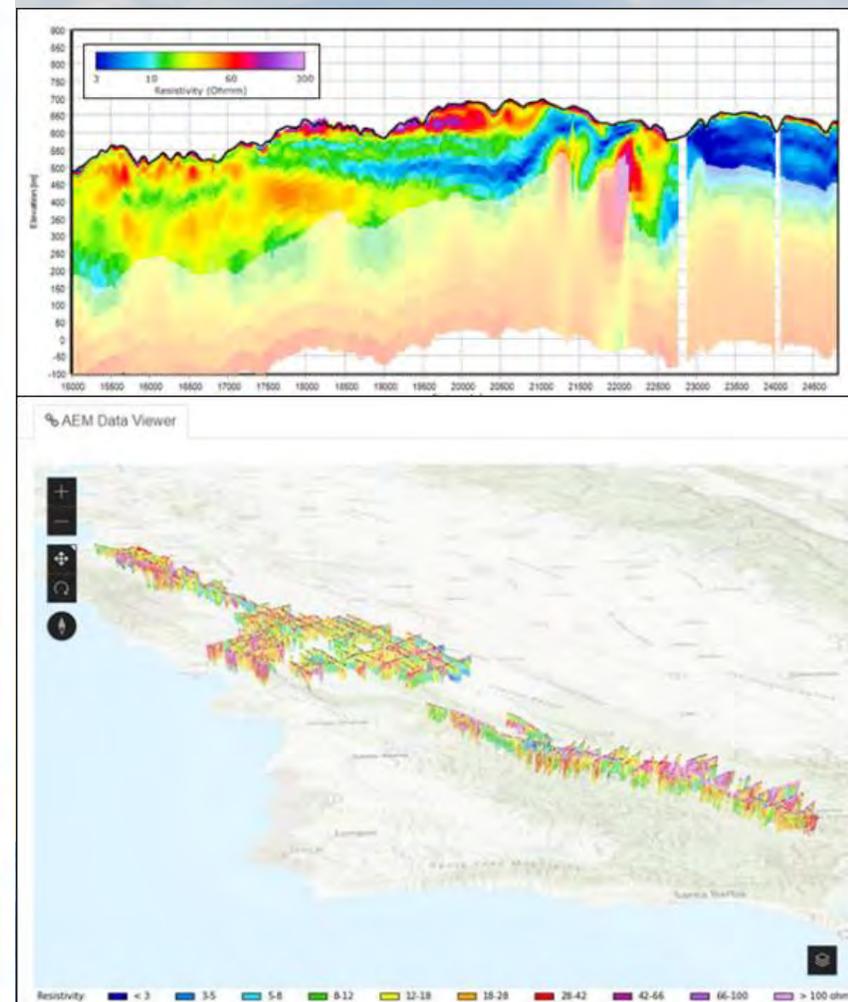
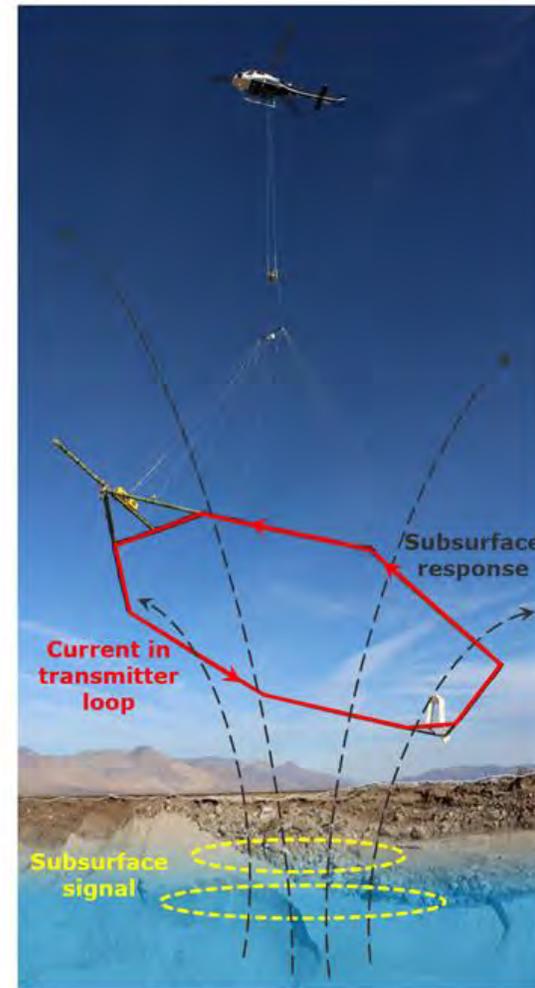
- Streambed LiDAR survey
 - Model requires consistent invert elevation and rating tables
 - Holding this update until improved rating tables are available
- Non-irrigated fields from LandIQ
 - Dataset was not available on time to integrate into the land use
 - Instead manually checked satellite images for the last two years and marked them as non-irrigated
 - Can be incorporated in the next annual report



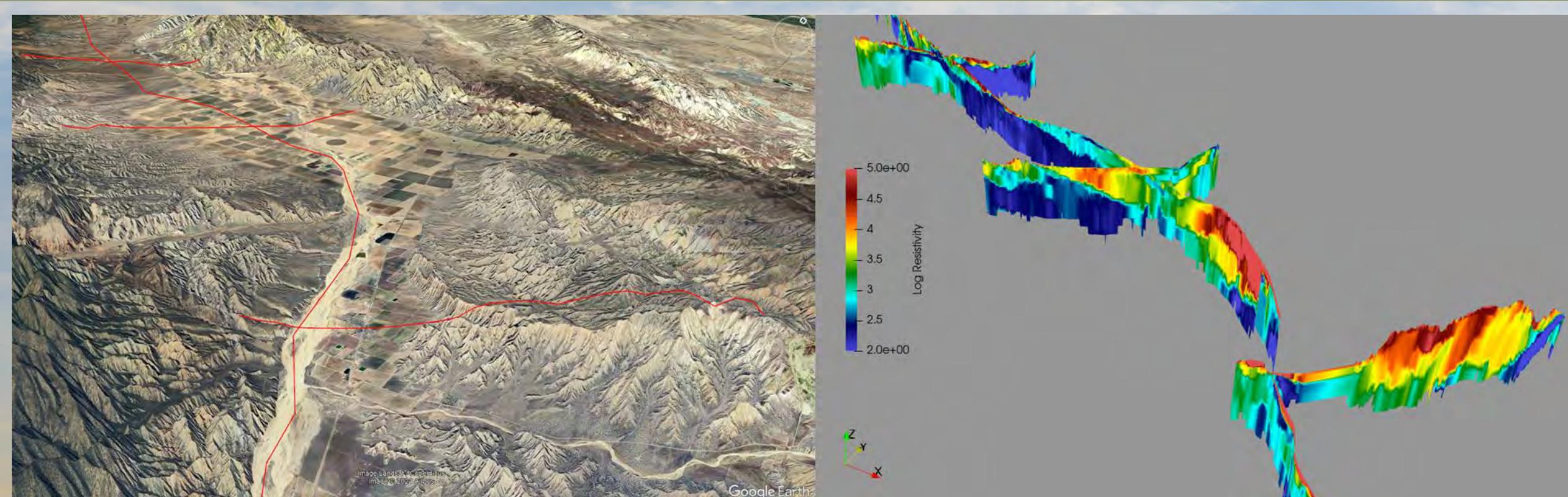
Geology Update

Airborne Electromagnetic (AEM) Surveys

- DWR conducted AEM surveys in California's high- and medium-priority groundwater basins as part of the Basin Characterization program.
- During an AEM survey, a helicopter tows electronic equipment that sends signals into the ground which bounce back. The data collected is used to develop continuous images that are interpreted for underground geology.

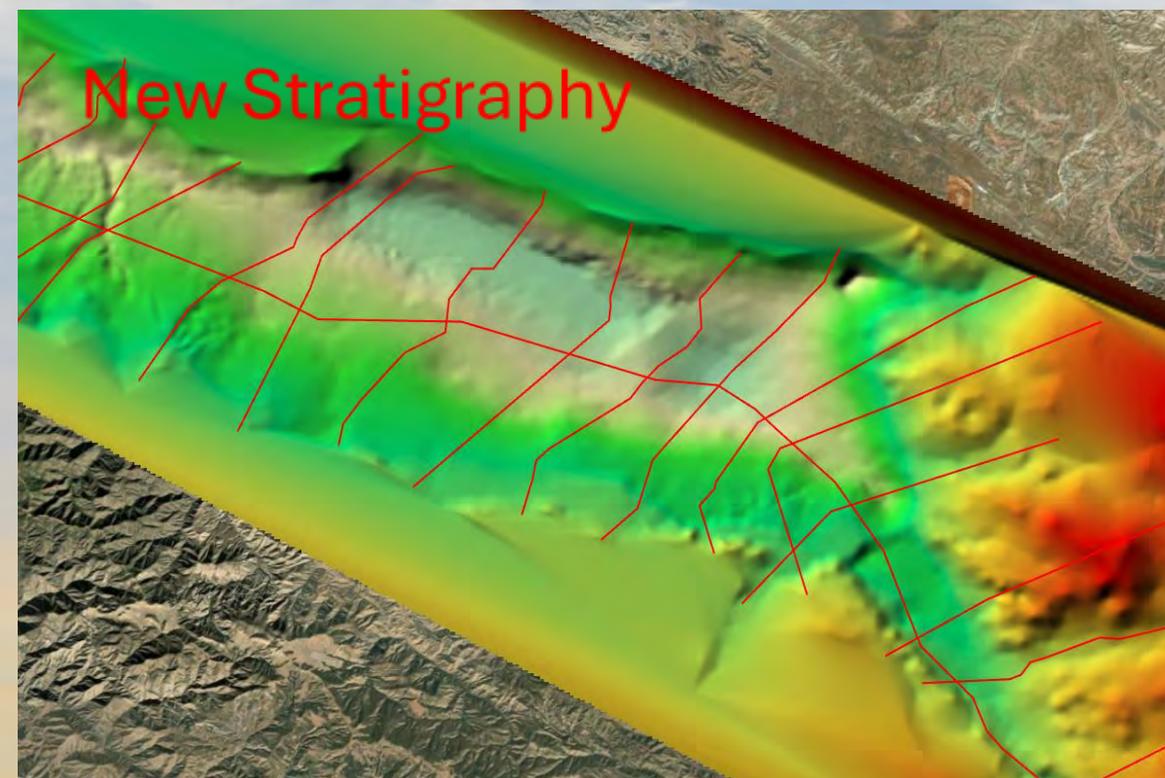
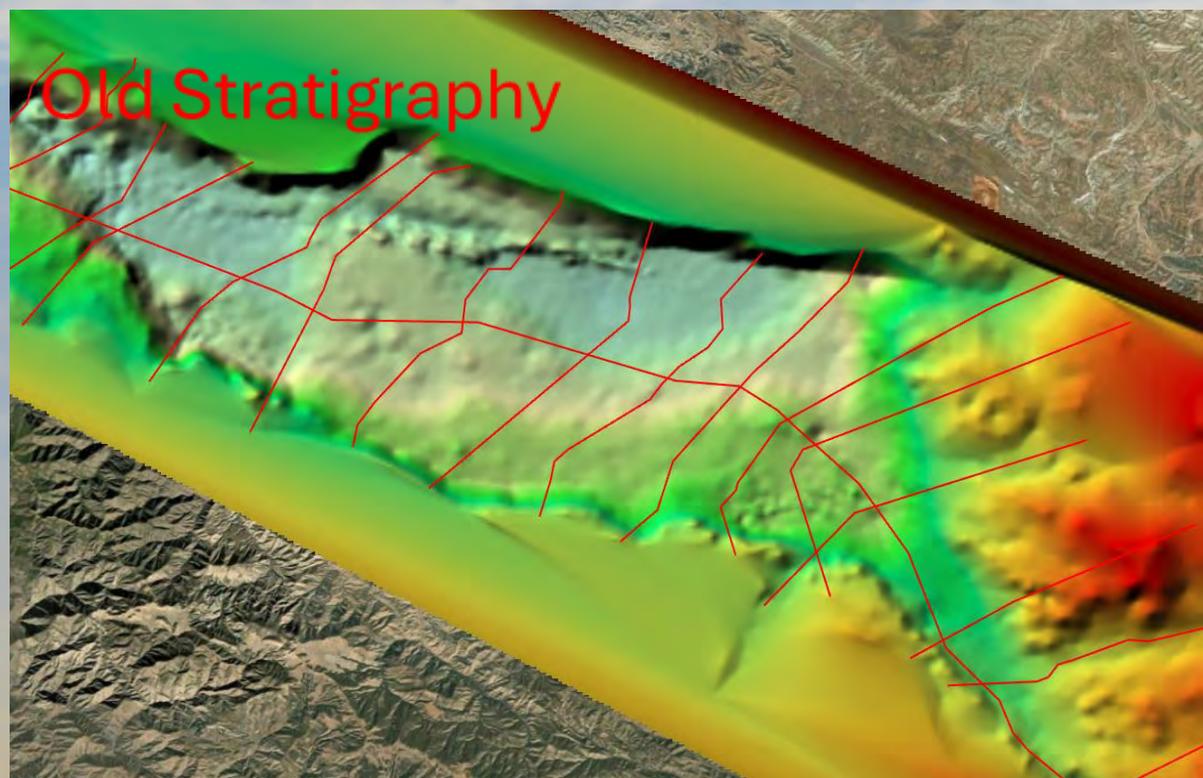


Used DWR's AEM Survey



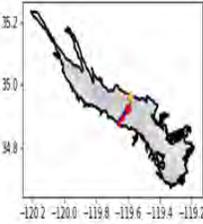
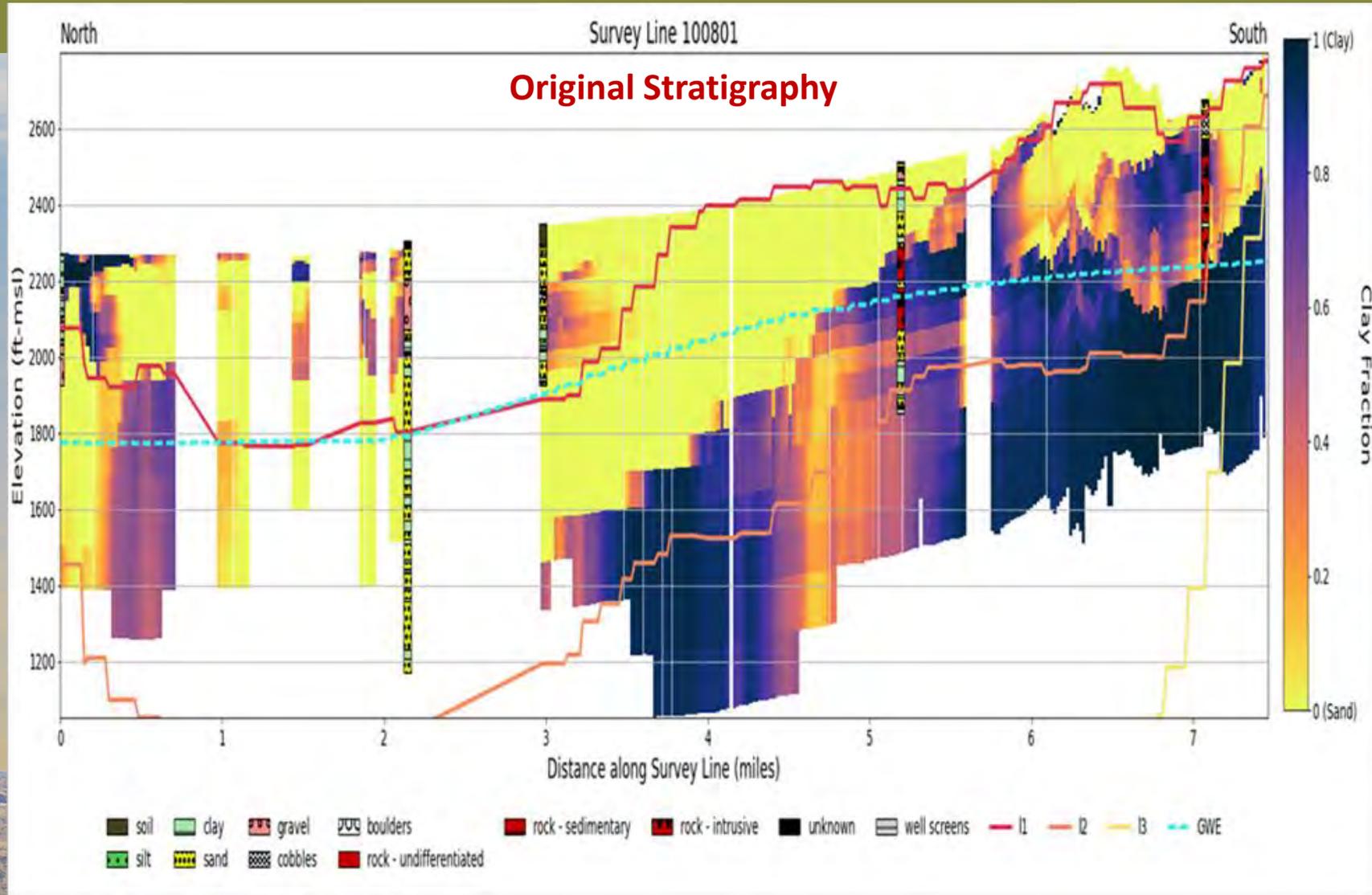
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Layer 2 of the Model is Updated



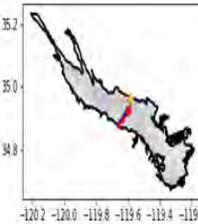
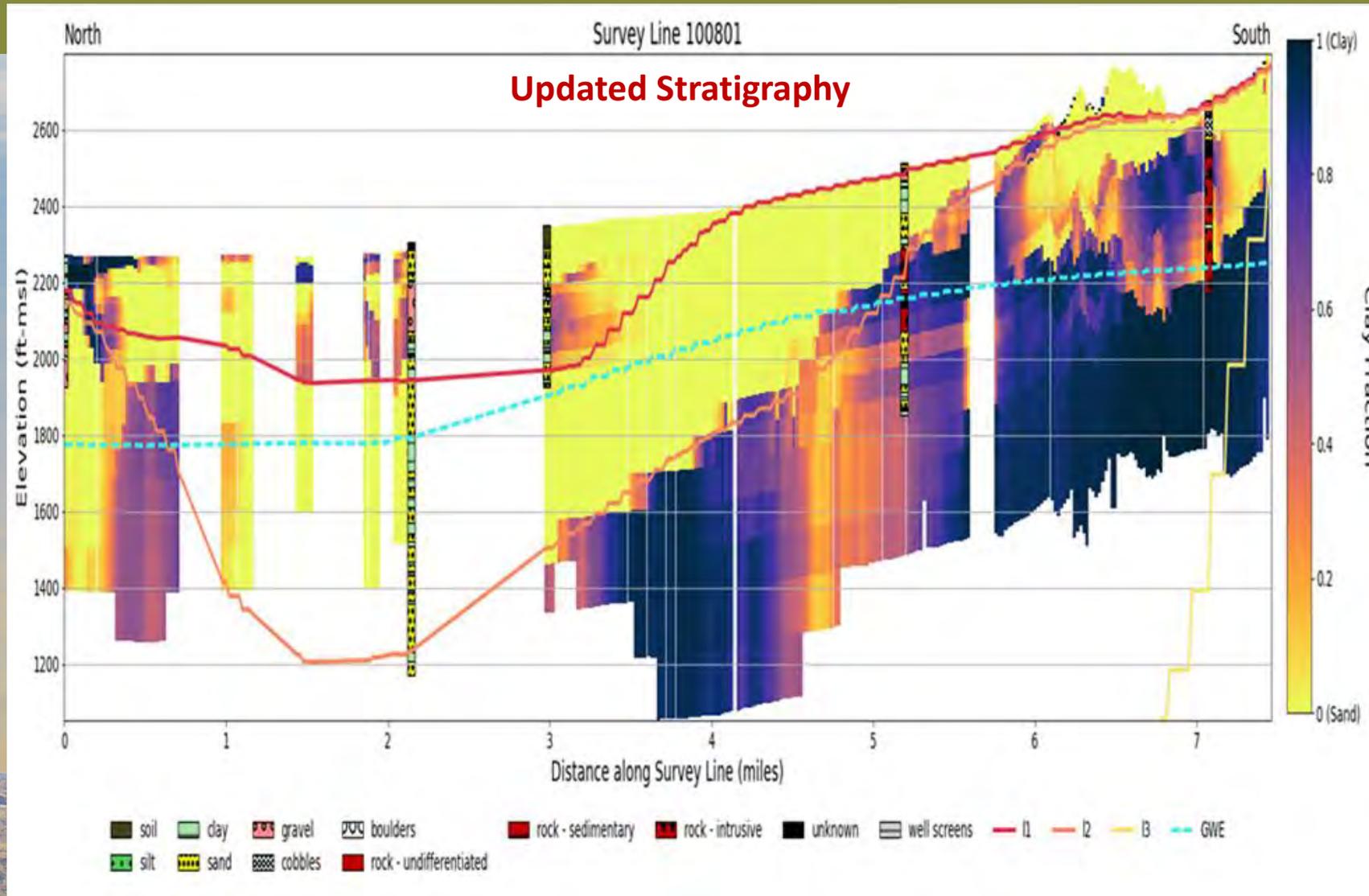
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Model layer definition have improved based on the AEM Data



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Model layer definition have improved based on the AEM Data



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Fault Investigation Study Summary

- Appropriate Resistivity Lines from AEM surveys were incorporated in the Model layers
- Based on the analysis, an improved representation of flow barrier conditions across the fault is incorporated in the model
Incorporating the AEM data in the model at the SBCF area, the model simulation capabilities near the SBCF has improved by reducing the head residuals

Land Use Update

Land Surface Update

- Revised historical land use data:
 - Combined historical land use data into a single, consistent shapefile
 - Reviewed and revised the matching of crop categories to model crop types when needed
 - Introduced non-irrigated land use type
- Revised IDC calibration:
 - Adjusted ET rates to align simulated pumping with the reported volumes for 2022-23
 - Reviewed root zone and land & water use budgets
 - Adjusted soil parameters as necessary

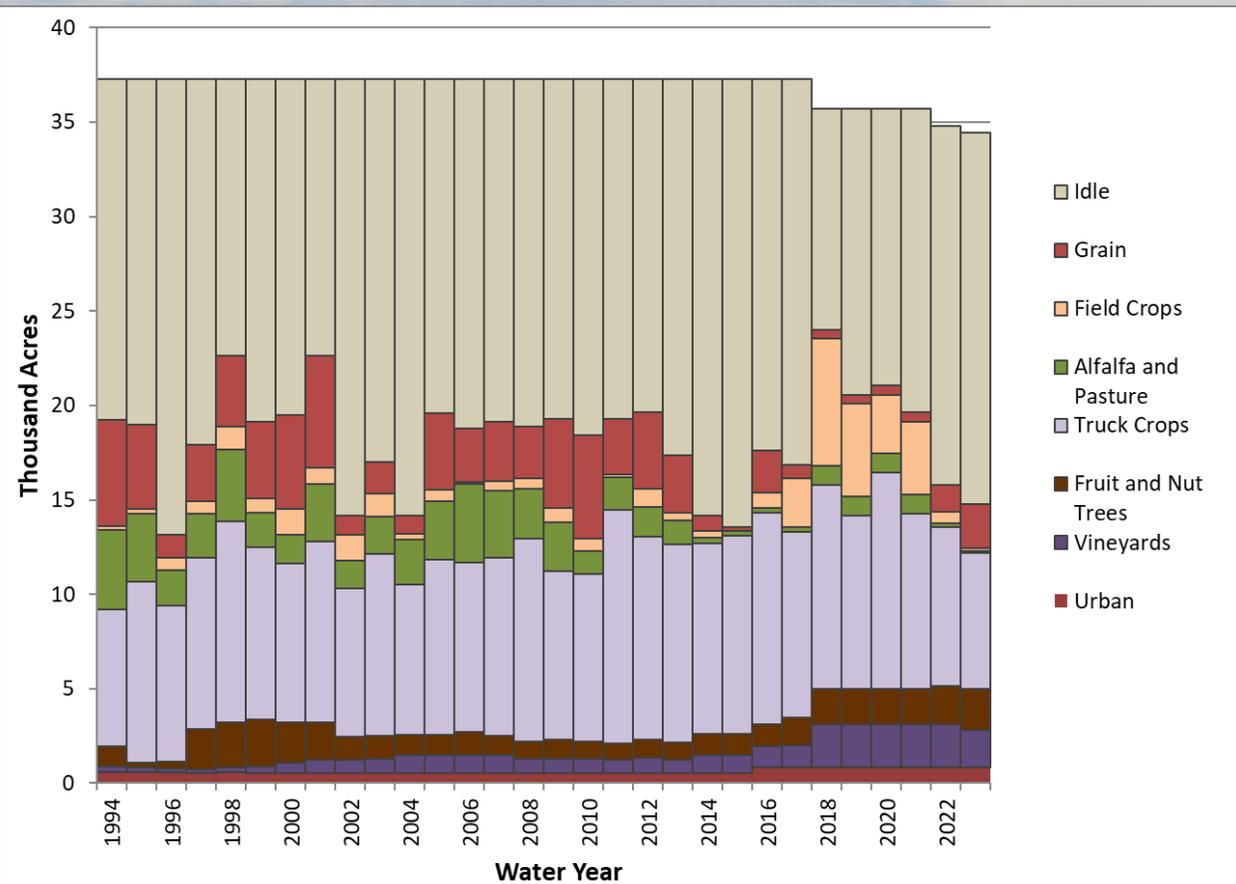
Historical Land Use Data

- v0.20 land use was developed:
 - By Davids Engineering for the years 1994-2017
 - By Woodard & Curran for the years 2018-recent
 - Data from each year is independently stored and processed, which may lead to inconsistency between years
- v0.30 land use is developed:
 - For the years 1994-recent
 - All the data is combined into a single master shapefile
 - All years are batch-processed with a consistent methodology using only LandIQ and local landowner provided data
- ***Updated land use data has a better representation of the historical conditions and agricultural development in the valley.***

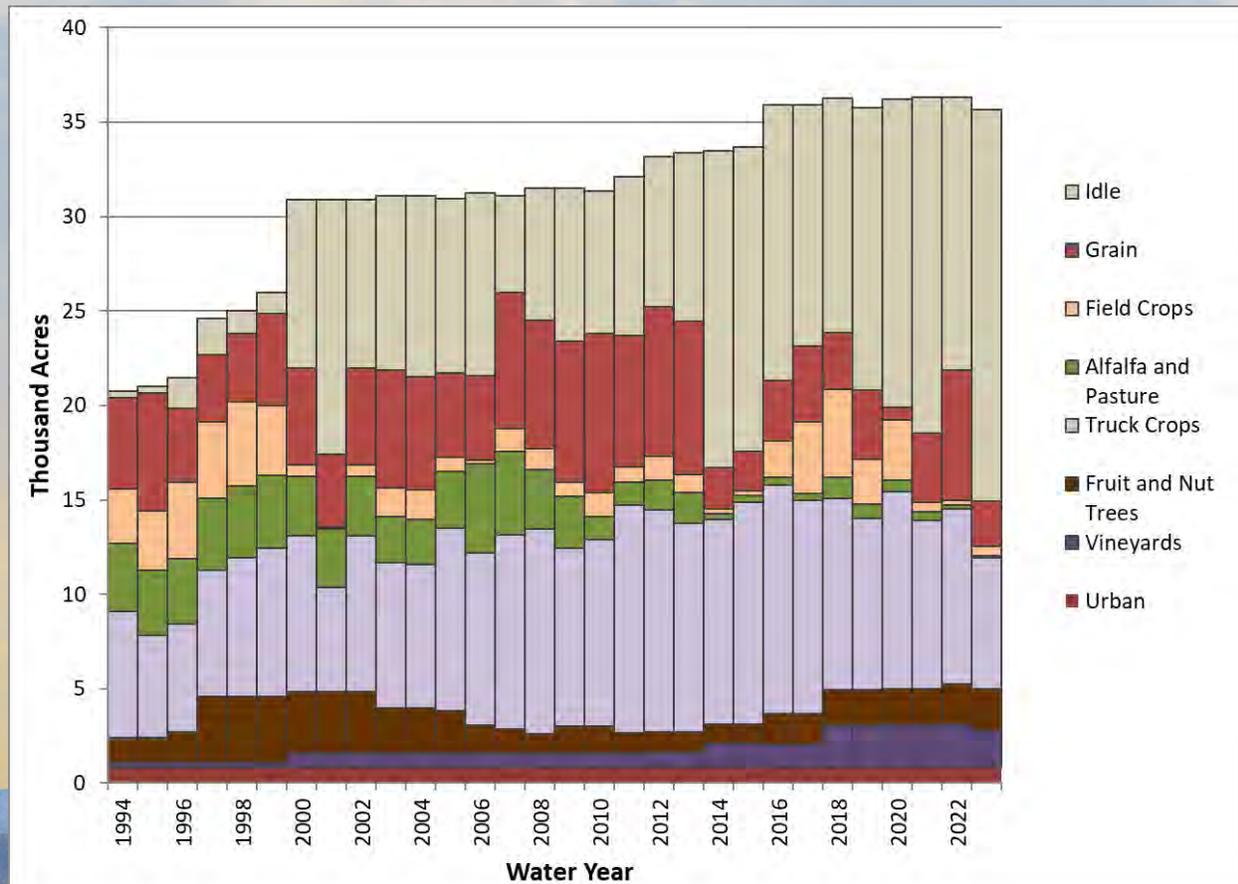


Historical Land Use Data

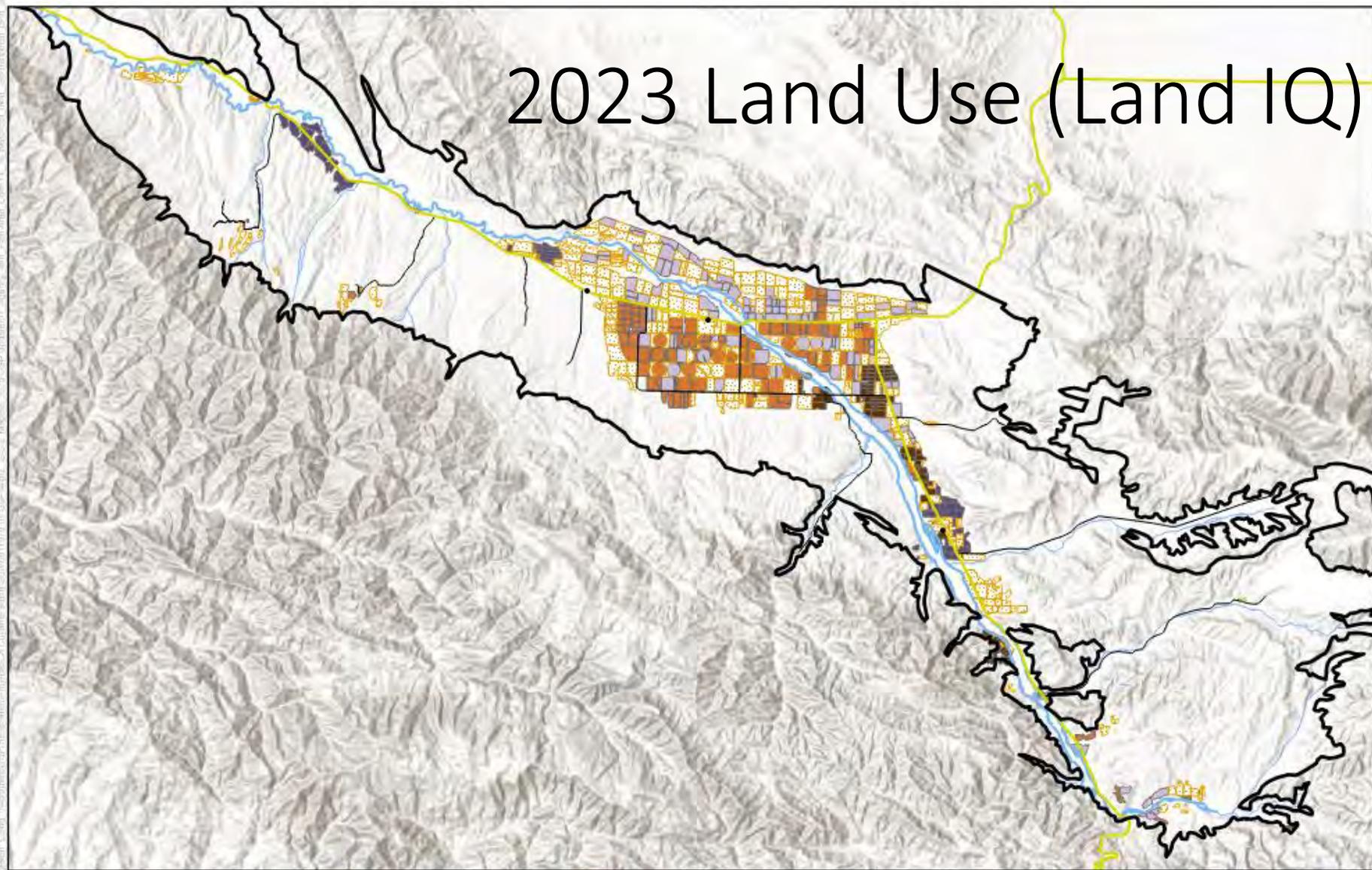
v0.20 (as of 2023 annual report)



v0.30 (updated version)



2023 Land Use (Land IQ)



2023 Land Use

Cuyama Valley
Groundwater Basin

Legend

- Alfalfa and Irrigated Pasture
- Fruit and Nut Trees
- Field Crops
- Truck Crops
- Vineyard
- Grain
- Idle
- Cuyama Basin
- Town
- Highway
- Local Road
- Cuyama River
- Creek



0 1.25 2.5 5 Miles

Map Created: July 2024

Third Party GIS Disclaimer: This map is for reference and graphical purposes only and should not be relied upon by third parties for any legal decisions. Any reliance upon the map or data contained herein shall be at the users' sole risk. Data sources: CA DWR, esri, USGS

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Pumping Update

Historical Potential ET rates

- Previous discussions with the locals concluded that the model does not correctly represent irrigation practices for certain crop types.
- Reported pumping volumes showed difference from simulated ones for 2022 and 2023.
- Potential ET rates are modified to take into account those practices, and to better match the reported pumping for 2022 and 2023.

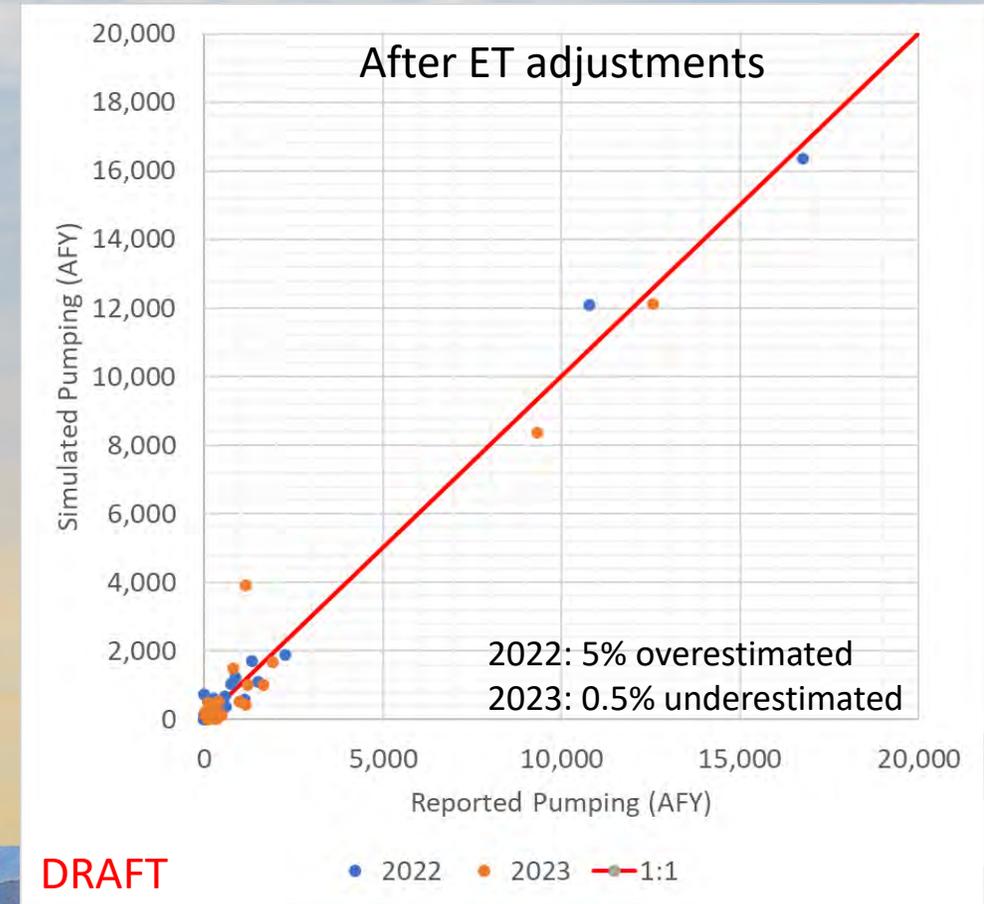
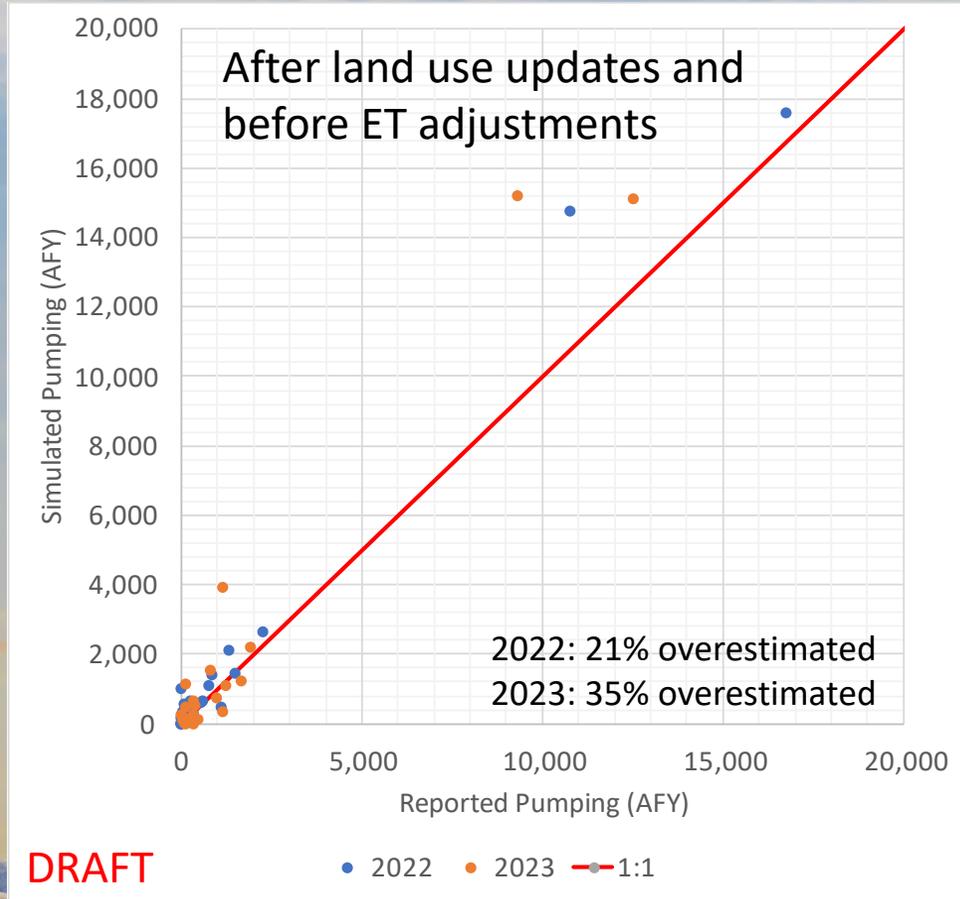
Crop	v0.20 ET (ft/yr)	v0.30 ET (ft/yr)	Change
Carrot	3.20	3.84	↗
Idle	0.82	0.08	↘
M Truck	2.84	3.84	↗
M Field	3.89	0.58	↘
M Grain	2.03	0.51	↘
Onion	2.53	2.78	↗
Pistachio	2.73	3.55	↗
Potato	2.74	3.02	↗
Safflower	1.28	0.26	↘

ET for these crops have not been changed:

Crop	v0.20 & v0.30 ET (ft/yr)
Alfalfa	4.48
Apple	4.00
Bean	1.74
Berry	1.89
Citrus	2.32
Cole	1.61
Corn	4.13
Grape	1.89
Green	1.02
Lettuce	1.54
Melons	2.35
M Decid.	2.54
M Grass	3.12
M Subt.	1.94
Olive	1.33
Wheat	2.05
YTrees	1.34

*Native, Mixed Pasture and Non-irrigated land use type ETs are limited by available precipitation. Actual ET is around 10 inches/year.

Simulated vs. Reported Pumping

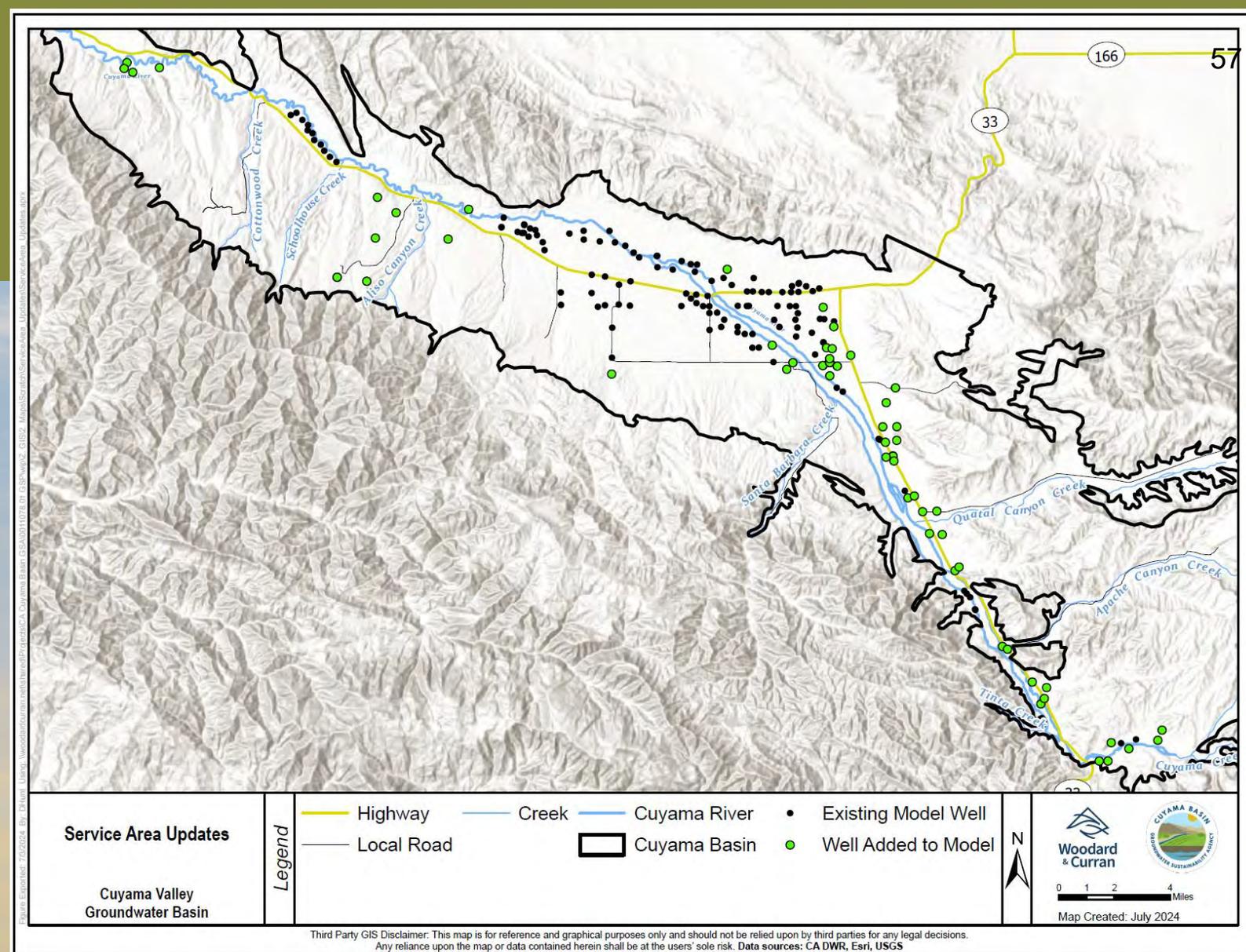


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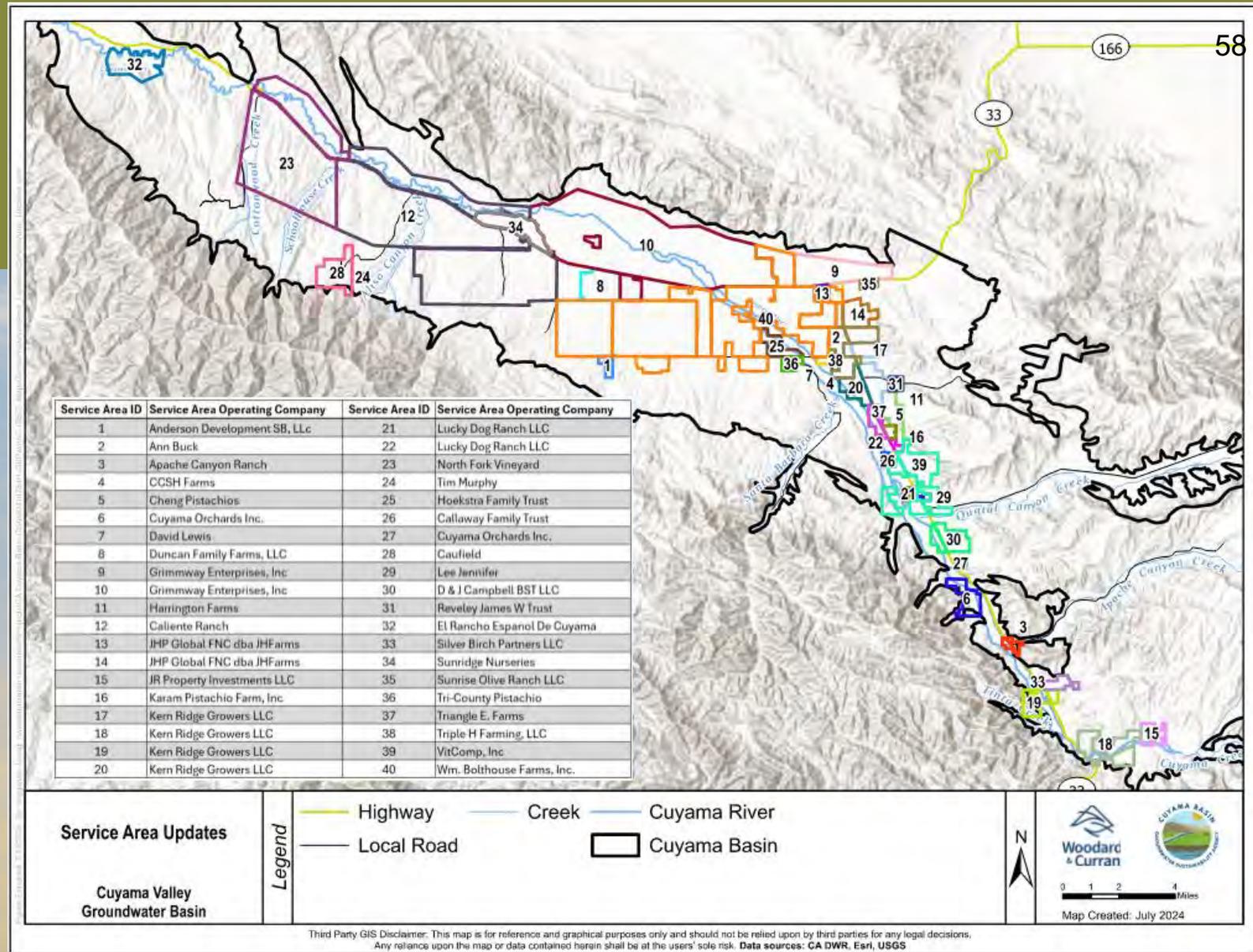
Pumping Wells

- Most of Central basin wells, and some others, were already in the model.
- Coordinates are updated for the existing wells.
- More wells are added in the Western and Eastern parts of the basin.



Service Areas

- 40 service areas are defined for reporting operating companies' fields.
- These service areas are linked to the wells serving those areas.
- Information is mostly coming from pumping reports and farm unit applications.



Land Use and Pumping Refinements

- Refinements to the land use data have contributed to improvement of model representation of the agricultural and crop acreage over time
- Identification of pumping wells and reporting of pumping rates along with the service area delineation has helped improve model representation of location and amount of pumping
- Pumping and crop reporting should continue on an annual basis to help improve the sustainability analysis and accounting process
- These improvements have contributed to more accurate calibration of the model, which is presented in the following slides



Model Recalibration

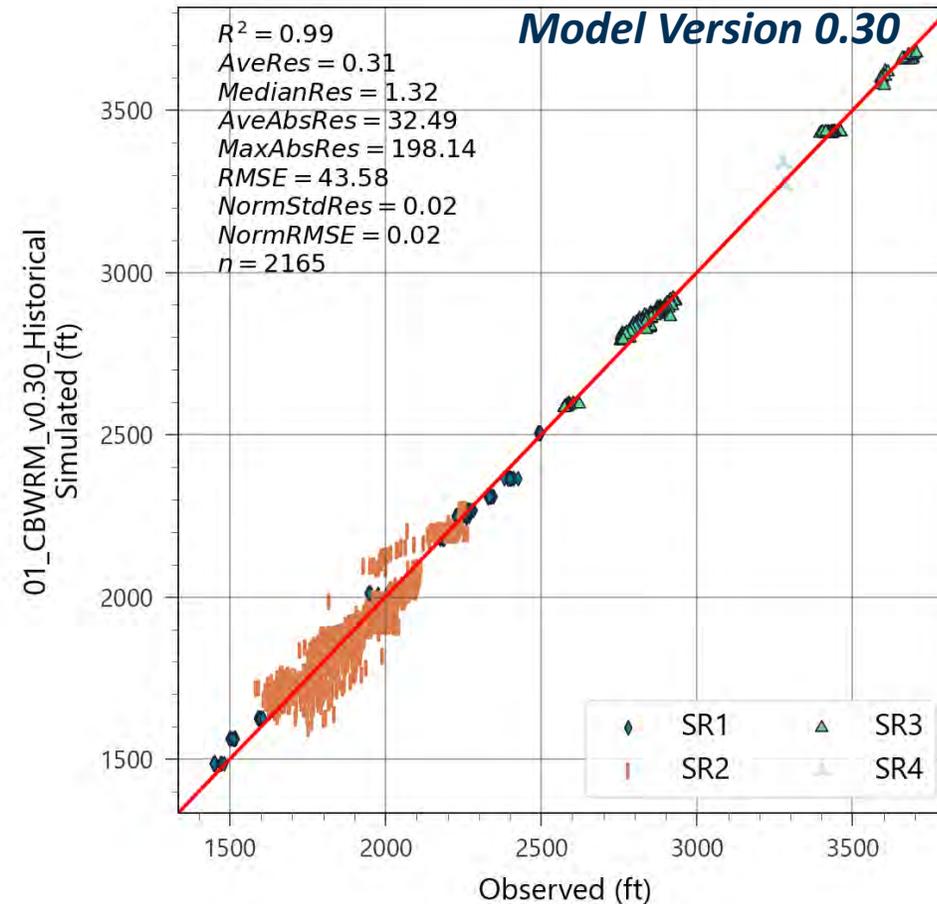
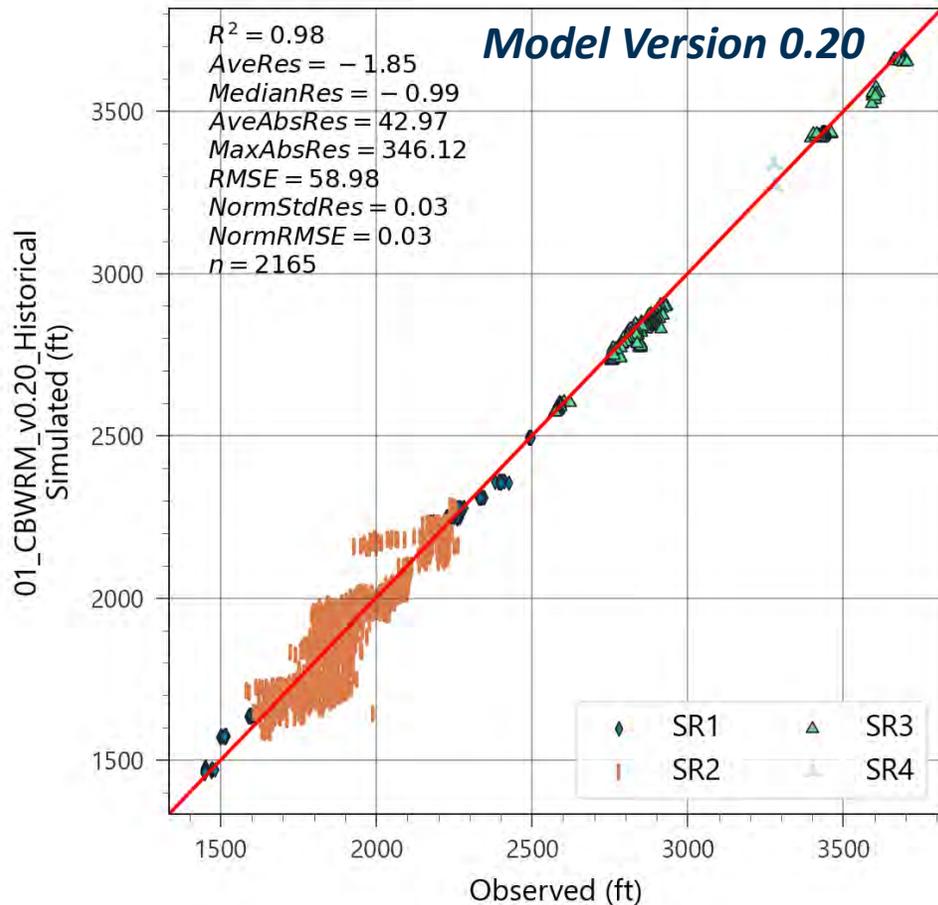
Model Recalibration

- As a result of the changes in model stratigraphy and land surface water budget components (crop demand, pumping, and deep percolation estimates), model required a recalibration.
- Aquifer parameter distribution was revised to better match the understanding from the AEM hydrogeologic information.
- Uncertainties in representation and interpretation of observed GWL data was minimized by vertical averaging of the observed data.

Model Calibration Statistics

Observed GWLs vs. Simulated GWLs

“perfect results would be on the red line”



v0.30 shows improved residual statistics compared to v0.20.

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Summary of Re-calibration Effort

- Model calibration has improved in many areas of the basin
- Improvements in model representation of the historical conditions helps:
 - Improve projection of future conditions
 - Better estimation of sustainable yield
 - More representative delineation of Management Area boundaries and GW allocation

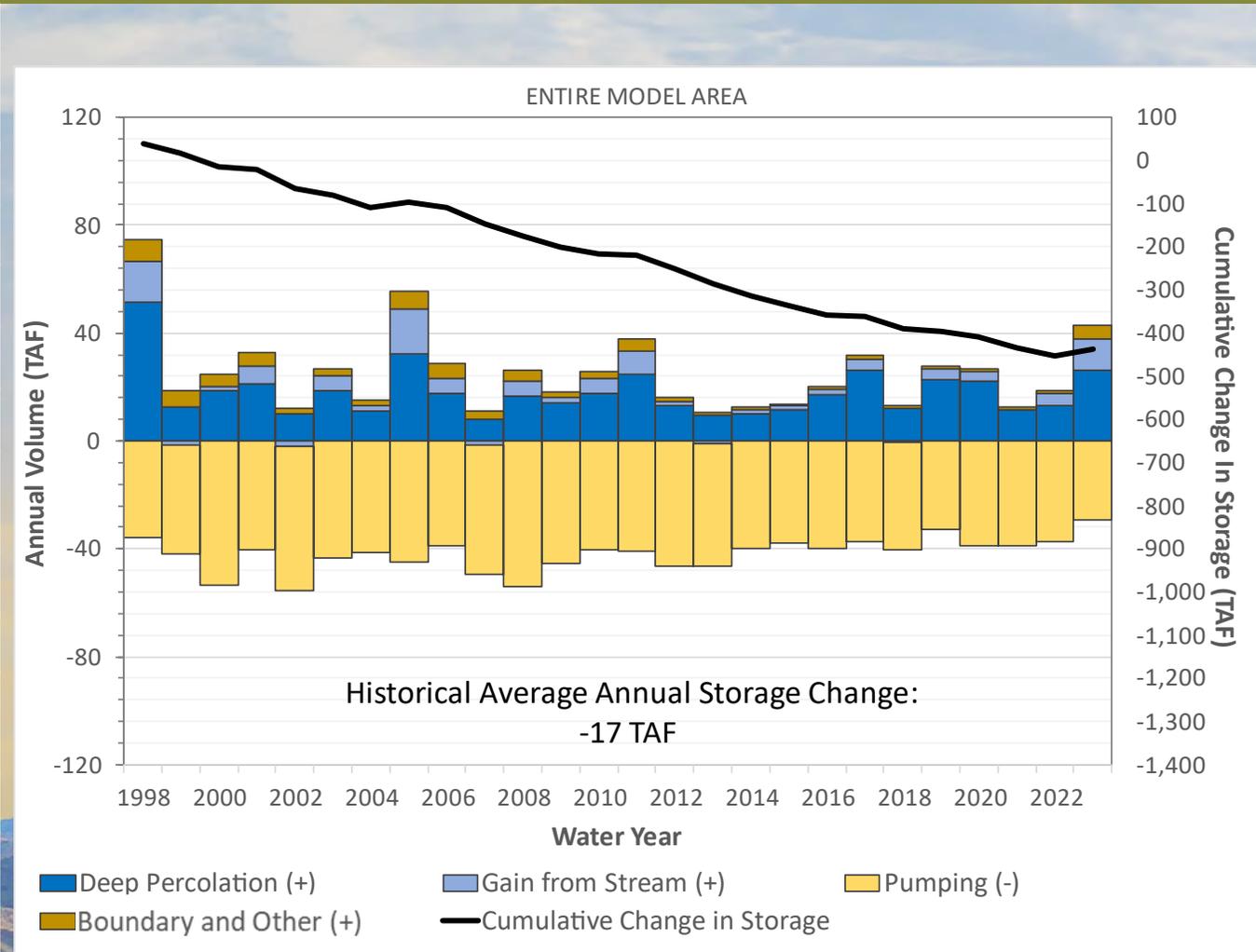
Updated Results

Budgets, GWL Change, Sustainable Yield

Updated Basin-Wide Conditions

Historical Groundwater Budget

Component	GSP – v0.10 (1998-2017) AF/Yr	v0.20 (1998-2021) AF/Yr	v0.30 (1998-2023) AF/Yr
Inflow			
Deep Percolation	28,000	27,000	18,100
<i>DP (Precip)</i>	18,400	17,800	11,900
<i>DP (AW)</i>	9,600	9,200	6,200
Stream Seepage	3,000	4,700	4,000
Boundary and Other Inflows	5,000	2,800	2,800
Total Inflow	36,000	34,500	24,900
Outflow			
Groundwater Pumping	59,000	59,300	41,700
Total Outflow	59,000	59,300	41,700
GW Storage Deficit	23,000	24,800	16,800



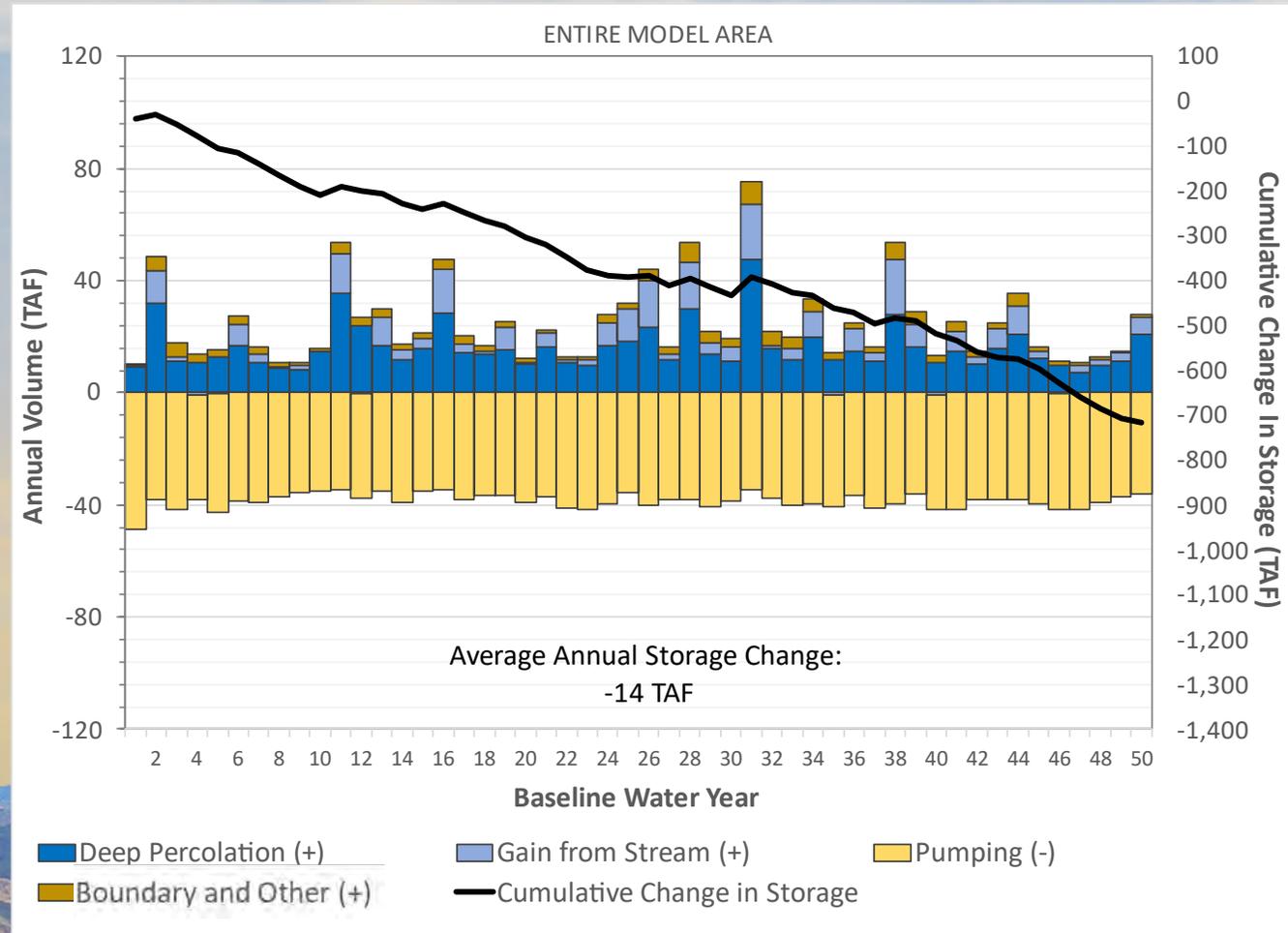
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Updated Basin-Wide Conditions

Projected Groundwater Budget

Based on the 50-year hydrology (WY 1968-2017)

Component	GSP – v0.10 Projected AF/Yr	v0.20 Projected AF/Yr	v0.30 Projected AF/Yr
Inflow			
Deep Percolation	25,000	24,800	16,100
DP (Precip)	16,600	16,500	10,700
DP (AW)	8,400	8,300	5,400
Stream Seepage	5,000	5,600	5,500
Boundary and Other Inflows	5,000	2,900	2,800
Total Inflow	35,000	33,300	24,400
Outflow			
Groundwater Pumping	60,000	56,500	38,500
Total Outflow	60,000	56,500	38,500
GW Storage Deficit	25,000	22,300	14,100



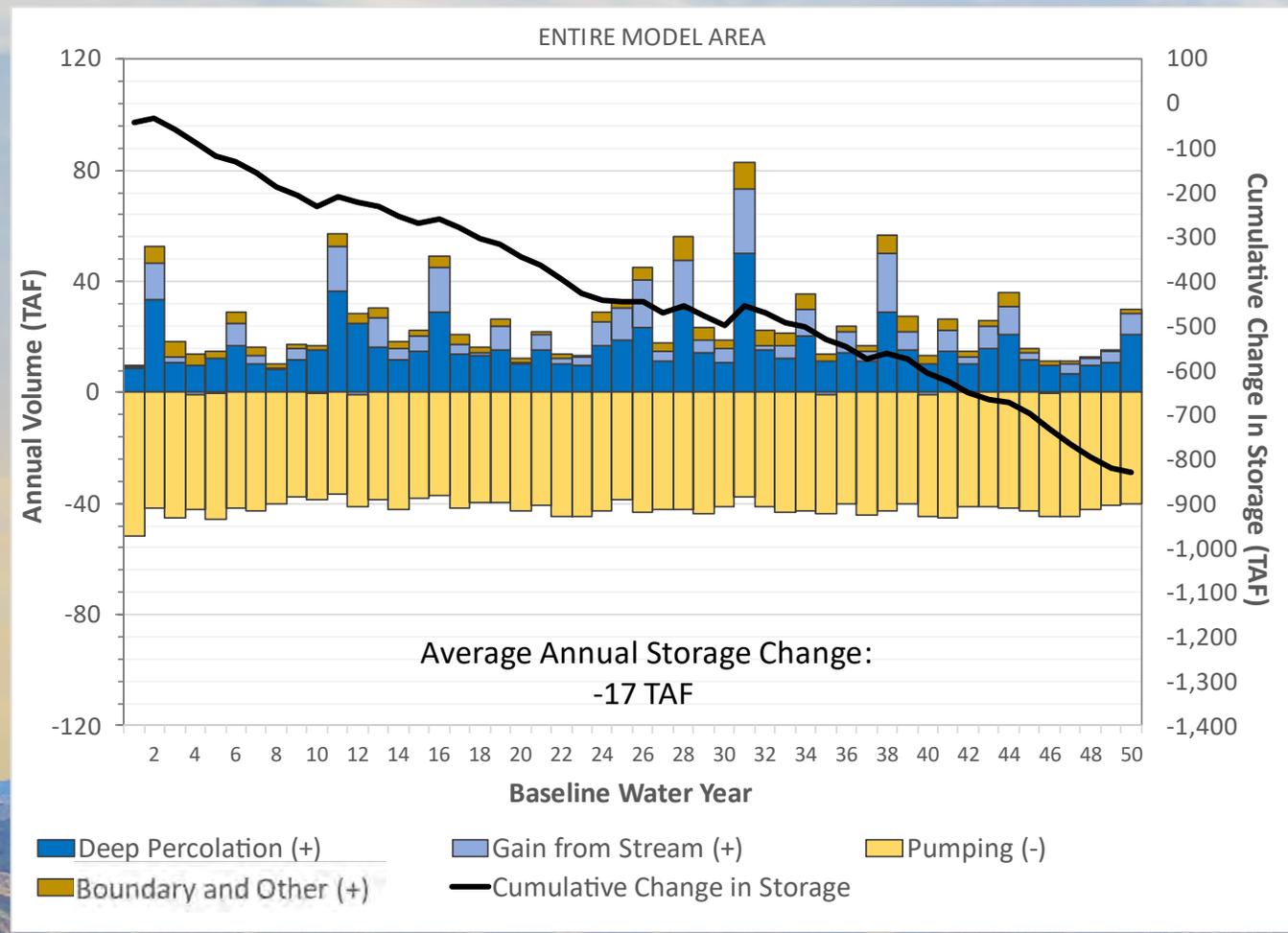
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Updated Basin-Wide Conditions Projected with Climate Change Groundwater Budget

Based on the 50-year hydrology (WY 1968-2017)
adjusted for climate change

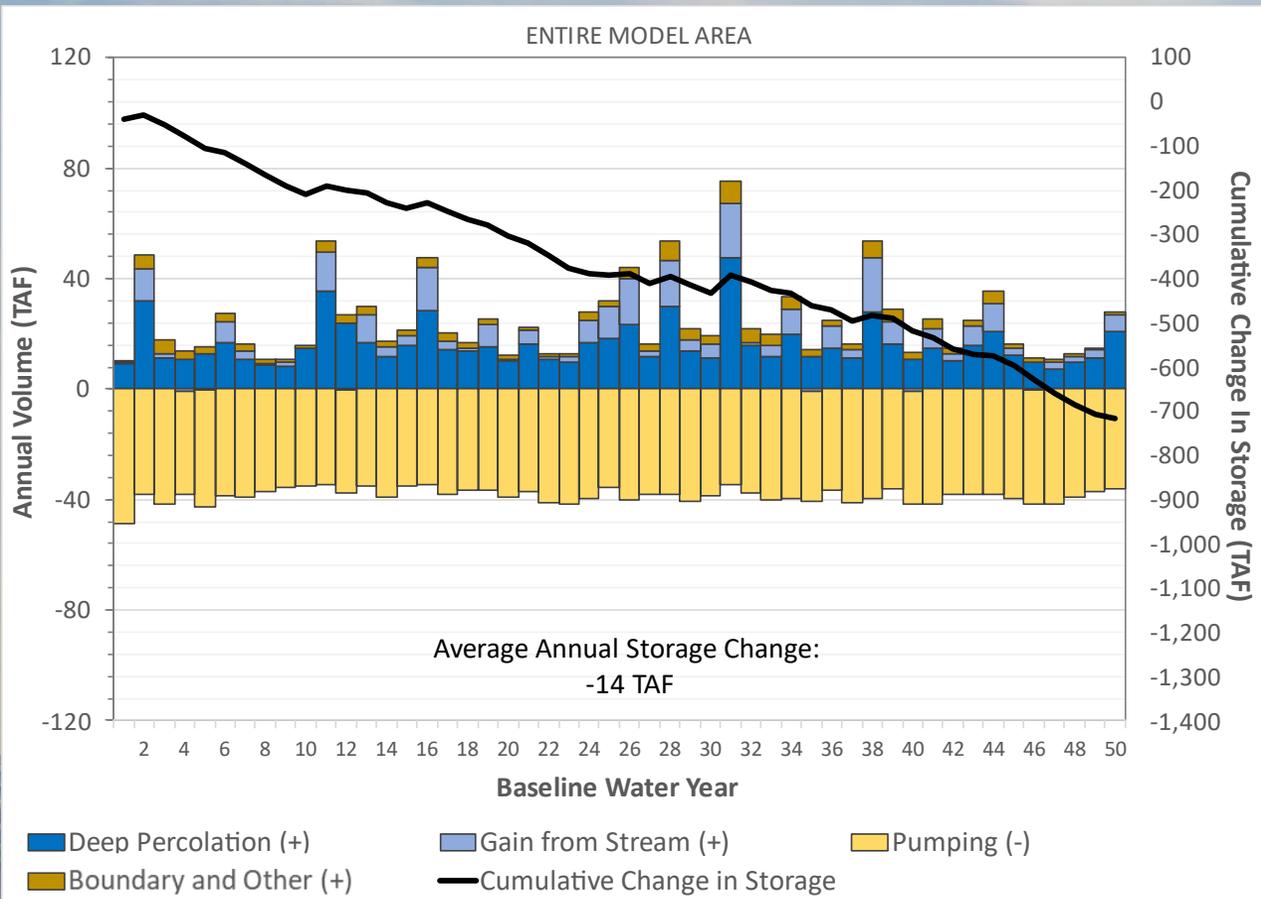
Component	GSP – v0.10 Projected w/CC AF/Yr	v0.20 Projected w/CC AF/Yr	v0.30 Projected w/CC AF/Yr
Inflow			
Deep Percolation	26,000	25,000	16,100
DP (Precip)	17,300	16,600	10,700
DP (AW)	8,700	8,400	5,400
Stream Seepage	6,000	6,200	6,000
Boundary and Other Inflows	5,000	3,300	3,200
Total Inflow	37,000	34,500	25,300
Outflow			
Groundwater Pumping	64,000	61,200	41,800
Total Outflow	64,000	61,200	41,800
GW Storage Deficit	27,000	25,800	16,500

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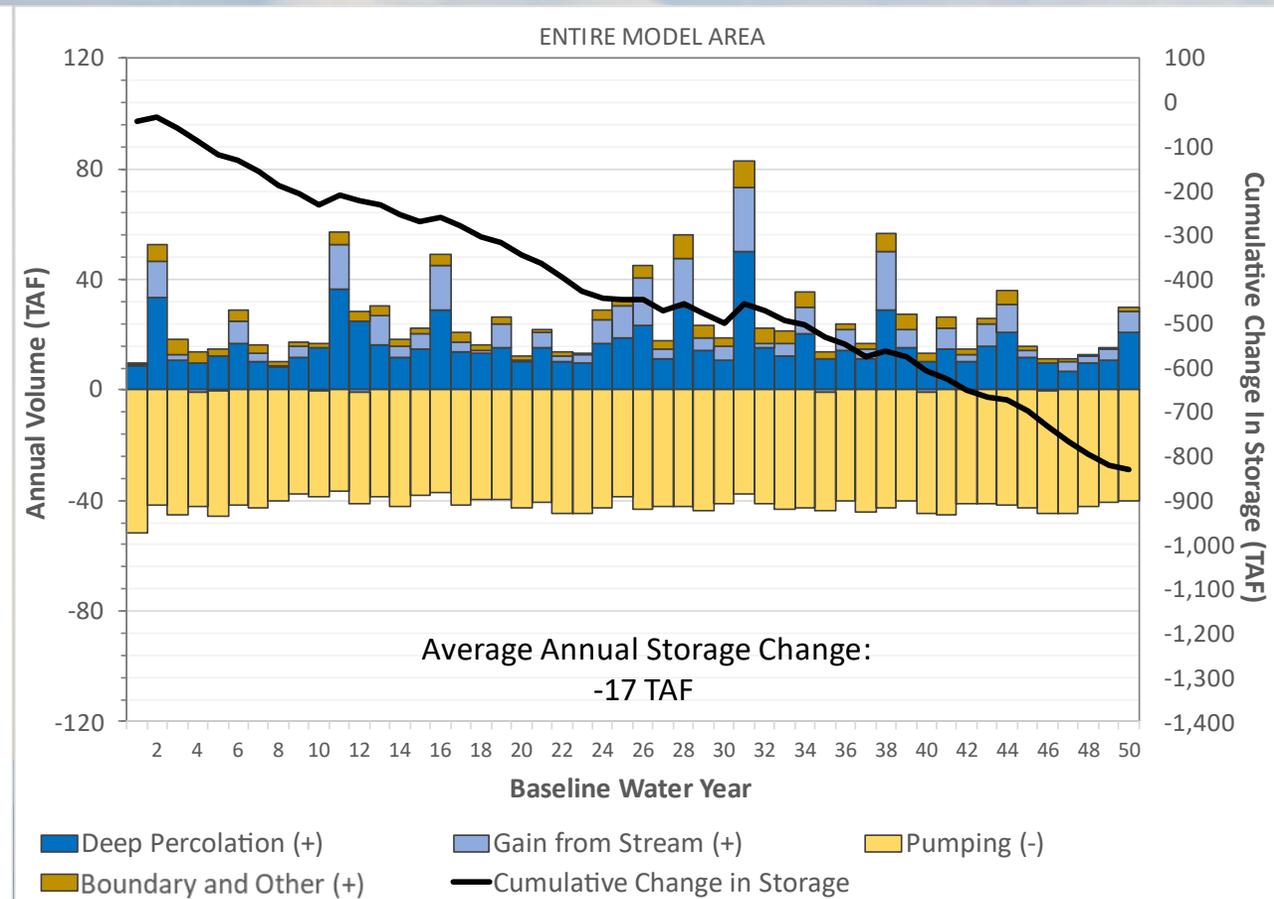


Effects of Climate Change on Basin-Wide Water Budget

Baseline GW Budget



Baseline GW Budget under Climate Change



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Updated Basin-Wide Conditions

Summary of the Updated Groundwater Budgets

Component	Historical AF/Yr	Projected AF/Yr	Projected w/CC AF/Yr
	WY 1998-2023	WY 1968-2017	WY 1968-2017
Inflow			
Deep Percolation	18,100	16,100	16,100
Stream Seepage	4,000	5,500	6,000
Boundary and Other Inflows	2,800	2,800	3,200
<i>Total Inflow</i>	<i>24,900</i>	<i>24,400</i>	<i>25,300</i>
Outflow			
Groundwater Pumping	41,700	38,500	41,800
<i>Total Outflow</i>	<i>41,700</i>	<i>38,500</i>	<i>41,800</i>
GW Storage Deficit	16,800	14,100	16,500

Summary Slide

- Updated estimates of groundwater budget are more credible and based on the latest reports on cropping acreage and reported water use for 2022-23
- Updated Pumping estimates are:
 - Historical: 41,700 AFY
 - Projected: 38,500 AFY
 - Projected w CC: 41,800 AFY
- Updated overdraft estimates are:
 - Historical: 16,800 AFY
 - Projected: 14,100 AFY
 - Projected w CC: 16,500 AFY

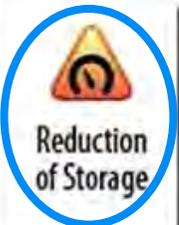


Next Steps in Model Use

- Sustainable Yield Estimation
- Delineation of Management Area Extent

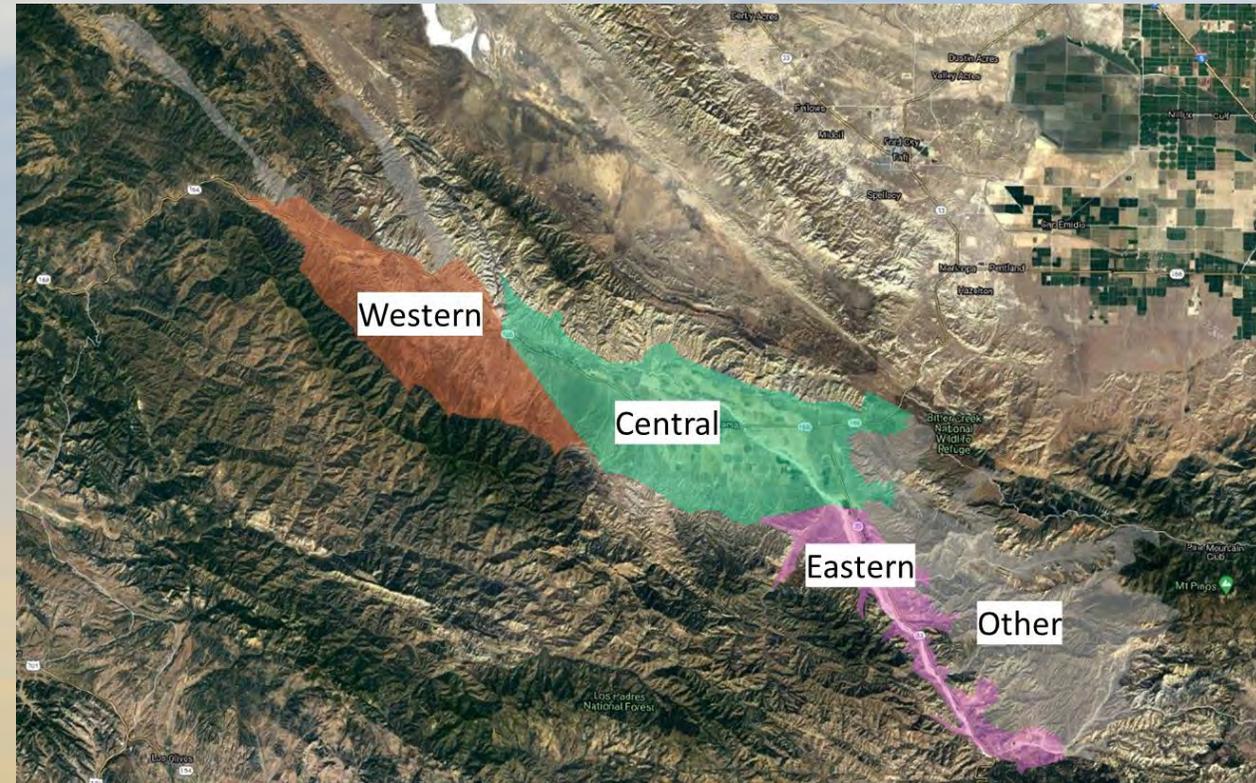
Sustainable Yield

- Sustainable Yield** – Sustainable yield is the average annual groundwater pumping that can be sustained without any long-term negative net change in groundwater storage. *(GSP p. 2-122)*

Sustainability Indicators	 Lowering GW Levels	 Reduction of Storage	 Seawater Intrusion	 Degraded Quality	 Land Subsidence	 Surface Water Depletion
Metric(s) Defined in GSP Regulations	<ul style="list-style-type: none"> Groundwater Elevation 	<ul style="list-style-type: none"> Extraction Volume 	<ul style="list-style-type: none"> Chloride concentration isocontour 	<ul style="list-style-type: none"> Migration of Plumes Number of supply wells Volume Location of isocontour 	<ul style="list-style-type: none"> Rate and Extent of Land Subsidence 	<ul style="list-style-type: none"> Volume or rate of surface water depletion

Sustainable Yield Estimation Approach

- Permanently fallow annual crop acreage in Central Region to have approximately zero long-term storage change in the Central Region.
- Maintain Western and Eastern regions pumping, because these regions are not expected to be in overdraft under projected conditions.



Updated Sustainable Yield Estimate

Basin-Wide GW Budget

Component	Projected Baseline AF/Yr	Sustainable Conditions AF/Yr
Inflow		
Deep Percolation	16,100	9,600
Stream Seepage	5,500	5,400
Boundary and Other Inflows	2,800	2,800
Total Inflow	24,400	17,800
Outflow		
Groundwater Pumping	38,500 <i>(GSP: 60,000, v0.20: 56,500)</i>	17,800 <i>(GSP: 20,000, v0.20: 23,900)</i>
Total Outflow	38,500	17,800

Sustainable Yield for the entire basin: 17,800 AFY

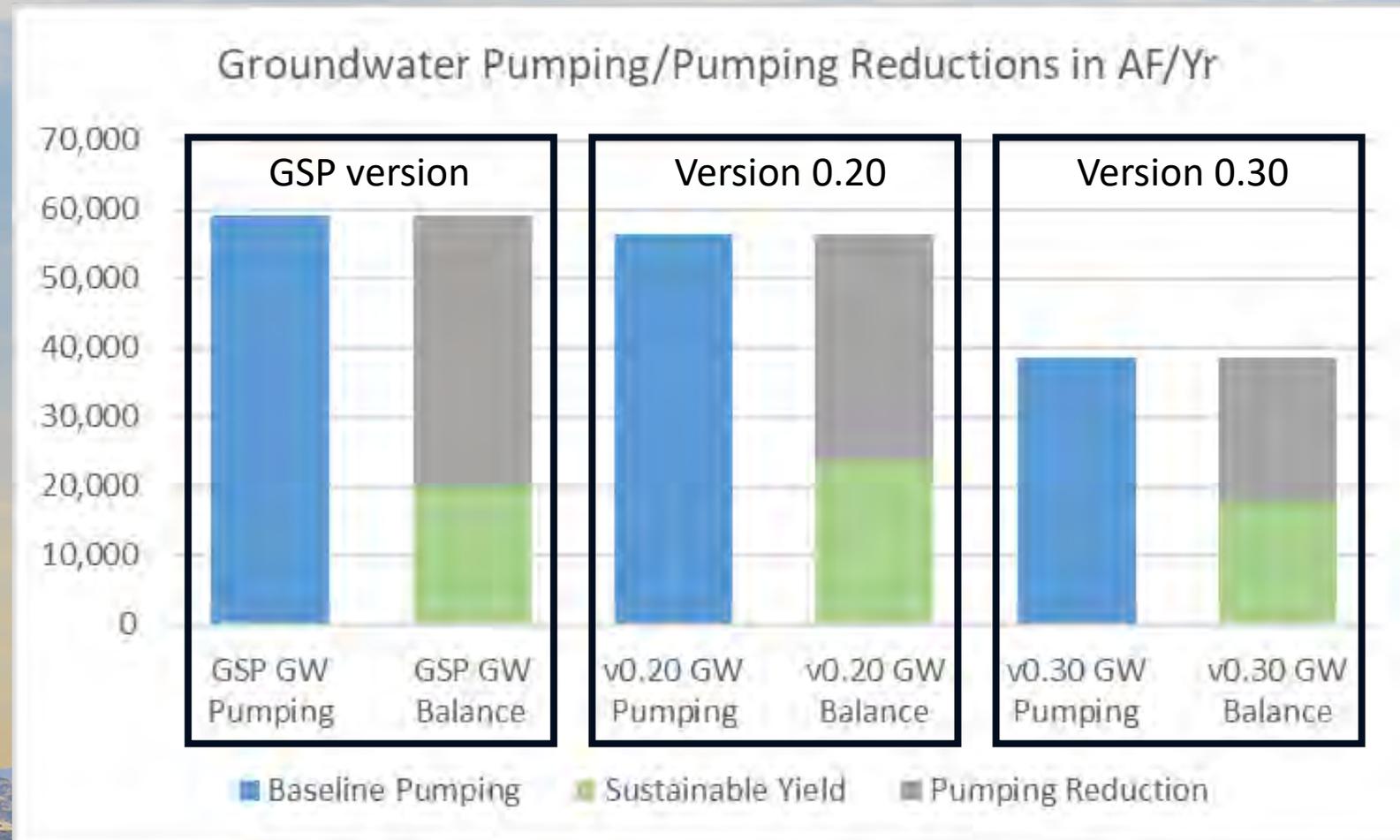
Central Region: 13,200 AFY

Western Area: 1,200 AFY

Eastern Area: 3,400 AFY

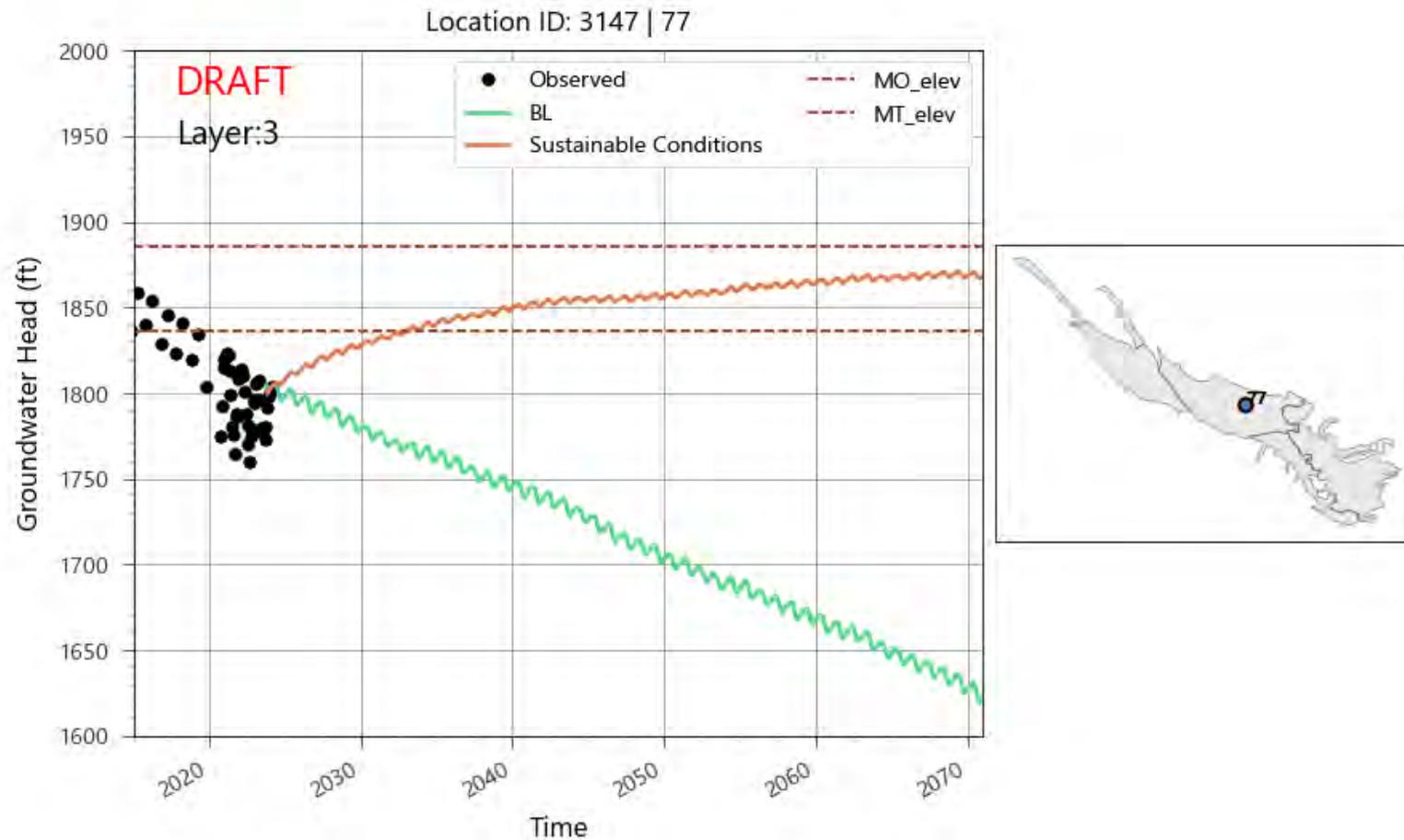
Pumping cap within current CMA+Farming Unit area: 10,500 AF/Yr

Sustainable Yield Update – Basin wide GW Balance



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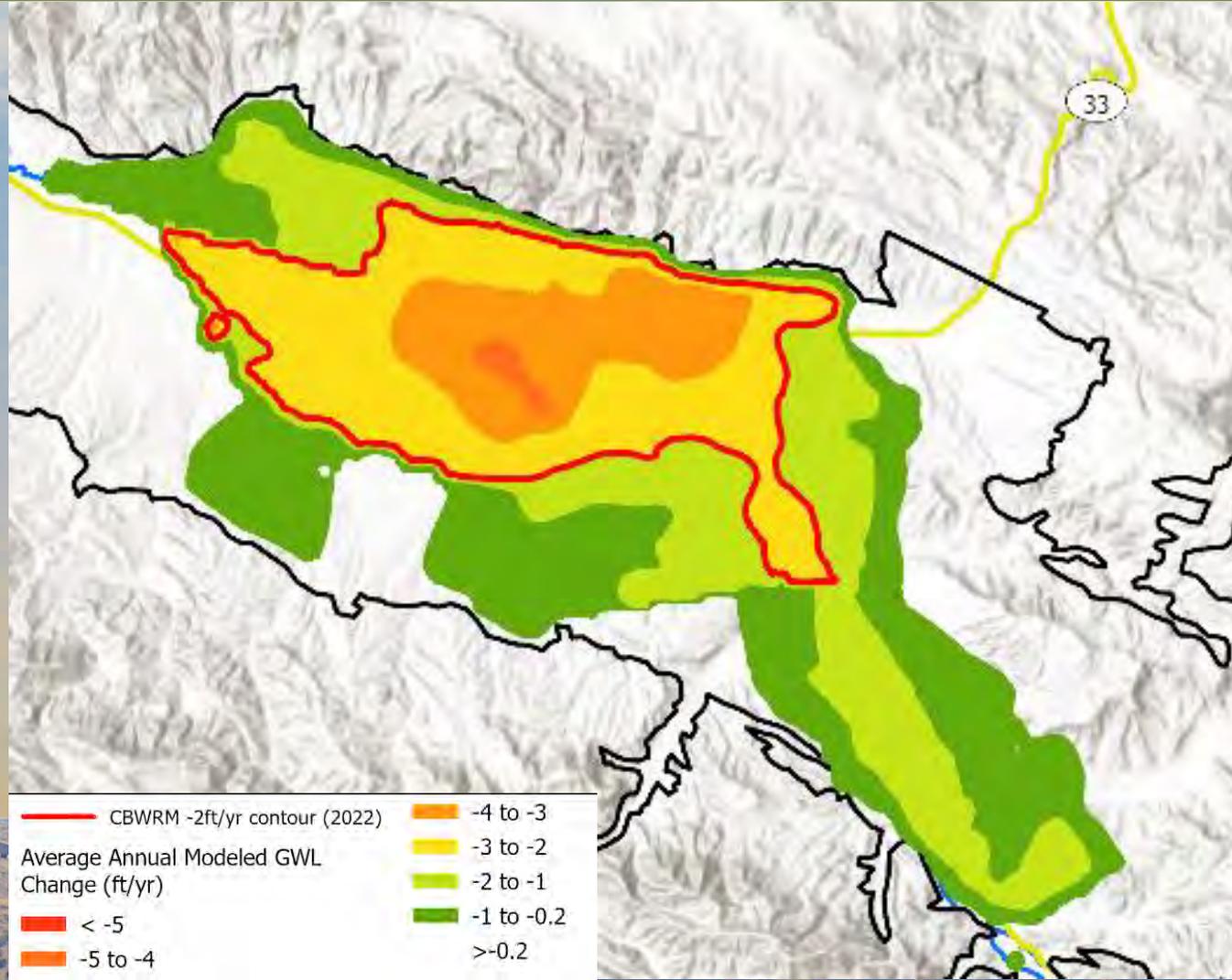
Example of GW Levels Under Sustainable Conditions



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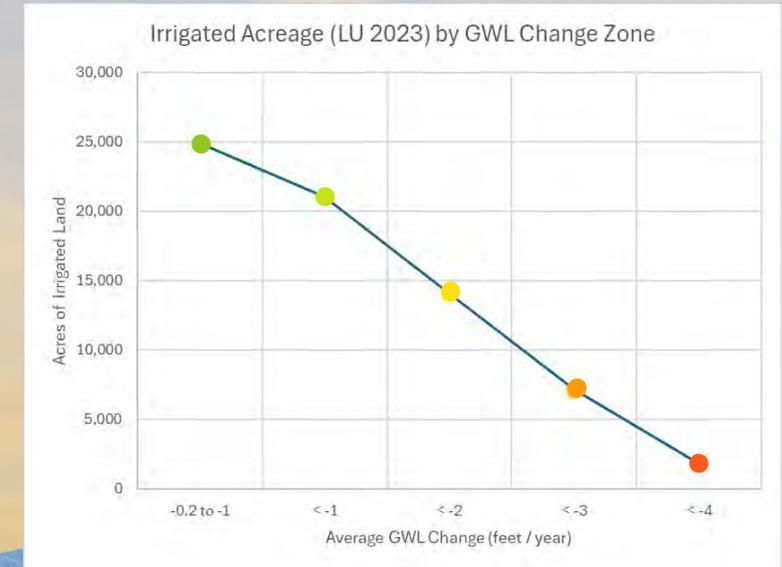
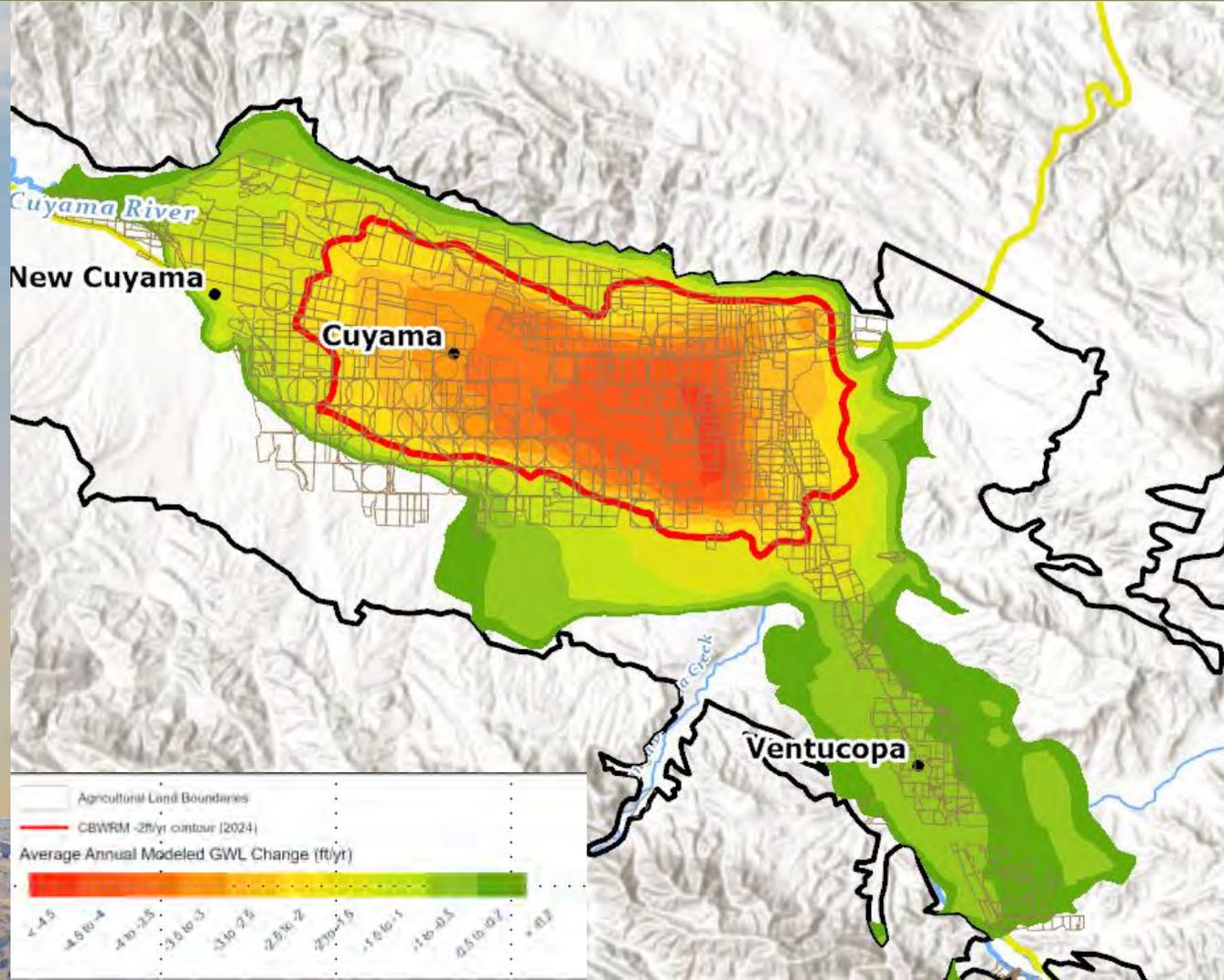


Current Management Area Average Annual Groundwater Level Change during Projected BL (2022 Version)



Updated Management Area

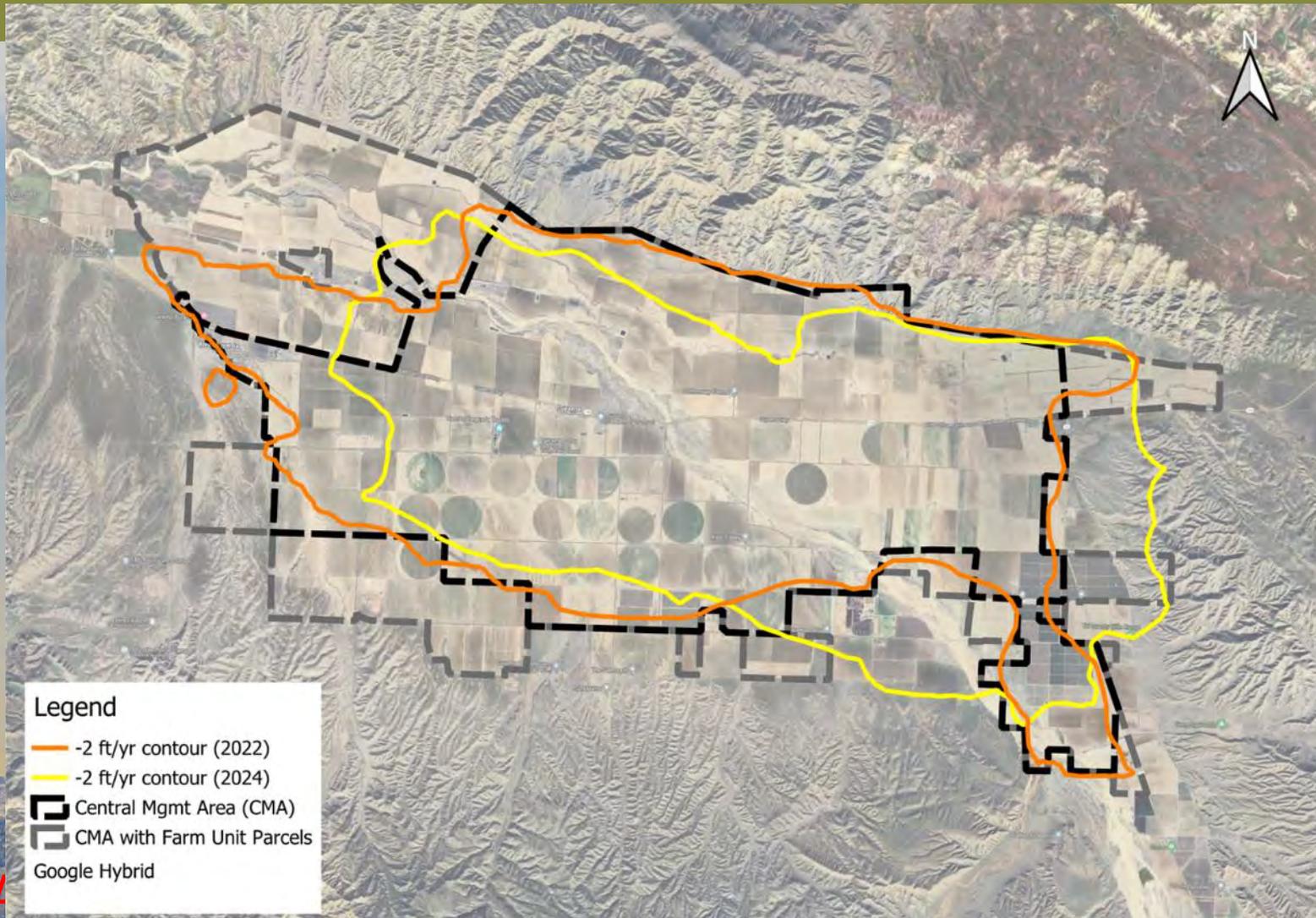
Average Annual Groundwater Level Change during Projected BL



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Updated Management Area

2022 Version vs. Updated 2 ft/yr Contour



- Total acreage within 2ft/yr contour:
 - 2022: 22,500 acres
 - 2024: 21,800 acres
- Causes of shift:
 - Updated geology and aquifer parameters
 - Reduced pumping
 - Improved calibration

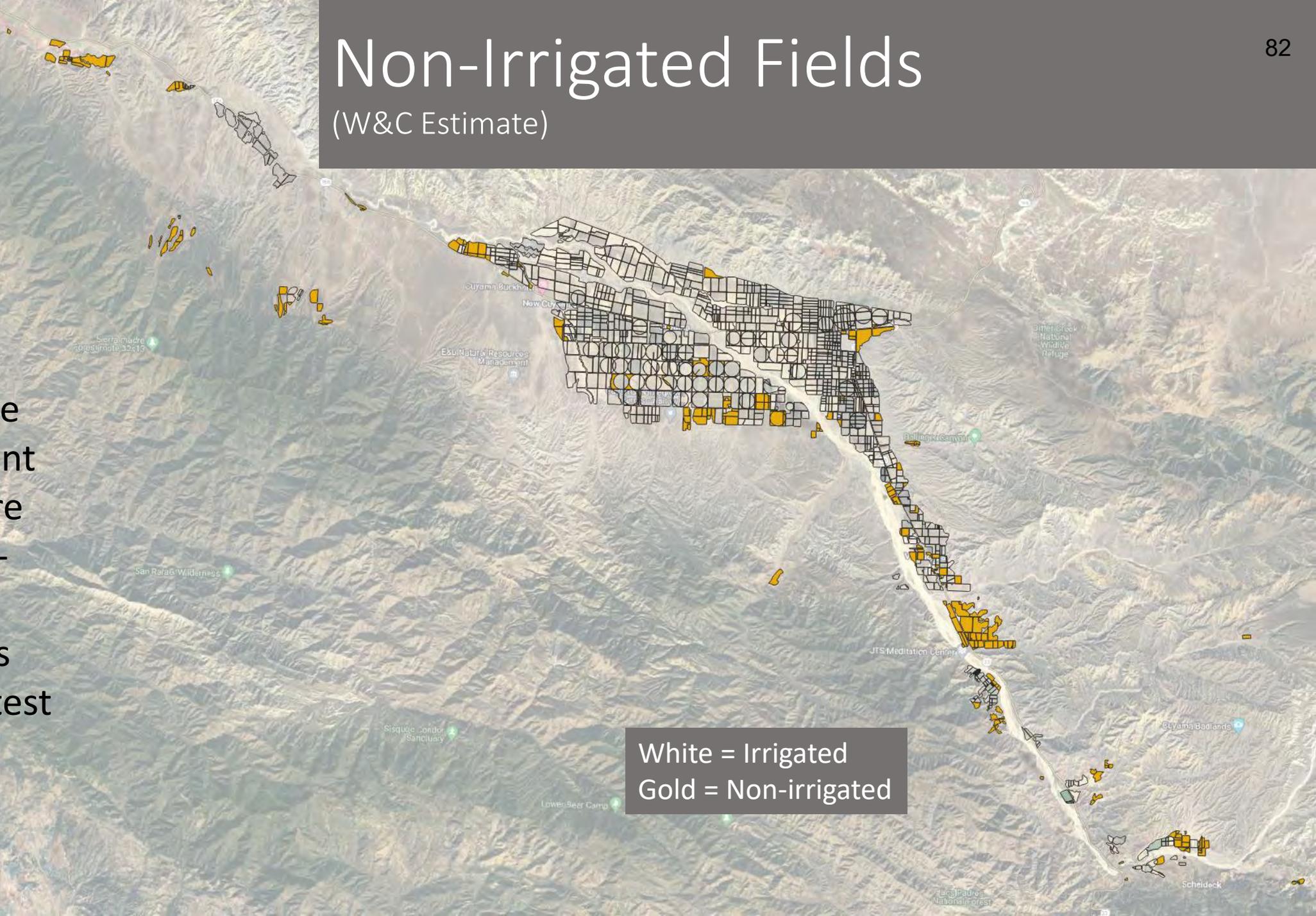
Key Outcomes

- The updated model incorporates significant new data that was previously unavailable
- Projected basin-wide pumping (38,500 AFY) and groundwater storage deficit (14,100 AFY) are both lower than previous estimates
- Central Management Area is reduced by approx. 700 acres (3% reduction)
- Basin-wide sustainable yield is estimated to be 17,800 AFY
- Pumping cap in current Central Management Area plus Farming Units is 10,500 AF
- Approach to uncertainty analysis for the updated model will be similar to that of the GSP.

Supplementation Information

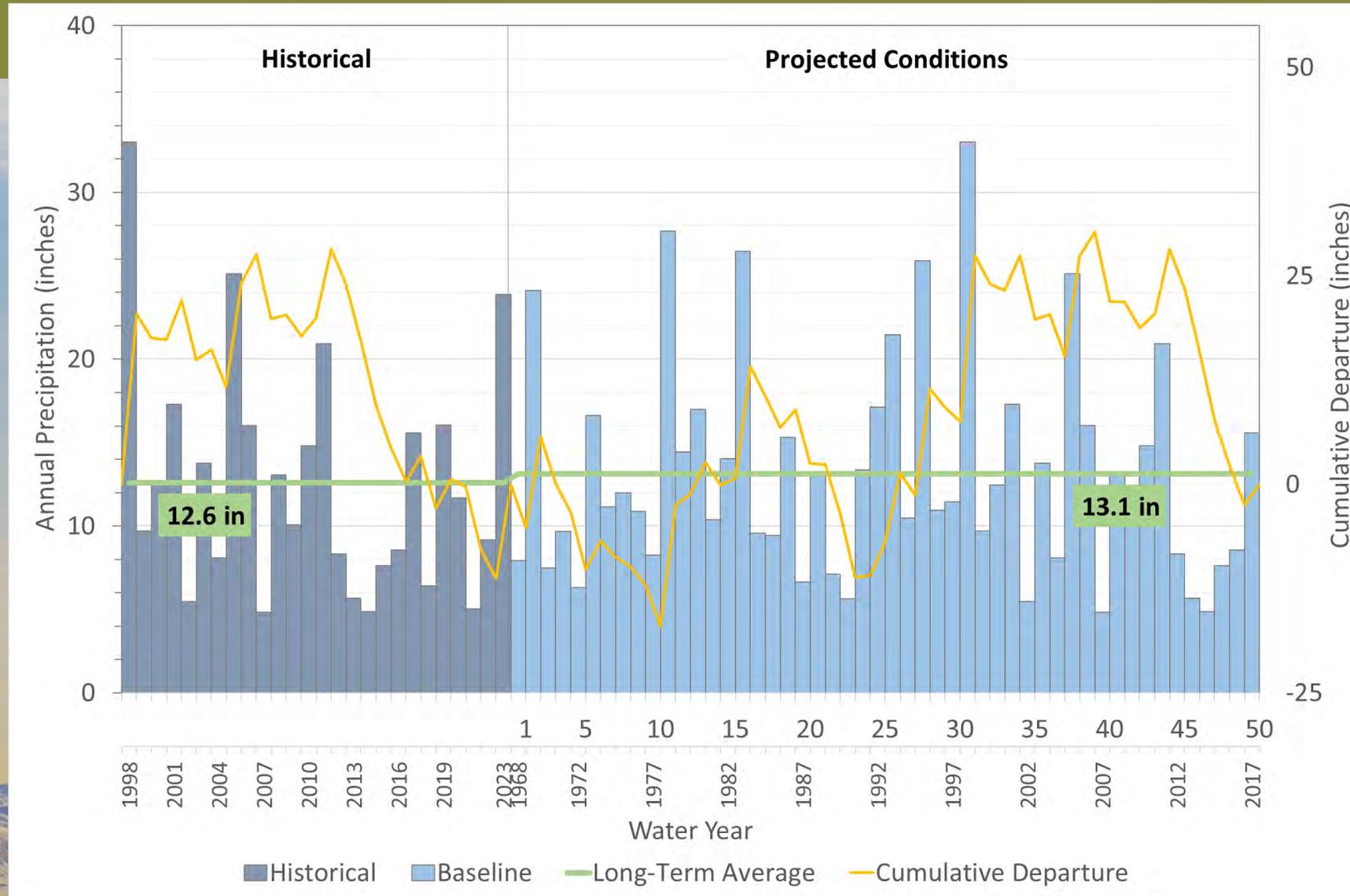
Non-Irrigated Fields (W&C Estimate)

Parcels that were idle for five consecutive years and show as native vegetation in recent satellite images are classified as “Non-Irrigated”. This information is included in the latest CBWRM Update.



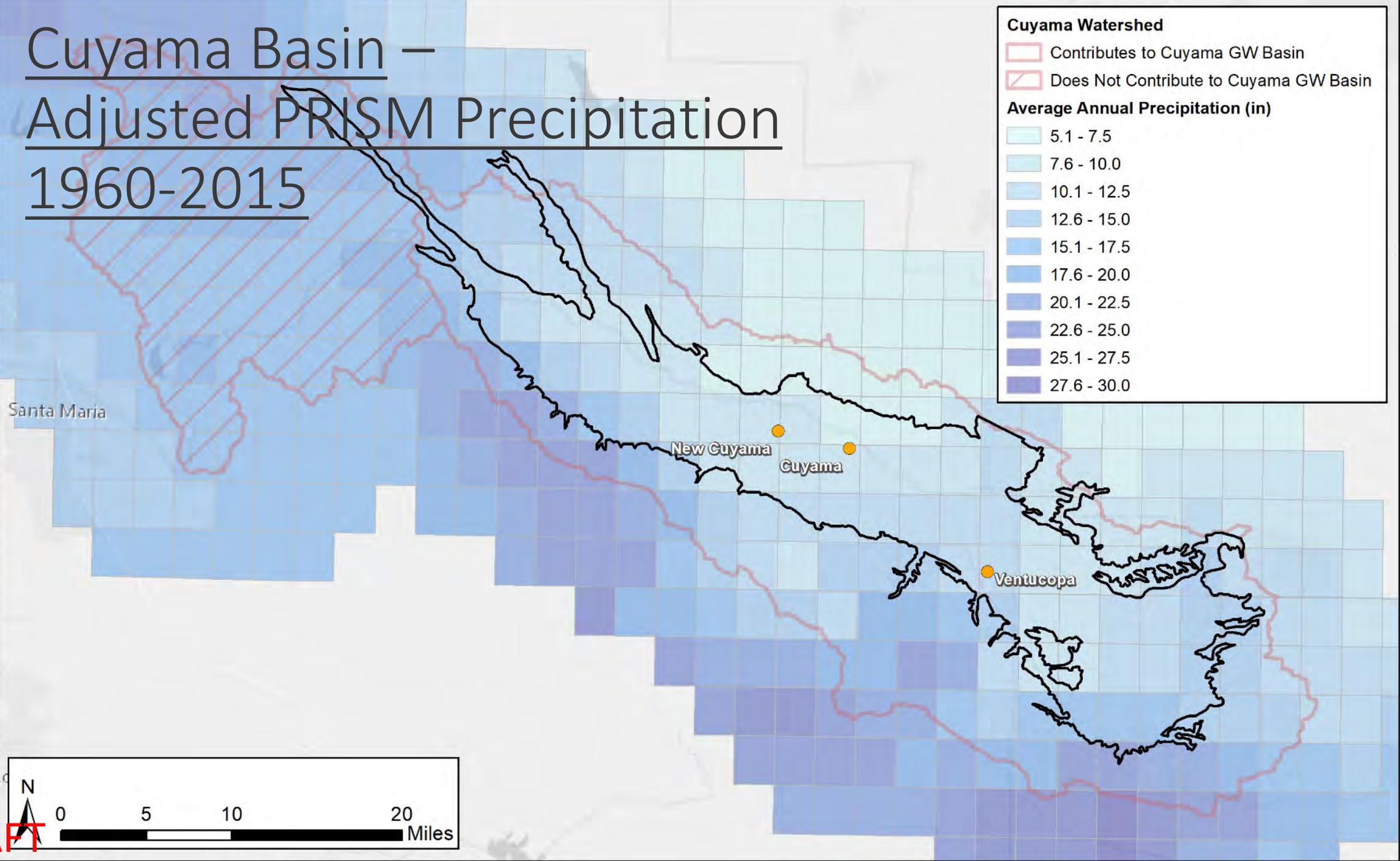
White = Irrigated
Gold = Non-irrigated

Historical Precipitation for the period from 1968-2017



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Cuyama Basin – Adjusted PRISM Precipitation 1960-2015



DRAFT

ard
an

California Irrigation Management Information System (CIMIS)

CIMIS Monthly Report

Rendered in ENGLISH Units.

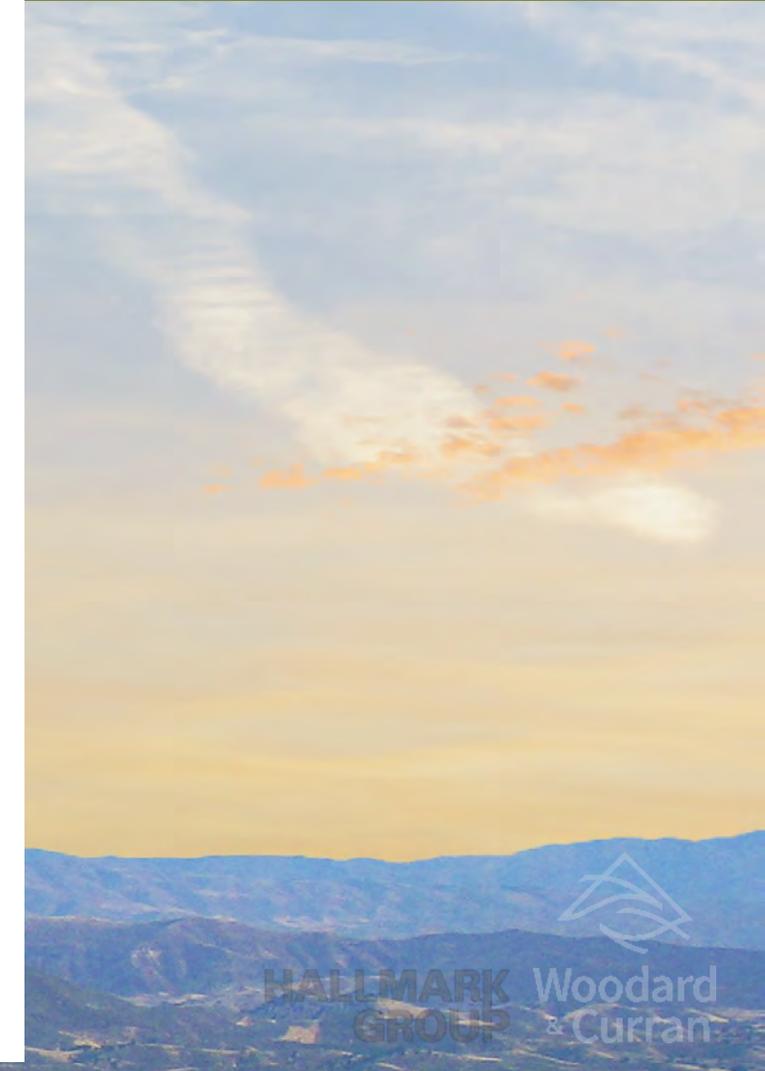
January 2022 - December 2022

Printed on Wednesday, July 17, 2024

Cuyama - Central Coast Valleys - Station 88

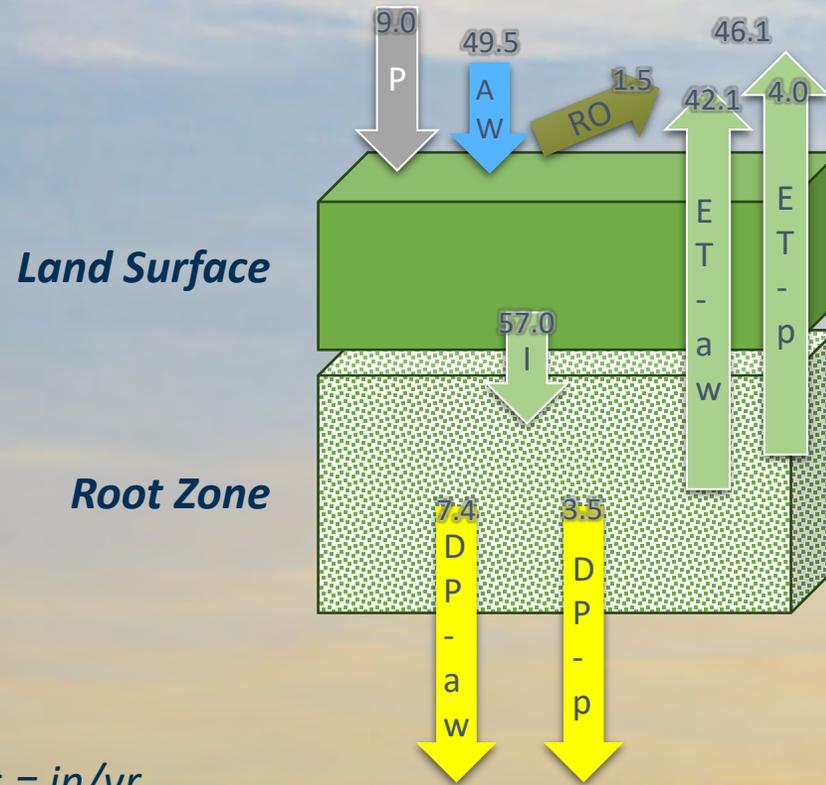
Month Year	Total ETo (in)	Total Precip (in)	Avg Sol Rad (Ly/day)	Avg Vap Pres (mBars)	Avg Max Air Temp (°F)	Avg Min Air Temp (°F)	Avg Air Temp (°F)	Avg Max Rel Hum (%)	Avg Min Rel Hum (%)	Avg Rel Hum (%)	Avg Dew Point (°F)	Avg Wind Speed (mph)	Avg Soil Temp (°F)
Jan 2022	2.35	0.12	258	6.3	62.8	33.0	45.8	85	33	60	31.7	4.7	47.9 L
Feb 2022	3.25	0.05	376	4.5 K	66.0 K	29.6 K	46.0 K	75	21	44 K	24.3 K	5.3	51.4 L
Mar 2022	4.90	0.72	471	6.4 K	70.5 K	37.4	53.0 K	78	24	47 K	32.1 K	5.6	60.2 L
Apr 2022	6.36	0.19	604 K	6.5 K	73.5 K	40.9 K	57.2 K	72	21	41 K	32.6 K	5.8 K	67.5 L
May 2022	8.37	0.00	712 K	6.6 K	81.5 K	45.9 K	64.0 K	60	15	32 K	33.2 K	6.0	75.8
Jun 2022	9.24	0.00	728 K	7.6 K	91.6	54.6 K	74.1 K	56	14	27 K	36.6 K	6.0 K	84.7
Jul 2022	9.52	0.01	693	8.7 K	97.8	59.9 K	78.9 K	49	14	26 K	40.1 K	5.2	90.3 L
Aug 2022	8.26 K	0.00 K	628 K	9.5 K	99.1	62.1 K	80.1 K	51 L	14 L	27	42.7	5.2 K	91.9 K
Sep 2022	1.43 K	0.20 K	488 K	10.8 K	92.3 K	58.1 K	74.4 K	50 L	12 L	37 L	45.0 L	5.4 K	85.3 L
Oct 2022	4.11 K	0.00 K	401 K	7.7 K	82.9	46.7 K	63.5 K	62 L	18 L	39	36.9	5.2 K	75.3 K
Nov 2022	2.64	0.83	281	5.5	63.9	32.3	46.3	77	28	52	28.2	5.0 K	53.0 L
Dec 2022	1.58 K	2.33 K	200 K	7.8 K	59.4	35.8 K	45.9 K	93 K	48 K	73 K	37.3 K	4.7 K	48.6 L
Tots/Avgs	62.01	4.4	487	7.3	78.4	44.7	60.8	67	22	42	35.1	5.3	69.3

Flag Legend		
M - All Daily Values Missing	K - One or More Daily Values Flagged	
J - One or More Daily Values Missing	L - Missing and Flagged Daily Values	
Conversion Factors		
W/sq.m = Ly/day/2.065	inches * 25.4 = mm	(F-32) * 5/9 = c
	mBars * 0.1 = kPa	--



Example for Carrot Fields

Potential ET rate is 3.84 ft/yr = 46.1 in/yr



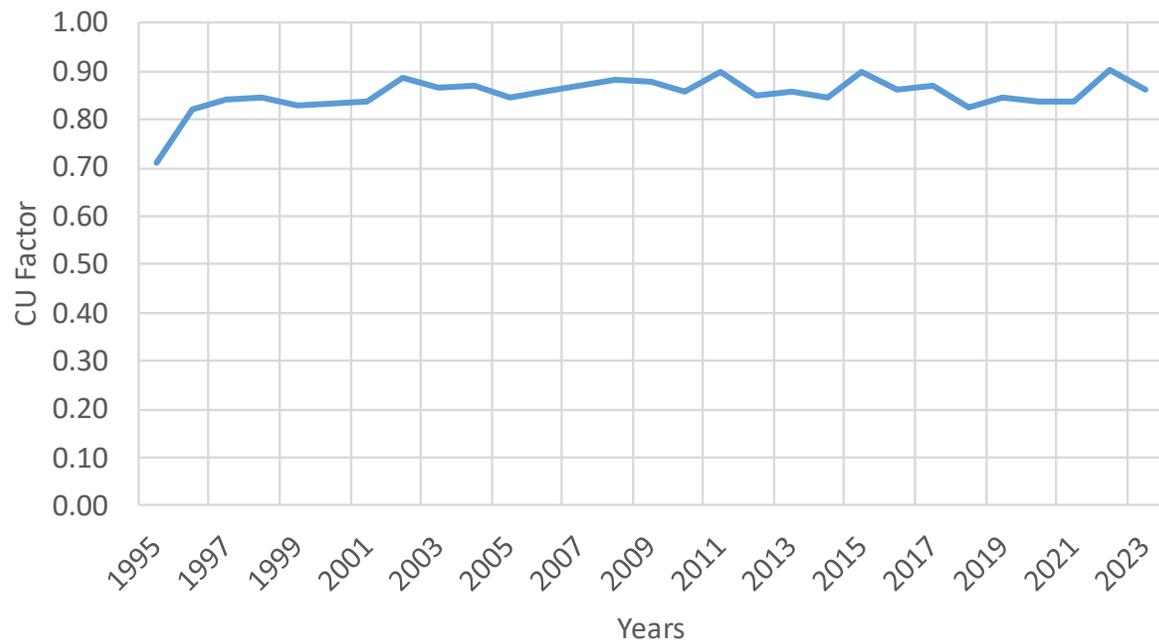
Acronym	Meaning
P	Precipitation
AW	Applied water
RO	Runoff of precipitation
ET - aw	Evapotranspiration of applied water
ET - p	Evapotranspiration of precipitation
I	Infiltration
DP - aw	Deep percolation of applied water
DP - p	Deep percolation of precipitation

All Values = in/yr

Consumptive Use Factors (I.E.) Modeled

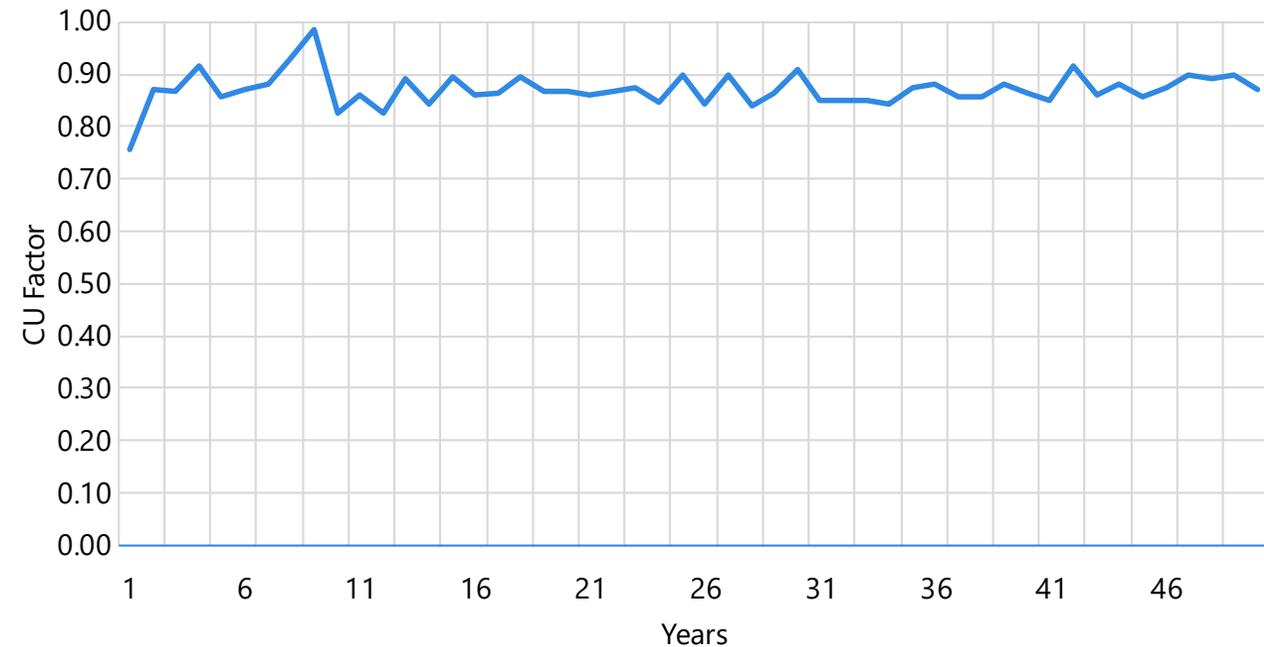
Historical Conditions

Consumptive Use Factor
(ETAW / Applied Water)



Projected Conditions

Consumptive Use Factor
(ETAW / Applied Water)

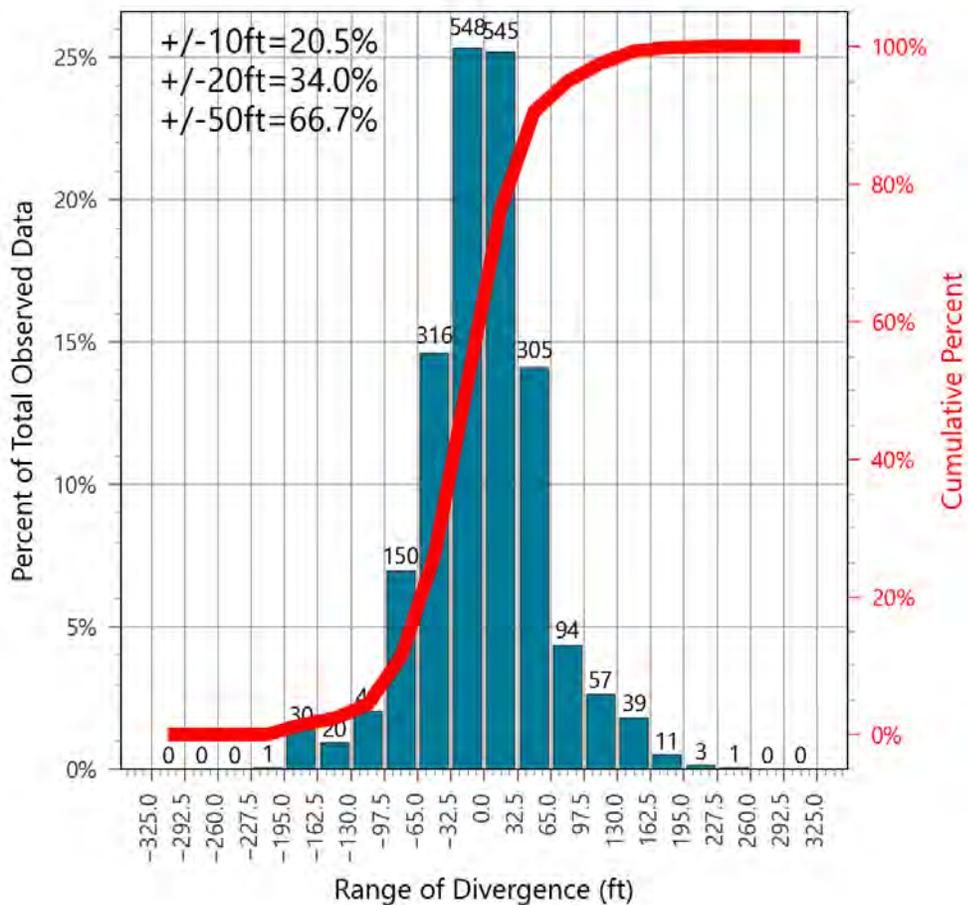


Model Calibration Statistics

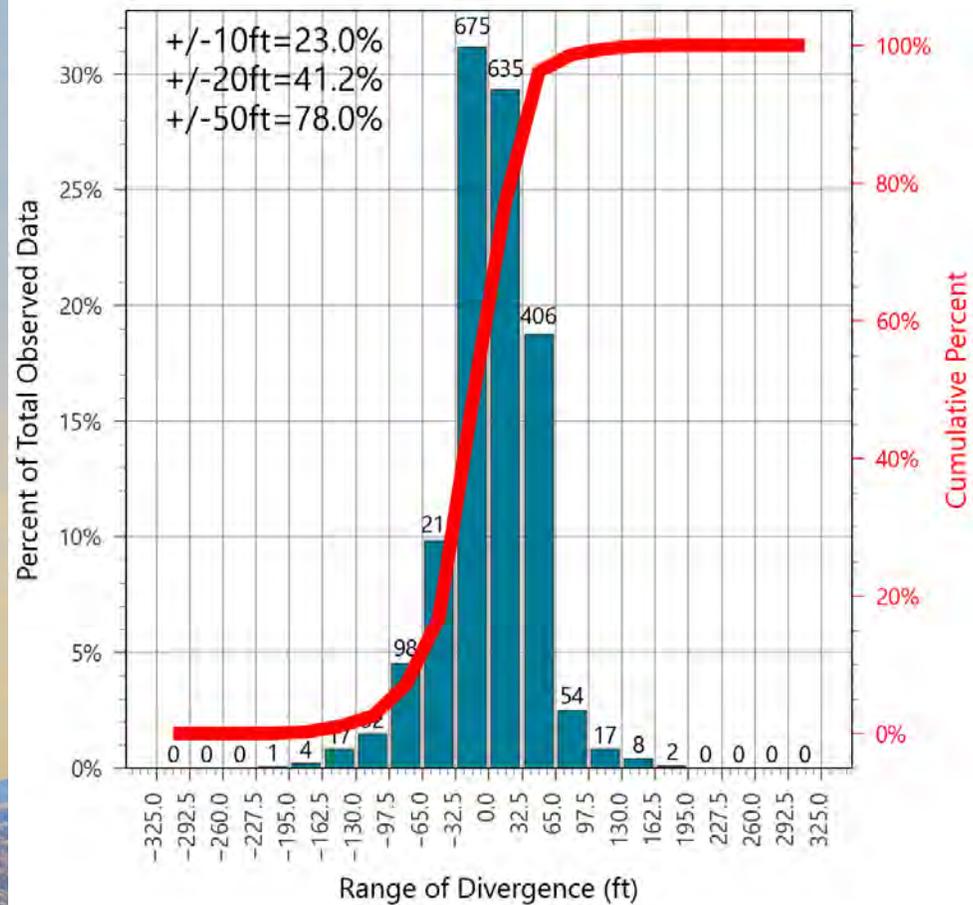
Observed GWLs vs. Simulated GWLs

“better results would be closer to the orange line and distributed symmetrically”

Model Version 0.20



Model Version 0.30



v0.30 shows improved residual statistics compared to v0.20.

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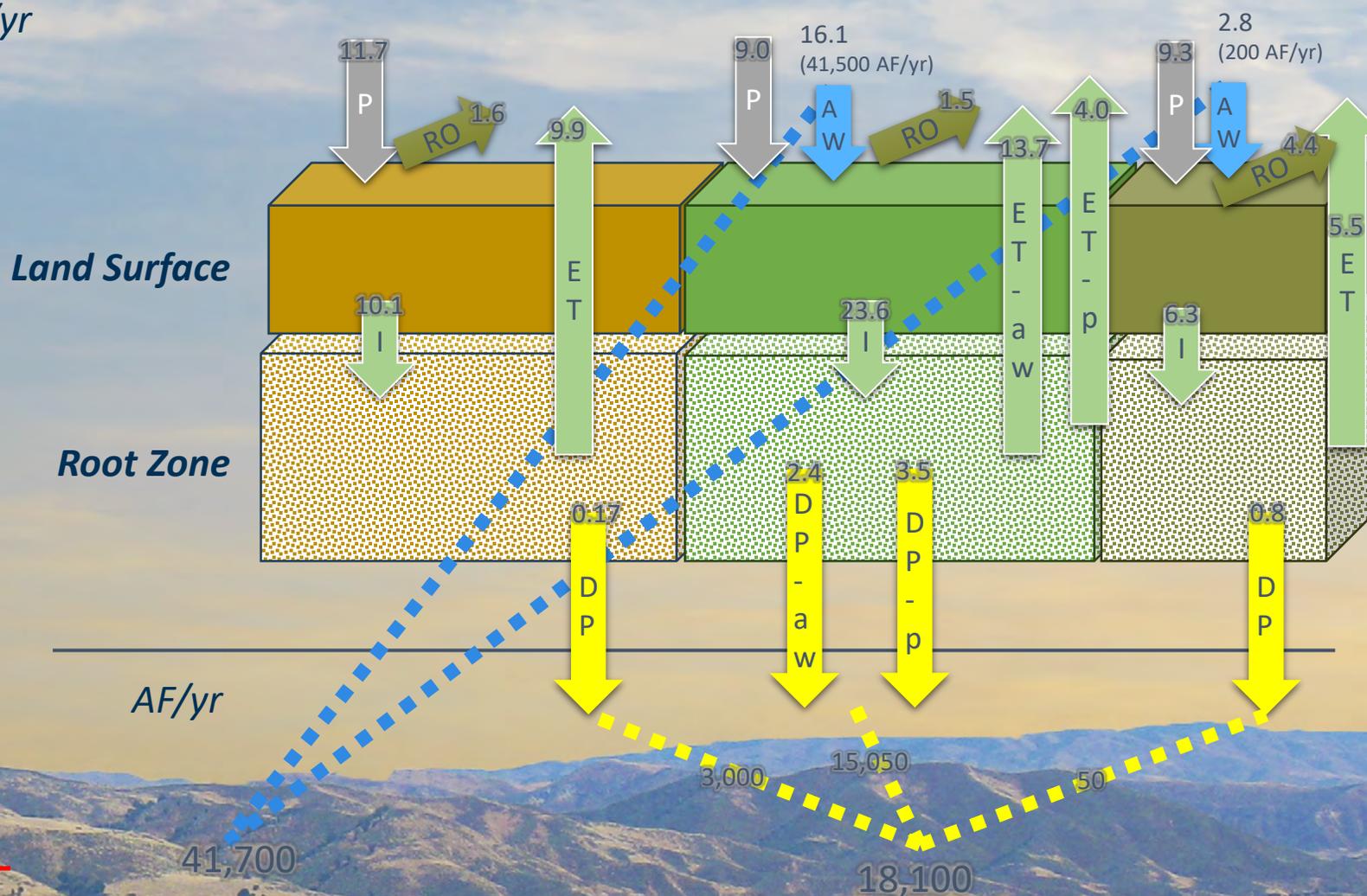
Historical Land Surface & Root Zone Budget

Native Veg.
210,600 ac.

Ag.
30,700 ac.

Domestic
800 ac.

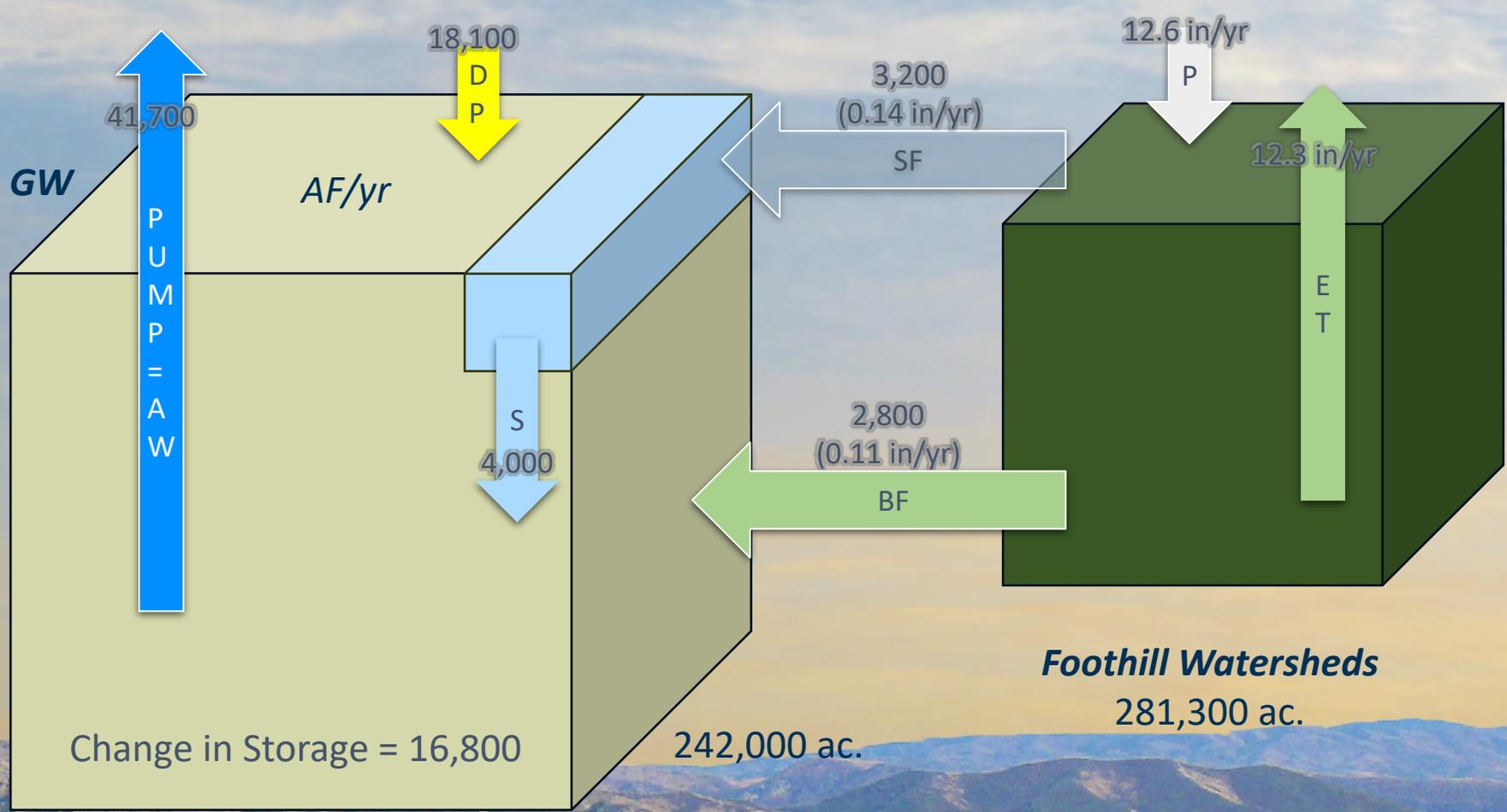
All Values = in/yr



Acronym	Meaning
P	Precipitation
AW	Applied water
RO	Runoff of precipitation
ET	Evapotranspiration
ET-aw	Evapotranspiration of applied water
ET-p	Evapotranspiration of precipitation
I	Infiltration
DP	Deep percolation
DP-aw	Deep percolation of applied water
DP-p	Deep percolation of precipitation

DRAFT

Historical Groundwater and Foothill Watersheds Budget



Acronym	Meaning
DP	Deep percolation
Pump = AW	Pumped water = Applied Water
S	Stream seepage
SF	Surface flow
BF	Base flow
P	Precipitation
ET	Evapotranspiration

Foothill Watersheds
281,300 ac.

DRAFT

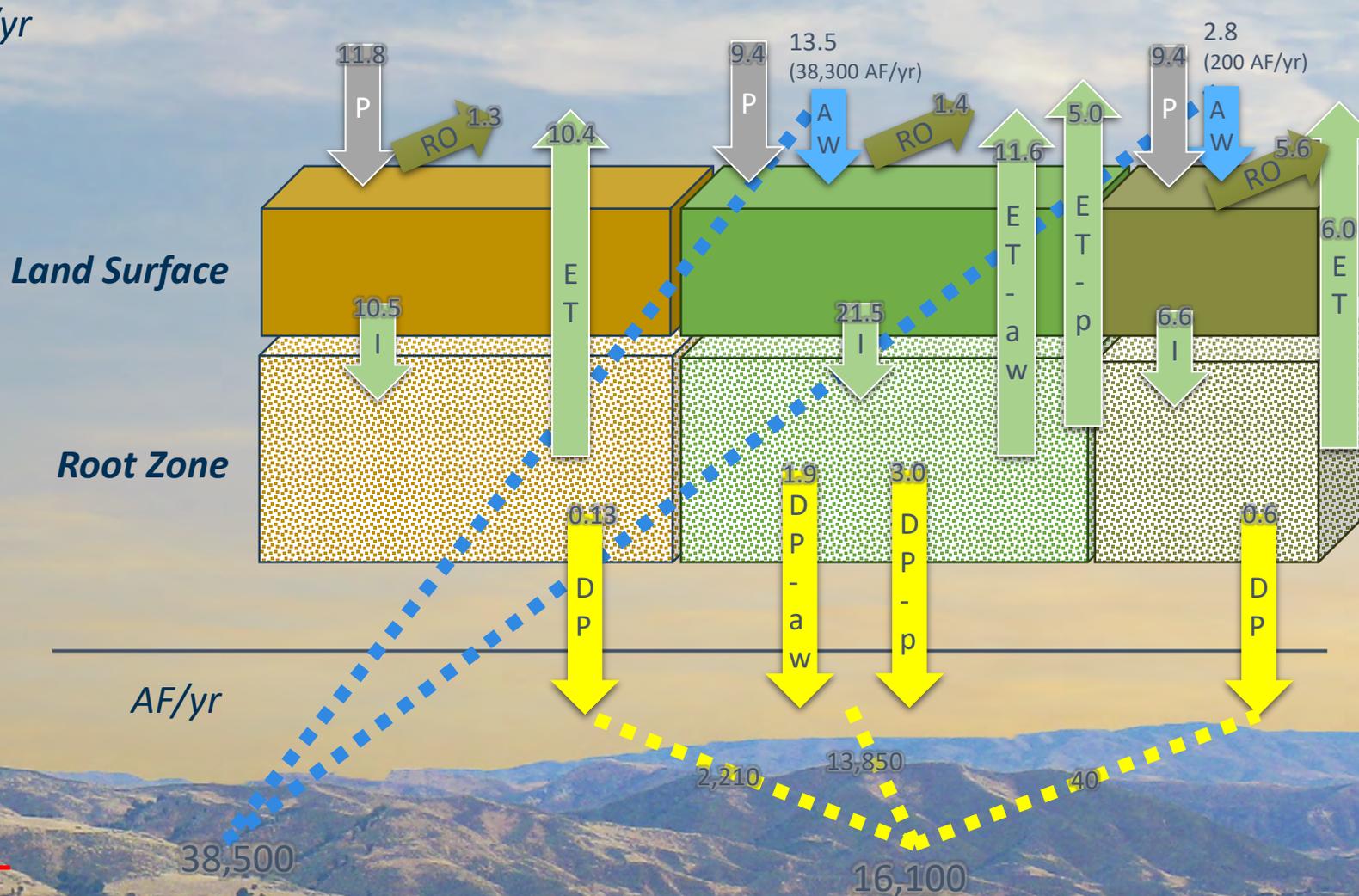
Projected Land Surface & Root Zone Budget

Native Veg.
207,200 ac.

Ag.
34,000 ac.

Domestic
800 ac.

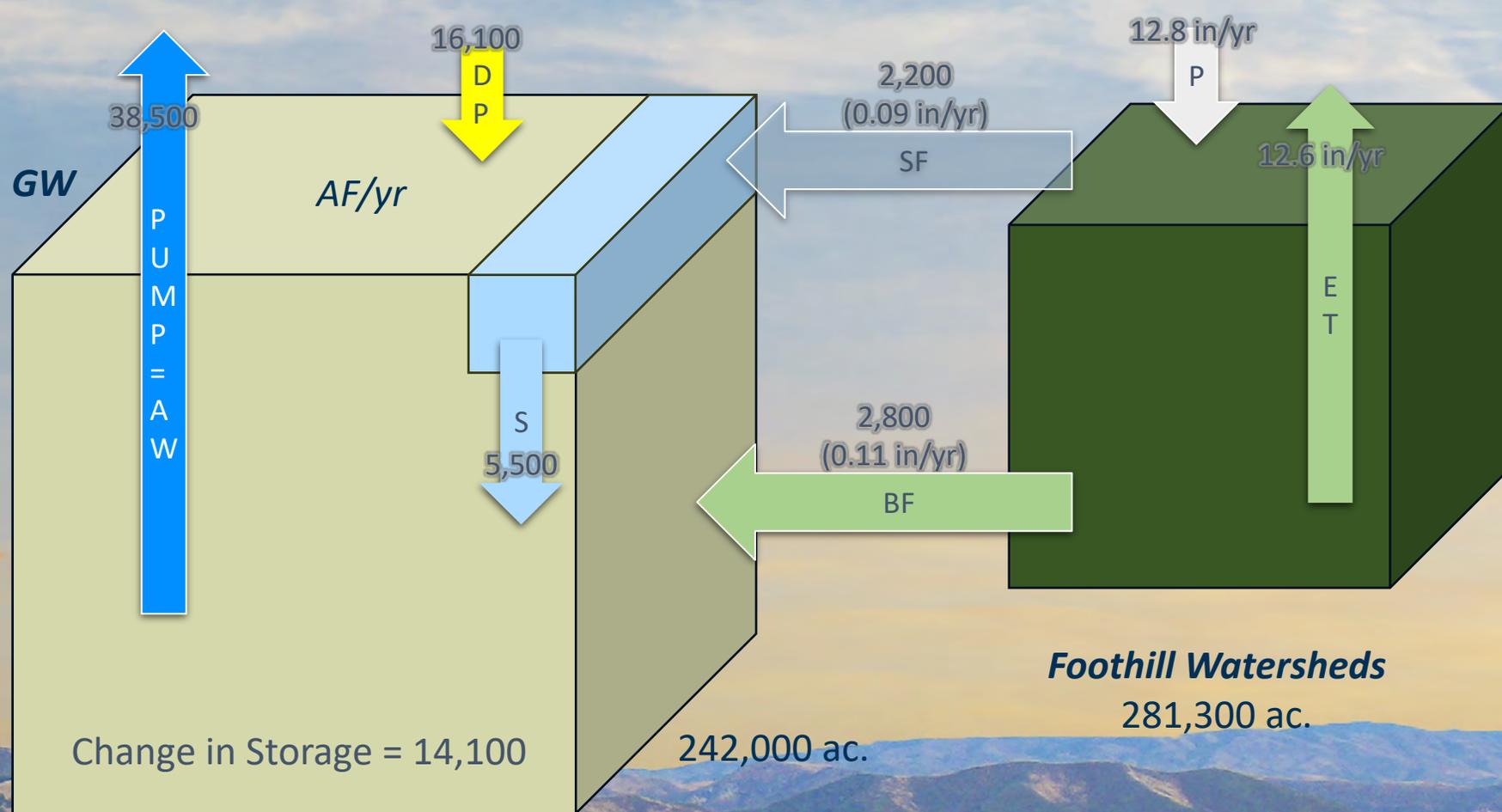
All Values = in/yr



Acronym	Meaning
P	Precipitation
AW	Applied water
RO	Runoff of precipitation
ET	Evapotranspiration
ET - aw	Evapotranspiration of applied water
ET - p	Evapotranspiration of precipitation
I	Infiltration
DP	Deep percolation
DP - aw	Deep percolation of applied water
DP - p	Deep percolation of precipitation

DRAFT

Projected Groundwater and Foothill Watersheds Budget



Acronym	Meaning
DP	Deep percolation
Pump = AW	Pumped water = Applied Water
S	Stream seepage
SF	Surface flow
BF	Base flow
P	Precipitation
ET	Evapotranspiration

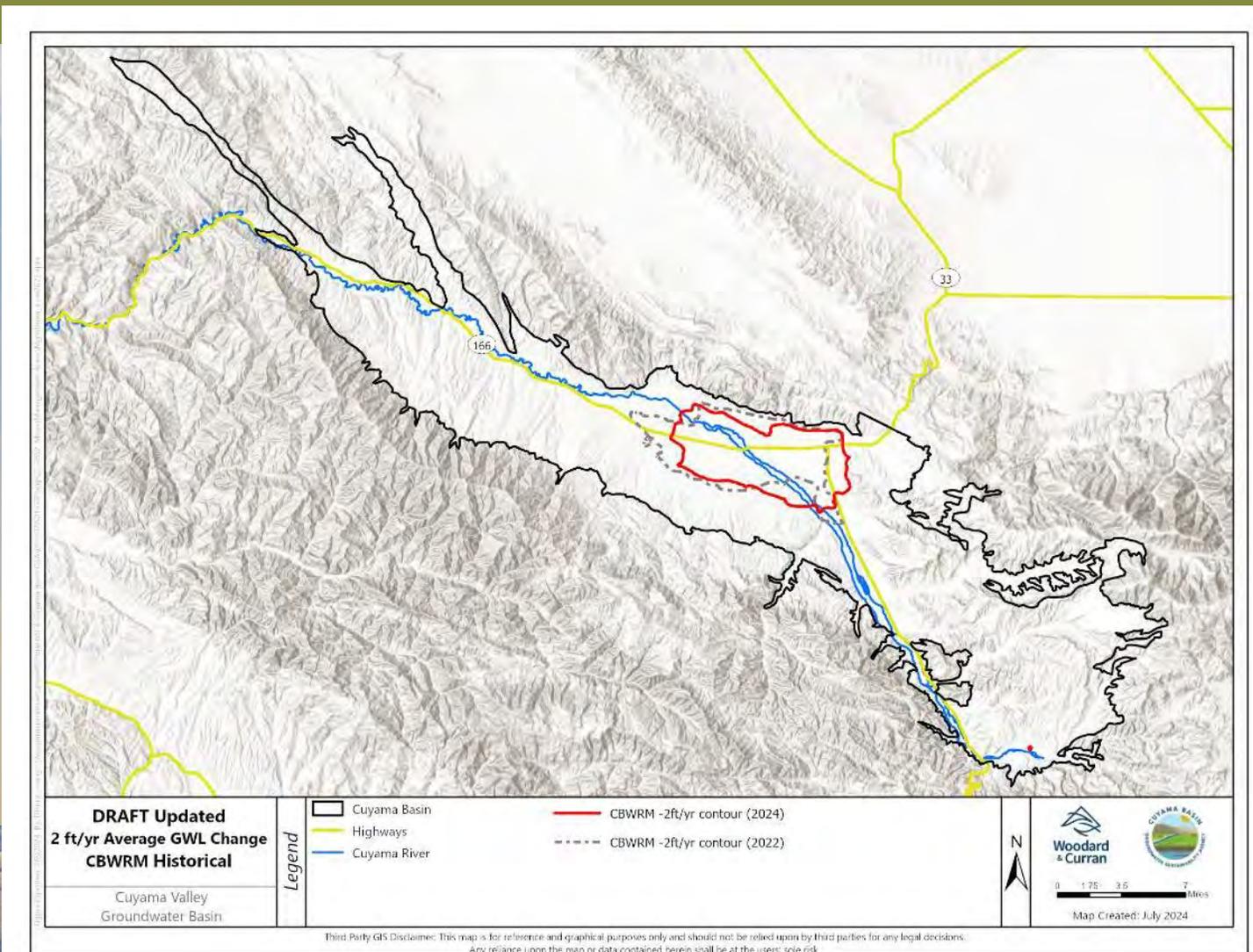
DRAFT

Validation of Sustainable Yield Calculation

		Sustainable Yield Scenario	Notes
Area	1 Ag Area (Ac)	17,800	16,200 acres of ag. land converted to Native land
	2 Native Area (Ac)	223,400	Total Native land acreage increased by 16,200 acres
	3 Urban Area (Ac)	800	No change
Deep Percolation	4 AW on Ag Area (AFY)	2,818	Ag Area x 1.9 in/yr
	5 Precip on Ag Area (AFY)	4,450	Ag Area x 3 in/yr
	6 Precip on Native Area (AFY)	2,420	Native Area x 0.13 in/yr
	7 Precip on Urban Area (AFY)	40	Urban Area x 0.6 in/yr
Flow	8 Net Boundary Flow (AFY)	2,800	From Model Runs
	9 Net Stream Seepage to GW (AFY)	5,400	From Model Runs
Natural Yield		15,110	Row 5+6+7+8+9
Natural Yield + Deep Perc. of Applied Water		17,929	Row 4+5+6+7+8+9
Sustainable Yield per GSP Method		17,800	
Difference		-1%	

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Updated Management Area 2022 Version vs. Updated 2 ft/yr Contour



- CBWRM -2ft/yr contour (2024)
- - - - CBWRM -2ft/yr contour (2022)

- Total acreage within 2ft/yr contour:
 - 2022: 22,500 acres
 - 2024: 21,800 acres

DRAFT



TO: Board of Directors
Agenda Item No. 7c

FROM: Provost & Pritchard

DATE: July 25, 2024

SUBJECT: Discuss and Take Appropriate Action on a Monitoring Network Consultant Contract for FY 24-25

Recommended Motion

Approve groundwater level and water quality monitoring contract with Provost & Pritchard for Fiscal Year 2024-2025 for an amount not to exceed of \$68,000.

Discussion

Provost & Pritchard was selected by the Board to monitor quarterly groundwater levels and water quality. Provided as Attachment 1 is a draft contract with P&P to continue these services in Fiscal Year 2024-2025 for an amount not to exceed of \$68,000. This contract amount was budgeted in the adopted Fiscal Year 2024-2025 budget.



400 East Main Street, Suite 300
 Visalia, CA 93291-6367
 Tel: (559) 636-1166
 Fax: (559) 636-1177
www.ppeng.com

July 17, 2024

Taylor Blakslee
 Cuyama Basin Groundwater Sustainability Agency
 4900 California Ave, Tower B, 2nd Floor
 Bakersfield, CA 93309

Subject: CBGSA – Groundwater Monitoring (WY 2025)

Dear Mr. Blakslee:

Thank you for the opportunity to submit this proposal to provide consulting and monitoring services for the Cuyama Basin groundwater level monitoring network. This proposal discusses our understanding of the project, recommends a scope of services together with associated fees, deliverables, and approximate schedules, sets forth our assumptions and discusses other offered services that may be of interest as the project proceeds.

The dedicated and experienced team at Provost & Pritchard's Visalia and Bakersfield offices have extensive experience with the Sustainable Groundwater Management Act (**SGMA**), groundwater monitoring network development, groundwater level measurements, and coordinating with multiple agencies to unify efforts and accomplish varied goals.

Project Understanding

The Cuyama Basin Groundwater Sustainability Agency (**CBGSA**) developed a Groundwater Sustainability Plan (**GSP**) as required by SGMA.

For the 2025 water year, the CBGSA would like to continue monitoring groundwater levels quarterly. The 2025 network anticipates an approximate total of 66 wells at 52 locations.

The network will be monitored quarterly during the months of October, January, April, and July. The monitoring schedules may be adjusted to access wells outside of rain events or surface water flows.

Scope of Services

Provost & Pritchard will continue to be in contact the CBGSA to prepare for the work and ensure all requirements will be met. Our scope of work for this proposal will be completed in two phases, described below.

Phase LVL: Groundwater Level Monitoring

1. Project Administration and Management
 - a. Provide consistent and available communications with CBGSA.
 - a. Track project deliverables, budget, and schedule.
2. Quarterly groundwater level measurements for up to 66 wells at approximately 52 locations and Quarterly Water Quality Measurements for up to 10 transducer equipped wells.
 - a. Groundwater levels in excel format reporting groundwater surface elevation, reference point elevation, and depth to groundwater with measurement reference on a quarterly basis.
 - b. Groundwater quality measurements in excel format reporting electroconductivity and water temperature on a quarterly basis for a preselected list of transducer-equipped wells
3. Technical Memo
 - a. Summary memorandum to the CBGSA documenting work performed at the conclusion of the 12-month reporting period.

Deliverables:

- Signed access and monitoring agreement from landowners that require them.
- Technical memorandum summarizing work performed.
- Excel workbook including date, time, location, groundwater level, water quality metrics for qualifying wells and pertinent notes for each measurement.
- Individual well dossier sheets for each well with measurements and pertinent notes for any newly added wells.

Phase QLT: Groundwater Quality Monitoring

1. Project Administration and Management
 - a. Provide consistent and available communications with CBGSA.
 - b. Track project deliverables, budget, and schedule.
2. Annual groundwater quality measurements for up to 30 wells at approximately 21 locations.
3. Obtain Landowner Agreements
 - a. Research missing contact information.
 - b. Request access from landowners/managers to sample wells.
 - c. Provide Access and Monitoring Agreements upon request and follow up.
4. Water quality measurements
 - a. Review any new wells for suitability.
 - b. Coordinate water quality testing with well owners.
 - c. Measure salinity as EC and TDS at each well. Measurement will be taken with a Horiba multimeter according to Standard Operating Procedures, including meter calibration, well purging, and applicable site condition notes.
 - d. Collect salinity as EC and TDS data at each well equipped with a transducer.

5. Data management and reporting

- a. Compile water quality data and complete data quality assurance and control measures.
- b. Develop technical memorandum documenting work performed.
- c. Complete Excel workbook with EC and TDS results.
- d. Complete dossier sheets for each well.

Deliverables:

- Signed access and monitoring agreement from landowners that require them.
- Technical memorandum summarizing work performed.
- Excel workbook including date, time, location, EC, TDS, and pertinent notes for each measurement.
- Individual well dossier sheets for each well with measurements and pertinent notes.
- All analyses documents provided by the lab.

Professional Fees

Provost & Pritchard Consulting Group will perform the services on a time and materials basis, in accordance with our Standard Fee Schedule in effect at the time services are rendered. For budgeting purposes, our preliminary estimate is that our fees will be **\$68,000**. Reimbursable expenses and professional fees are included in the estimate. These fees will be invoiced monthly as they are accrued, and our total fees, including reimbursable expenses, will not exceed our estimate without additional authorization.

Schedule

Provost & Pritchard is prepared to begin immediately upon authorization to proceed. Once we receive an executed copy of this Proposal along with the Consultant Services Agreement, and are authorized to proceed, we will work with the CBGSA to develop a mutually agreed upon schedule.

Assumptions

Phase LVL

- Survey by a CA State licensed surveyor is additional work and not included in the scope or fee estimate.
- Landowners are assumed to be amenable to monitoring and prompt in their communication. Landowners that require more than three (3) communication attempts to sign land access permissions and schedule a sample date are additional work and outside of the scope and fee estimate.
- Landowners are not required to be on premises for level measurements. Expecting field staff to communicate and meet discrete measurement appointments to allow landowner supervision is additional work, reduces the number of wells that can be measured within a day, and outside the scope of work and the fee estimate.
- Wells are in sufficient condition to be measured and modifications are not necessary.

- Additional wells for which landowner introductions and, site information forms, and/or access agreement can be added for additional scope and fee.

Phase QLT

- If any of the proposed wells are not suitable for sampling, then upon CBGSA's prior approval, other wells can be added for additional scope and fee. Wells without pumps will be sampled with passive sampling equipment, if possible.
- Landowners are assumed to be amenable to sampling and prompt in their communication. Landowners that require more than three (3) communication attempts to sign land access permissions and schedule a sample date are additional work and outside of the scope and fee estimate.
- Landowners are not required to be on premises for well sampling if the well will be running. Expecting field staff to communicate and meet discrete sampling appointments to allow landowner supervision is additional work, reduces the number of wells that can be sampled within a day, and outside the scope of work and the fee estimate.
- Surveying (establishing elevations) will not be required for wells which are not included in the Groundwater Level Monitoring Network.
- Data is to be reported to Woodard & Curran via Excel spreadsheet.
- Wells are in sufficient condition to be sampled and modifications are not necessary.
- Well Completion Reports will not be needed at this time.
- Without Well Completion Reports, the volume of three well casings cannot be calculated. Therefore, a standard purge time and/or volume will be utilized, which will be based on purge requirements for similar water quality networks.
- Provost & Pritchard will not turn pumps on or off. The landowner or authorized manager will need to be present if a well is not in operation.
- Landowners will provide guidance regarding discharge locations for purged water.

Additional Services

The following services are not included in this proposal. However, these and others can be provided at additional cost, either directly by Provost & Pritchard Consulting Group or through subconsultants, upon request.

- Data management system.
- Expansion of the CBGSA's monitoring network if the original wells are not sufficient.
- Licensed survey of ground surface elevation and well reference point elevation.

Terms and Conditions

If this proposal is acceptable, please sign the Consultant Services Agreement, and return a copy to our office. These documents will serve as our Notice to Proceed. This proposal is valid for 60 days from the date above.

Respectfully,

Provost & Pritchard Consulting Group



Jon Vander Schuur QSD/QSP CPESC
Project Manager

Soo Ho Park, RCE 89361
Director of Operations

Terms and Conditions Accepted

By: Cuyama Basin Groundwater Sustainability Agency

Signature

Printed Name

Title

Date



TO: Standing Advisory Committee
Agenda Item No. 7d

FROM: Brian Van Lienden, Woodard & Curran

DATE: July 25, 2024

SUBJECT: Discuss and Take Appropriate Action on Data Management System Update Options

Recommended Motion

Standing Advisory Committee feedback requested.

Discussion

A presentation on Data Management System (DMS) option enhancements is provided as Attachment 1, and a scope of work and budget breakdown is provided as Attachment 2.

Cuyama Basin Groundwater Sustainability Agency

7d. Data Management System Update Options

July 25, 2024



Potential DMS Updates

- Available grant budget: ~\$40,000
- Staff recommended updates:
 - Implement automated connections to external databases (GAMA, CASGEM)
 - Update DMS input tools
 - Implement SMC displays for TDS
- A scope of work and budget breakdown for the staff recommended updates are provided in the attached document



Woodard & Curran recommends the following data management system (DMS) updates. For each task, Woodard & Curran will implement the upgrades in the development environment and perform user testing. Upon completion, Woodard & Curran will migrate the completed enhancements to the production environment in coordination with the GSA. Woodard & Curran will also update the User Guide as needed to accommodate the enhancements.

Implement Automated Connections to External Databases - \$21,290 (80 hours)

Woodard & Curran will integrate with readily available and relevant public datasets via published APIs. Dataset linkages will include GAMA and DWR's Period Groundwater Level Measurements (at a minimum) using published APIs on the California Natural Resources Agency Open Data Portal.

Woodard & Curran will copy measurement data and other relevant data (e.g., reference point elevation, ground surface elevation) that does not exist within the DMS for wells that are included in the DMS. The linkage will be automated to run on a monthly basis. Data pulled from API sources shall be displayed and available through the well's graphs, tables, and well information module.

Deliverables:

- *DMS connection to California Natural Resources Agency Open Data Portal GAMA and DWR Groundwater Level APIs*
- *Updated data visualization to well chart, table, and information module.*

Update DMS Input Tools - \$15,960 (60 hours)

Woodard & Curran will update input tools and quality check functionality in the DMS to streamline data entry and quality control, and more closely align with recent work done with DWR to standardize groundwater data reporting formats. The updated import tool includes functionality to allow users to enter field measurements, automate calculations for groundwater elevation and depth to water from ground surface based on available reference point data, and automate calculations based on different measurement methods. Quality control functions will be updated based on the new import functionality. Import templates will be updated as needed to implement the upgrade.

Deliverables:

- *Updated import tool and data quality check functionality*
- *Updated import templates*

Implement Sustainable Management Criteria Displays for TDS - \$2,680 (10 hours)

Woodard & Curran will integrate sustainable management criteria (SMC) displays for groundwater quality constituent total dissolved solids (TDS). Updated chart display allows for user to easily distinguish SMC values related to the selected well.

Deliverables:

- *Updated groundwater quality well chart displays*



TO: Standing Advisory Committee
Agenda Item No. 8a

FROM: Jim Beck / Brian Van Lienden

DATE: July 25, 2024

SUBJECT: Update on GSP Components Schedule

Recommended Motion

None – information only.

Discussion

On July 12, 2023, the Cuyama Basin Groundwater Sustainability Agency Board of Directors reviewed and approved a schedule for updating the Groundwater Sustainability Plan (GSP) ahead of the January 2025 deadline and that schedule is provided as Attachment 1 for reference.

GSP Update and Board Policy Discussions Schedule

Updated/New Schedule

	2023			2024							2025
	1 July	2 Sep	3 Nov	4 Jan	5 Mar	6 May	7 Jul	8 Sep	9 Nov	10 Jan	
Board Direction:	<p>Finalize: Feedback on engagement strategy</p>	<p>Basin-wide pumping restrictions/Central Management Area (CMA) boundary</p> <p>Finalize: Groundwater (GW) levels & storage monitoring networks</p> <p>GW levels & storage sustainable management criteria (SMC) and undesirable results (UR) criteria options</p> <p>Allocation methodology</p>	<p>Finalize: Subsidence, Interconnected surface water (ISW), and water quality (WQ) monitoring networks</p> <p>GW subsidence ISW, and WQ SMC and UR options</p> <p>Glidepath methodology</p>	<p>Finalize: GW levels, storage, subsidence, ISW, WQ SMC and UR</p>	<p>Project and Management Action (PMA) options</p> <p>Sustainable yield (SY) methodology</p>	<p><i>Continued:</i> PMA options</p> <p>Basin-wide pumping restrictions</p> <p>Allocation program</p> <p>-----</p> <p>Issue 90-Day Notice</p>	<p>Finalize: Basin-wide Pumping Restrictions/MA Boundary (updated model)</p> <p>Allocation methodology</p> <p>Glidepath methodology</p> <p>PMA options</p> <p>SY approach</p>	<p>Review Public draft</p>	<p>**Public Hearing to adopt amended GSP</p>	<p>Submit revised GSP and periodic evaluation to DWR</p>	
GSP Chapter Review:				<p>Ch 1. Agency Info/Plan Area</p> <p>Ch 4. Monitoring Network</p>		<p>Ch 3. URs</p> <p>Ch 5. SMCs</p>	<p>Ch 2. Basin Setting</p> <p>Ch 6. DMS</p>	<p>Ch 7. PMAs</p> <p>Ch 8. Plan Implementation Executive Summary</p>			
Public Workshop		✓					✓	✓			



TO: Standing Advisory Committee
Agenda Item No. 8b

FROM: Brian Van Lienden / Jim Beck

DATE: July 25, 2024

SUBJECT: Discuss and Take Appropriate Action on Project and Management Action Options

Recommended Motion

Standing Advisory Committee feedback requested.

Discussion

On March 6, 2024, Cuyama Basin Groundwater Sustainability Agency (CBGSA) staff presented draft projects and management action options to the Standing Advisory Committee (SAC) and Board, and options for final direction are provided as Attachment 1.

Cuyama Basin Groundwater Sustainability Agency

8b. Discuss and Take Appropriate Action on Project and Management Action Options

Brian Van Lienden / Taylor Blakslee

July 25, 2024



Projects and Management Action Options

- **Projects and Management Actions Included in the GSP**
 - Flood and Stormwater Capture
 - Water Supply Transfers/Exchanges
 - Precipitation Enhancement
 - Improve Reliability of Water Supplies for Local Communities
 - Basin-Wide Economic Analysis - **completed**
 - Pumping Allocations in Central Management Area (covered separately)
 - Adaptive Management
- **New Projects for Consideration**
 - Flow Meter Recalibration Program
 - Rangeland and Forest Management
- **Board Direction Required: the Board needs to decide which projects to include in the 2025 GSP Update at the July 2024 Board meeting**
 - Staff recommends inclusion of all projects listed above with the exception of rangeland and forest management

Flood and Stormwater Capture

- **Flood and stormwater capture** was described in **GSP Section 7.4.1: Flood and stormwater capture would include infiltration of stormwater and flood waters to the groundwater basin using spreading facilities (recharge ponds or recharge basins) or injection wells.**
- Technical Analysis performed for the GSP:
 - Assumed that there would be sufficient flows for recharge in 3/10 years, with an average of 14,700 AF/year available
 - Estimated benefits: ~4,000 AF/year on average
- Updated technical analysis that accounts for Lake Twitchell operations indicate that recharge may be possible in approximately 1/10 years
 - Revised estimated benefits: ~1,000-1,500 AF/year on average
- **Board Decision: Should this project be included in the 2025 GSP?**
 - Staff recommends that this project should be included

Water Supply Transfers/Exchanges

- **Water supply transfers/exchanges** were described in **GSP Section 7.4.3:** *This project would evaluate the feasibility of purchasing transferred water and exchanging it with downstream users (downstream of Lake Twitchell) to allow for additional stormwater and floodwater capture in the Basin to protect water rights of downstream users. Because this action is intended only as a complement to a potential stormwater or floodwater capture project, all potential purchase transfer water would originate outside of the Cuyama River watershed, and **this action would not include the transfer or sale of existing Cuyama Basin groundwater out of the watershed.***
- This project would only be explored if flood and stormwater capture was feasible but greater volumes of recharge were desired
- **Board Decision: Should this project be included in the 2025 GSP?**
 - Staff recommends that this project should be included

Precipitation Enhancement

- **Precipitation enhancement** was described in **GSP Section 7.4.2**: *A precipitation enhancement project would involve implementation of a cloud seeding program to increase precipitation in the Basin. This project would target cloud seeding in the upper Basin, southeast of Ventucopa, and would include introduction of silver iodide into clouds to increase nucleation (the process by which water in clouds freeze to then precipitate out).*
- Technical analysis performed for the GSP:
 - Assumed cloud seeding would increase precipitation by 10% from November through March each year
 - Estimated benefits: ~1,500 AF/year on average
- An updated cloud seeding study by Desert Research Institute is currently underway, with results available in August 2024. These results will help refine what a potential project may look like.
- **Board Decision: Should this project be included in the 2025 GSP?**
 - Staff recommends that this project should be included

Improve Reliability of Water Supplies for Local Communities

- **The Improve Reliability of Water Supplies for Local Communities project** was described in **GSP Section 7.4.4**: *This management action would include consideration of opportunities to improve water supply reliability for Ventucopa and within the CCSD service area. Potential projects that would be considered under this management action include a replacement well for CCSD Well 2, which is currently abandoned, and improvements to Ventucopa Water Supply Company's (VWSC's) existing well*
- The GSP also supported a potential project for the town of Cuyama (GSP pg 7-19)
- Since submittal of the GSP, CCSD has received grant funding to install a new well
- **Board Decision: Should this project be included in the 2025 GSP?**
 - Staff recommends that this project should be included

Adaptive Management in the Cuyama GSP

- What does the GSP say?
 - Section 7.6 of the Adopted GSP: “Adaptive management triggers are threshold that, if reached, initiate the process for considering implementation of adaptive management actions or projects.”
 - Adaptive Management Triggers
 - **Pumping reductions are more than 5 percent off the glide path identified in the pumping allocation plan:** CBGSA would evaluate why pumping allocation are not being met and implement additional outreach or enforcement, as appropriate.
 - **If the Basin is whin the Margin of Operational Flexibility, but trending toward Undesirable Results, *and* within 10 percent of the Minimum Threshold:** CBGSA will investigate the cause and determine appropriate actions
- **Board Decision: Should this project be included in the 2025 GSP as shown above?**
 - Staff recommends that this project should be included as shown above

Flow Meter Recalibration Program

- The flow meter recalibration program would require all flow meters to be tested for accuracy on a periodic basis to demonstrate accuracy
 - Testing would be performed by a qualified flow meter testing company or other person approved by the GSA
 - Approved testing methods would also be approved by the GSA
- A similar program has been implemented by Fox Canyon GSA, where testing for accuracy is required once every three years to demonstrate accuracy within +/- 5%
- **Board Decision: Should this project be included in the 2025 GSP?**
 - **Staff recommends that this project should be included**

Rangeland and Forest Management

- Description: Removal of native vegetation in forest or rangeland areas through controlled burning could reduce water consumption through decreased evapotranspiration
- Potential Benefit: Reduction in ET consumption from native vegetation
- Potential Implementation Issues: potential adverse effects on wildlife habitat; air quality concerns from smoke and dust; potential increase in flood flows due to reduced water interception
- Estimated Cost: \$500-600/acre-foot
- Project was considered for 2020 GSP but was not included
- **Board Decision: Should this project be included in the 2025 GSP?**
 - Staff recommends that this project should NOT be included due to uncertain benefits and potential wildlife and air quality impacts



TO: Standing Advisory Committee
Agenda Item No. 8c

FROM: Jim Beck / Brian Van Lienden

DATE: July 25, 2024

SUBJECT: Discuss and Take Appropriate Action on Glidepath Methodology [Final Discussion]

Recommended Motion

Standing Advisory Committee feedback requested.

Discussion

Staff provided an initial presentation on glidepath options in September 2023. A presentation on the glidepath methodology for final direction is provided as Attachment 1.

Cuyama Basin Groundwater Sustainability Agency

8c. Discuss and Take Appropriate Action on Glide Path Methodology

Taylor Blakslee / Brian Van Lienden

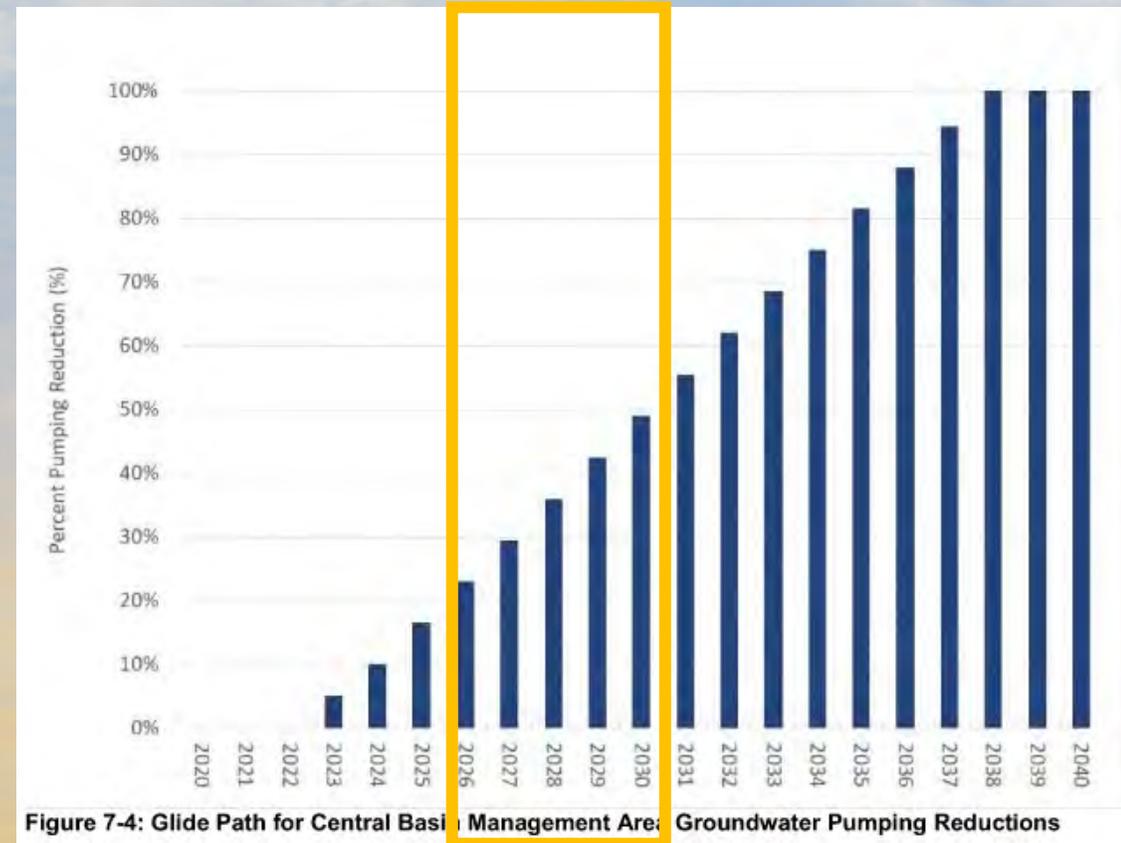
July 25, 2024



GSP Approach

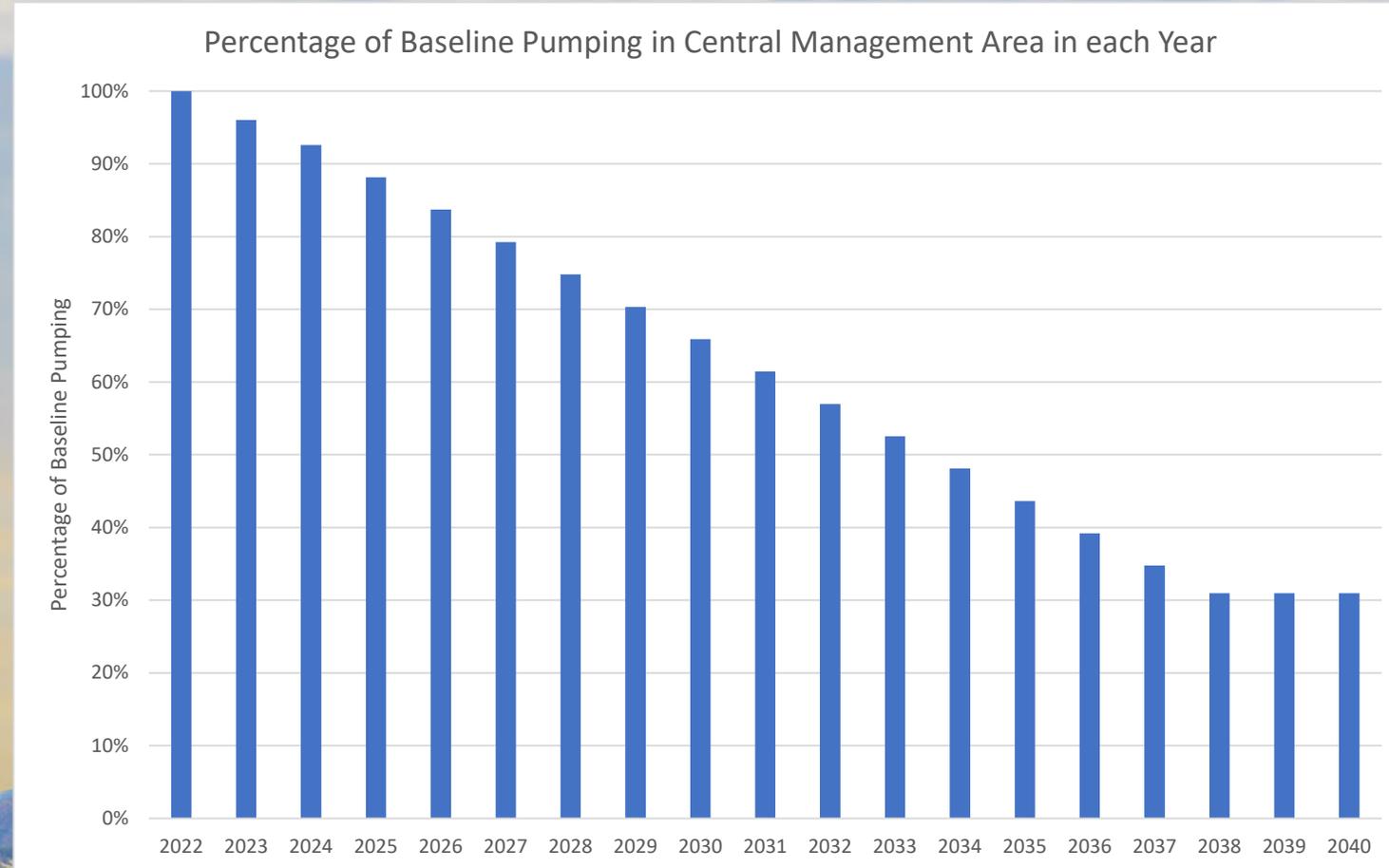
Board Policy in 2025 GSP Update will apply for 5 years until next update

- The glide path was developed as part of the Central Basin pumping allocations action in the GSP
- **GSP Section 7.5.2 (p. 7-23):** “The required decreases in pumping volumes to achieve balanced groundwater use in the Basin may result in substantial reductions in water availability over current use. The CBGSA plans to complete the pumping allocation plan in 2022, with pumping reductions beginning in 2023 at 5 percent of the total required reduction to achieve sustainability, and an additional 5 percent reduction in 2024. From 2025 to 2038, pumping would be reduced by 6.5 percent annually, so as to achieve sustainability in the Basin in 2038.”



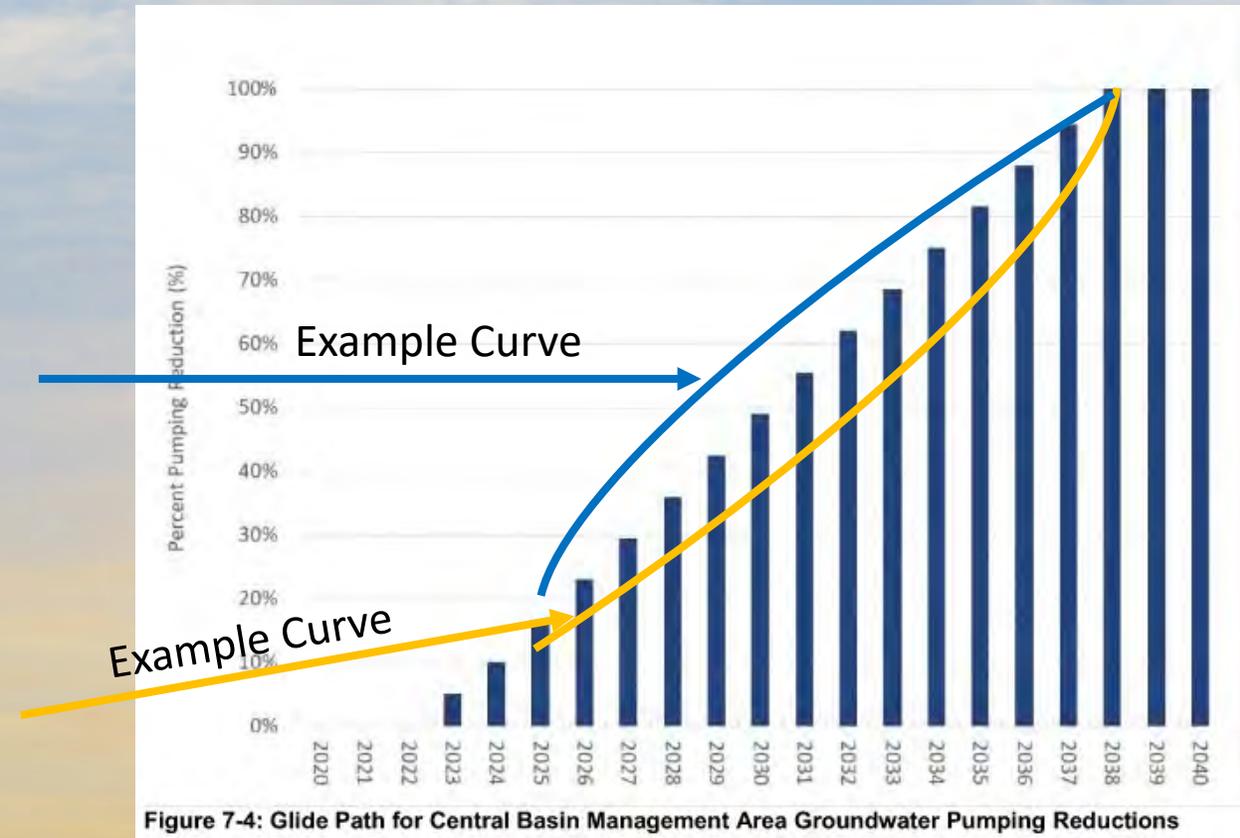
CBGSA GSP - Pumping Allocations Action

- Based on updated modeling estimates, the **Glide Path** results in Central Management Area pumping allocations equal to about 30% of baseline pumping levels in 2040 (a reduction of ~70%)



Potential Options presented in Nov 2023

- Central Management Area options:
 1. Continue to use the same glide path for pumping allocations
 2. Adjust glide path to have greater reductions earlier in the period and lesser reductions later in the period (less overall reduction in groundwater storage and levels)
 3. Adjust glide path to have lesser reductions earlier in the period and greater reductions later in the period (less early impacts to agricultural users)



Potential Options

- Other Central Management Area options presented in Nov 2023:
 1. Adjust the glide path to account for potential implementation of water supply projects
 2. Adjust the glide path schedule in conjunction with minimum thresholds so that that groundwater levels stay above minimum thresholds in 2040
- **Board Direction Needed: Which glide path option should be incorporated into the GSP?**



TO: Standing Advisory Committee
Agenda Item No. 8d

FROM: Jim Beck / Brian Van Lienden / Alex Dominguez

DATE: July 25, 2024

SUBJECT: Discuss and Take Appropriate Action on Basin-Wide Water Management Narrative

Recommended Motion

Standing Advisory Committee feedback requested.

Discussion

A presentation on the basin-wide water management narrative is provided as Attachment 1.

Cuyama Basin Groundwater Sustainability Agency

8d. Discuss and Take Appropriate Action on Basin-Wide Management Narrative

Jim Beck / Brian Van Lienden

July 25, 2024



What does the 2020 GSP say?

- **GSP Section 7.5.2:** “This project would involve development of pumping allocations in the Central Basin Management Area. Consistent with the magnitude of projected overdraft estimated by the numerical model, pumping allocations would not apply to the Ventucopa Management Area or to users outside of a Management Area. CCSD would be provided allocations based on historical water use, and would not be required to reduce pumping over time, but would be limited in how much pumping could increase in the future.”

Proposed Revision for 2025 Update

- **GSP Section 7.5.2:** “This project would involve development of pumping allocations in the Central ~~Basin~~ Management Area **plus farming units**. Consistent with the magnitude of projected overdraft estimated by the numerical model, pumping allocations would not apply to ~~the Ventucopa Management Area or to~~ users outside of **a the Central Management Area and farming units**. Potential pumping allocations in other areas of the Basin may be considered in the future as additional data collection and technical analysis is performed to obtain a better understanding of water balance conditions in these areas. CCSD would be provided allocations based on historical water use, and would not be required to reduce pumping over time, but would be limited in how much pumping could increase in the future.”



TO: Standing Advisory Committee
Agenda Item No. 8e

FROM: Taylor Blakslee / Brian Van Lienden

DATE: July 25, 2024

SUBJECT: Discuss and Take Appropriate Action on Updated CMA Boundary, Management Area Criteria, Use of an Operational Boundary and Use of Farm Units [Final Discussion]

Recommended Motion

Standing Advisory Committee feedback requested.

Discussion

Staff provided an initial presentation on the CMA Boundary and management area criteria in September 2023. A presentation on the management area criteria, central management area and use of farm units for final direction is provided as Attachment 1.

Cuyama Basin Groundwater Sustainability Agency

8e. Discuss and Take Appropriate Action on Management Area Criteria, Updated CMA Boundary and Use of Farm Units (Final Discussion)

Jim Beck / Brian Van Lienden

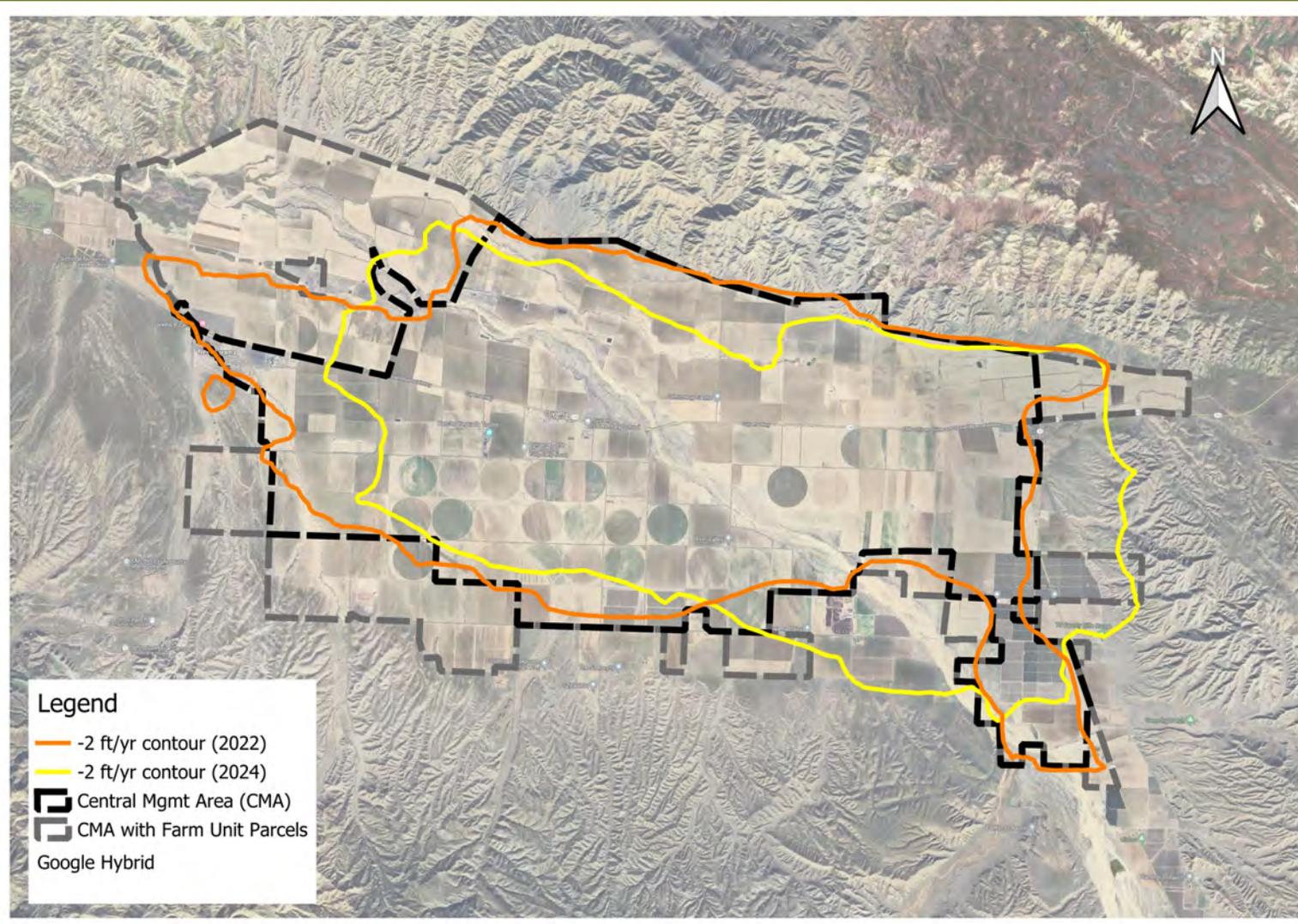
July 25, 2024



Management Area Criteria, CMA Boundary and Farming Units

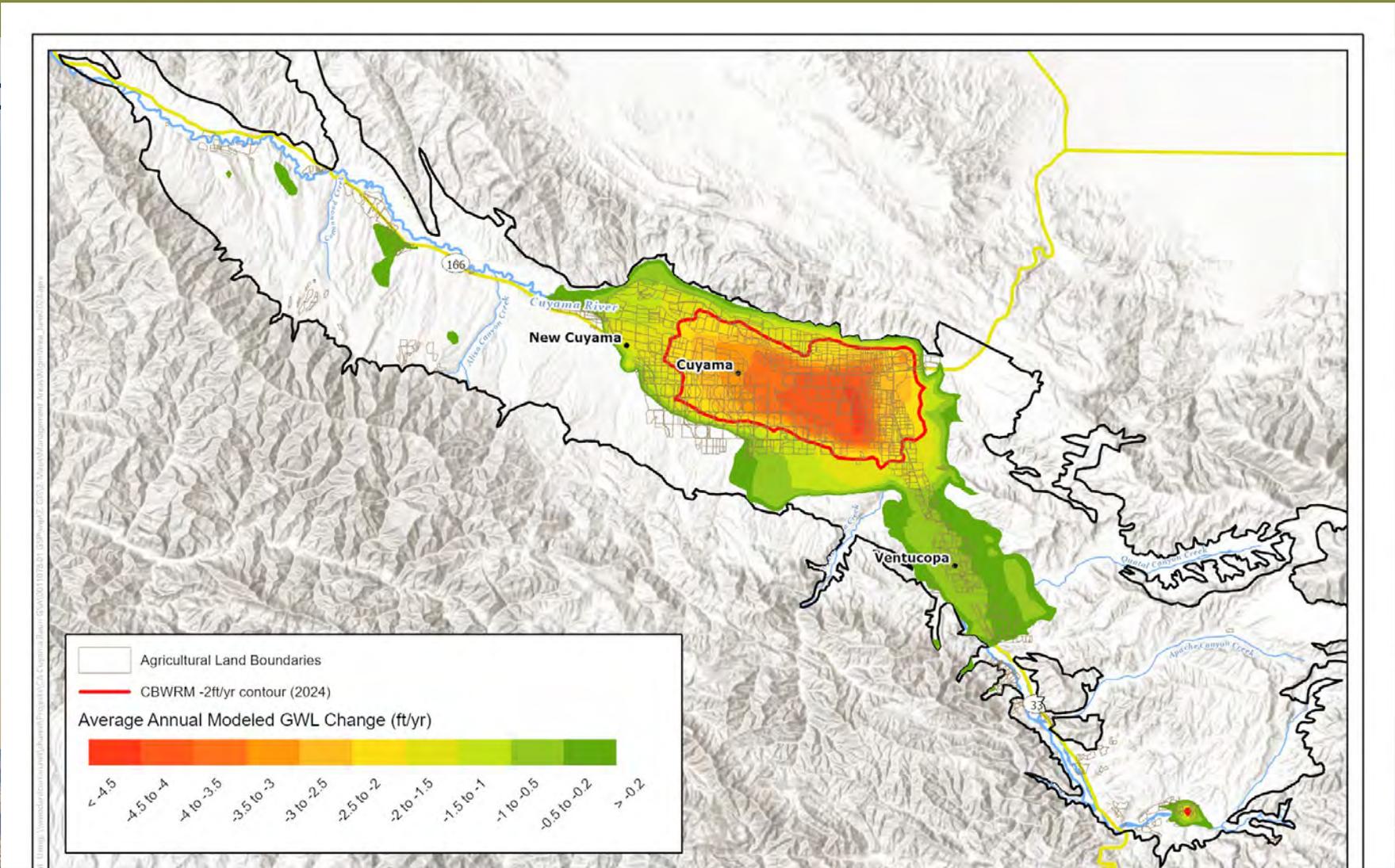
- As specified in the 2020 GSP, the current CMA includes all areas that have a 2-foot per year or greater projected overdraft as projected by the Cuyama groundwater model.
 - For implementation of pumping allocations, the Board approved creation of an “operational” CMA boundary
 - The Board established “farming units” to accommodate operators with irrigated lands both inside and outside the CMA boundary
- With the updated model, the 2-foot per year boundary has shifted
- **Questions for Board Consideration:**
 - Should the CMA continue to be defined by the 2-foot per year line as projected by the model?
 - Should the CMA be adjusted to conform with the boundary developed by the updated version of the model?
 - Should an operational boundary be used? Should the Board continue with the farming unit policy?

Updated Management Area 2022 Version vs. Updated 2 ft/yr Contour



- Total acreage within 2ft/yr contour:
 - 2022: 22,500 acres
 - 2024: 21,800 acres

■ Add





TO: Standing Advisory Committee
Agenda Item No. 8f

FROM: Taylor Blakslee / Brian Van Lienden

DATE: July 25, 2024

SUBJECT: Discussion and Take Appropriate Action on Groundwater Allocations [Final Discussion]

Recommended Motion

Standing Advisory Committee feedback requested.

Discussion

Staff provided an initial presentation on the groundwater allocations in September 2023 and January 2024. A presentation for the groundwater allocations for final direction is provided as Attachment 1.

Cuyama Basin Groundwater Sustainability Agency

8f. Discuss and Take Appropriate Action on Groundwater Allocations (Final Discussion)

Jim Beck / Brian Van Lienden

July 25, 2024



The CBGSA Board Approved the Existing Groundwater Allocation Program for 2023 and 2024

- Allocation Implementation: Calendar years 2023 and 2024
- Applies to: Central Management Area (CMA) + Farming Units
- Baseline Allocation Amount: 2021 modeled water use plus Farming Units in the CMA excluding CCSD metered use and residential pumping (estimated by model)
- Sustainable Yield: Calculated by the model for the CMA (including Farm Units)
- Allocation Methodology: estimated historic water use averaged from the 1998-2017 Water Year period for each parcel in the CMA

How Should the Groundwater Allocation Program Continue beyond 2024?

Board Feedback Needed:

1. Options for allocation Implementation period
 - 5 years (i.e. 2025-2029) and then reassess for next 5-year period
 - Other
2. Applies to
 - CMA + farming units
3. Baseline allocation amount
 - Jan 10th Board direction to use 2021 updated by the model. Continue with this?

How Should the Groundwater Allocation Program Continue beyond 2024?

Board Feedback Needed:

4. Sustainable yield

- Should we use the number estimated by the updated model?

5. Allocation methodology

- Should we continue to use estimated historic water uses average from the 1998-2017 water years?
- If so, should we revert to the numbers estimated by the updated model?

6. Carryover

- Should we incorporate a carryover policy? (general Board support from March 6th Board meeting)



TO: Standing Advisory Committee
Agenda Item No. 8g

FROM: Taylor Blakslee / Brian Van Lienden

DATE: July 25, 2024

SUBJECT: Discussion and Take Appropriate Action on Frequency of Changes to Groundwater Allocations [Final Discussion]

Recommended Motion

Standing Advisory Committee feedback requested.

Discussion

A presentation outlining options for determining if and when water management outside the Central Management Area is considered and provided as Attachment 1.

Cuyama Basin Groundwater Sustainability Agency

8g. Discuss and Take Appropriate Action on Frequency of Changes to Pumping Reduction Program

Jim Beck / Brian Van Lienden

July 25, 2024



Potential Options

- Staff recommends the Board adopt a policy to determine if and when pumping groundwater allocations would be applied to areas outside of the CMA plus farming units
- Potential options include:
 - Identifying a quantitative metric (e.g. based on groundwater level changes or modeled water budgets) that would trigger consideration of allocations
 - Perform a qualitative assessment of whether groundwater allocations should be considered outside the CMA on one of the following intervals:
 - During each Annual Report
 - During each GSP Periodic Evaluation (i.e. every 5 years)
 - Other
- **Which option does the Board want staff to include in the GSP?**



TO: Standing Advisory Committee
Agenda Item No. 8h

FROM: Jim Beck / Brain Van Lienden

DATE: July 25, 2024

SUBJECT: Discuss and Take Appropriate Action on GSP Draft Chapters

Recommended Motion

Approve groundwater sustainability plan chapters 2, 3, 5 and 6.

Discussion

An update on draft Groundwater Sustainability Plan (GSP) chapters 2, 3, 5, and 6 is provided as Attachment 1, and draft final redline GSP chapters are provided as Attachment 2 for consideration of approval.

- i. Chapter 2. Basin Setting
- ii. Chapter 3. Undesirable Results
- iii. Chapter 5. Minimum Thresholds, Measurable Objectives, and Interim Milestones
- iv. Chapter 6. Data Management System (DMS)

Cuyama Basin Groundwater Sustainability Agency

8h. Discuss and Take Appropriate Action on GSP Chapters

Jim Beck / Brian Van Lienden

July 25, 2024



Discuss and Take Appropriate Action on GSP Draft Chapters

- Updated versions of the following chapters have been provided for approval:
 - Chapter 2: Basin Setting
 - Chapter 3: Undesirable Results
 - Chapter 5: Minimum Thresholds, Measurable Objectives, and Interim Milestones
 - Chapter 6: Data Management System
- Updates account for:
 - New information not available when 2020 GSP was developed
 - Updated policies approved by the CBGSA Board at Jan 2024 Board meetings
- Staff is requesting Board approval of these chapters at this Board meeting
- Comments can be provided by email or by mail to Taylor Blakslee
 - These will be considered when preparing the full Public Draft version of the GSP in September 2024



2. Basin Settings: Overview

This Cuyama Valley Groundwater Basin (Basin) Settings chapter contains three main sections as follows:

- **Hydrogeologic Conceptual Model (HCM)** – The HCM section (Section 2.1) provides the geologic information needed to understand the framework that water moves through in the Basin. It focuses on geologic formations, aquifers, structural features, and topography.
- **Groundwater Conditions** – The Groundwater Conditions section (Section 2.2) describes and presents groundwater trends, levels, hydrographs and level contour maps, estimates changes in groundwater storage, identifies groundwater quality issues, addresses subsidence, and addresses surface water interconnection.
- **Water Budget** – The Water Budget section (Section 2.3) describes the data used to develop the water budget. Additionally, this section discusses how the budget was calculated, provides water budget estimates for historical conditions, and current conditions and projected conditions.

2.1 Basin Settings: HCM

This section of Chapter 2 describes the HCM for the Basin. Additionally, this HCM section satisfies Section 354.8 of the Sustainable Groundwater Management Act (SGMA) regulations. As defined in the regulations promulgated by the Department of Water Resources (DWR), the HCM:

1. “Provides an understanding of the general physical characteristics related to regional hydrology, land use, ~~geology~~ geologic structure, water quality, principal aquifers, and principal aquitards of the basin setting;
2. Provides the context to develop water budgets, mathematical (analytical or numerical) models, and monitoring networks, and
3. Provides a tool for stakeholder outreach and communication.”

This HCM was developed to understand and then convey information about the physical conditions by which water moves through the Basin. This information is also used to support development of water budgets (Section 2.3).

2.1.1 Useful Terms

This chapter includes descriptions of geologic formations and structures, aquifers, and properties of geology related to groundwater, among other related components.



A glossary of technical terms is below. The terms listed here are intended as a guide for readers, and are not a definitive definition of any term.

- **Formation** – A formation, or geologic formation, is a unit of rock of similar properties, such as grain size, mineral composition, or depositional environment. Geologic formations are distinct from surrounding rock types and are large enough to be mapped regionally. If the formation contains a dominant rock type, such as sandstone, it may be included in the name of the formation.
- **Basement rocks** – Basement rocks are the oldest and deepest rocks in the subsurface. Basement rocks are typically crystalline and metamorphic or igneous in origin, and groundwater generally only moves through fractures in the rock instead of pore spaces like in sedimentary rocks. No sedimentary layers are found below the basement rocks.
- **Water bearing formation** – A water bearing formation is a rock formation that is saturated and contains water within the pores or fractures of the unit. One or more water bearing formations compose an aquifer.
- **Aquifer** – An aquifer is an underground reservoir of water stored within the pores and fractures of rocks and sediments.
- **Unconfined aquifer** – An unconfined aquifer is an aquifer that does not have an impermeable layer above it (such as a clay layer). With an unconfined aquifer, the upper water surface is defined as the water table and is at atmospheric pressure. Water seeps from the ground surface directly into the aquifer, as there are not impermeable layers to prevent the water from entering the aquifer.
- **Cross section** – A cross section is a diagram that identifies subsurface layers located beneath a surficial trend. Stratigraphic cross sections depict geologic formations in the subsurface in relation to elevation. Cross sections are useful tools to interpret geology in the subsurface and visualize the relative thickness and distribution of geologic formations. Cross sections are often presented with an accompanying map that acts as a reference to spatially locate the trend of the cross section at the surface. To read cross sections, use the location and trend of the surficial lines on the location map as a key. For instance, where A-A' is marked on the map represents where the cross section named A-A' is located spatially
- **Hydraulic conductivity** – Hydraulic conductivity is defined as the “measure of a rock or sediment’s ability to transmit water,” typically measured in feet or meters per unit of time (day, hour, minute) (DWR, 2003). Rocks and sediments with high values of conductivity, such as gravels or coarse sands, are able to sustain groundwater flow better than rocks and sediments with low values of conductivity. Rocks and sediments with near zero values of hydraulic conductivity, such as very fine-grained sandstones, shale, or granites, do not transmit groundwater and are barriers to flow. Values of conductivity are used in the groundwater model to determine how quickly formations transmit groundwater and where barriers to groundwater flow (i.e., formations with very low values of conductivity) exist.
- **Hydrogeology** – The study of groundwater and aquifers.



- **Primary aquifer** – According to SGMA regulations, primary aquifers must be identified. In the Groundwater Sustainability Plan (GSP), aquifers requiring specific monitoring and management must also be identified. Primary aquifers are regionally extensive and are sources of groundwater used for beneficial uses.
- **Aquitard** – An aquitard is a layer of strata that has a low conductivity that groundwater flows very slowly through. Aquitards can be regional, ~~such as the Coreoran Clay~~ in the ~~Cuyama~~ San Joaquin Valley, where it prevents flow from upper strata to lower strata across the western side of the valley, or it can be localized, which is common in most alluvial settings. Localized aquitards restrict vertical flows in a small region of an aquifer, and water will generally move laterally around localized aquitards as it flows by gravity toward the bottom of the aquifer.
- **Piper diagrams** – A Piper diagram is used to characterize the chemical quality of a water sample, and involves plotting the relative proportions of major ions. Piper diagrams show the relative abundance of major cations (e.g., sodium, potassium, calcium, magnesium) and anions (e.g., bicarbonate, carbonate, sulfate, chloride, fluoride) commonly found in water on a charge equivalent basis, as a percentage of the total ion content of the water. Piper diagrams are useful for understanding what kind of salts make up the total dissolved solids (TDS) in a location.

2.1.2 Regional Geologic and Structural Setting

The Basin is located at the southeastern end of the California Coast Ranges and north of the Western Transverse Ranges (~~Figure 2-1~~;Figure 2-1) and is in an area of high tectonic activity. The Basin is bounded on the north and south by faults, and is located near major fault zones such as the San Andreas and Santa Maria River fault zones. Because the Basin is located in a mountainous region with high tectonic activity, it has a number of structural features generated by this activity. The Basin has been deformed by this tectonic activity, and is generally a synclinal basin, with multiple synclines that are oriented to the northwest and a number of faults ~~that cross~~within the Basin.

Tectonic activity from the northwest movement of the San Andreas Fault system has led to the development of a fold and thrust belt, which has driven the deformation of the Cuyama Valley for the past four million years (United States Geological Survey [USGS], 2013c). The Cuyama Valley was formed by a downfaulted block of the earth's crust called a graben. This block is bordered on the north by the Morales and Whiterock faults and on the south by the South Cuyama and Ozena faults. Along these borders the faults have thrust older rocks of pre-Pliocene age over the rocks of Pliocene age and younger. In the eastern part of the valley the north-bordering faults approach the San Andreas Fault zone and the south-bordering faults approach the Big Pine Fault zone. (Singer and Swarzenski, 1970)



Figure_Exported_10/19/2018 By: cegiplan Using: C:\Users\ceiplan\OneDrive - Woodard & Curran\PC\Folders\Desktop\11078-003 - Cuyama01 - Local\Cuyama GIS_20180603\MXD\Text\TCM\Fig_2_1-1_RegionalGeologicSetting.mxd

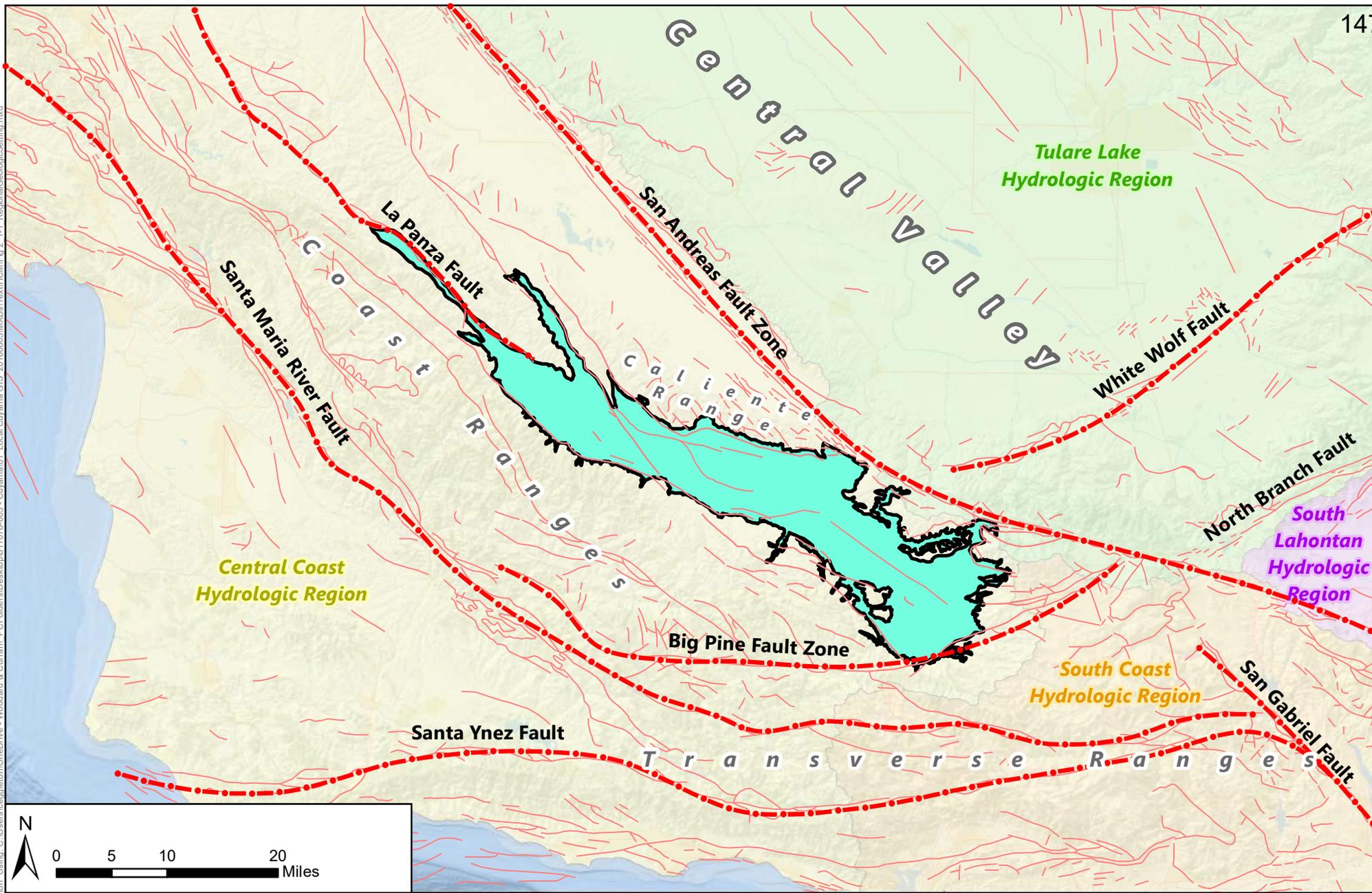


Figure 2-1: Regional Geologic Setting

Cuyama Basin Groundwater Sustainability Agency

Cuyama Valley Groundwater Basin Groundwater Sustainability Plan

December 2019



Legend

- Cuyama Basin
- Faults and Folds

Fault Data Sources:
 Fault Activity Map of California (2010) from the California Department of Conservation. Retrieved 6/13/2018. <<http://maps.conservation.ca.gov/cgs/fam/>>
 California Geologic Map Data from United States Geologic Survey. Retrieved 2/8/2018. <<https://mrdata.usgs.gov/geology/state/state.php?state=CA>>



2.1.3 Geologic History

The Basin has a long history of deformation and deposition, most of this influenced by tectonic activity and cycles of marine transgression and regression. Formations in the Basin reflect variable depositional environments, from the middle bathyal shales and siltstones to the nonmarine sandstone, conglomerate, and mudstones. Marine rocks are dominant in the western part of the Basin and interfinger to the east with nonmarine rocks (Ellis, 1994).

A major late Eocene/early Oligocene (38 to 28 million years (Ma)) unconformity affected all regions south of the San Andreas Fault, shown in the geologic record by nonmarine Oligocene (23 Ma) rocks overlying a thick section (i.e., several kilometers) of upper Eocene (56 Ma) marine rocks (Kellogg et al., 2008; Ellis, 1994). This unconformity is a result of the Ynezian orogeny (around 30 Ma) during which pre-Oligocene marine rocks were folded and uplifted above younger, Oligocene-age sediments (Kellogg et al., 2008).

Following a period of orogeny, deformation changed to extension from the late Oligocene and early Miocene (around 23 Ma) and the Basin became a major extensional basin (Ellis, 1994). This period also correlated with two transgressive-regressive cycles, where the sea advanced and retreated over geologic time over the sediments now in the Basin due to tectonic subsidence (Bazeley, 1988). Sediments deposited during this period reflect the cyclical nature of sea-level rise and are generally categorized by marine strata in the west and nonmarine strata to the east. Formations deposited during ocean transgression are thick marine sediments, including the Vaqueros Formation, Monterey Formation, Branch Canyon Sandstone, and Santa Margarita Sandstone (Kellogg et al., 2008; Lagoe, 1981). Many of the marine units interfinger with terrestrial units and eventually pinch out to zero thickness in the east. During the late Miocene (8 Ma), the sea regressed from the western part of the region, evident in the geologic record where the nonmarine Caliente Formation interfingers with the similarly aged marine Santa Margarita Sandstone and unconformably overlies the Branch Canyon Sandstone (Kellogg et al., 2008). By the middle Miocene (15 Ma), the eastern Cuyama Valley area was characterized by a shelf and nonmarine deposition. Deformation by the middle Miocene changed from extension to right-lateral strike slip motion, resulting in the development of the Russell ~~F~~fault.

Deformation from Oligocene extension and Miocene strike-slip faulting regimes was buried by the folding, uplift, and thrust faulting during the Pliocene through Pleistocene compression (beginning around 4 Ma) (Ellis, 1994). Compression led to the uplift of the Coast and Transverse mountain ranges surrounding the current topographic valley and the converging thrust faults that surround the present day topographic basin, including the Whiterock, Morales, and South Cuyama ~~F~~faults (USGS, 2013b). The transition to a predominantly compressional system led to the development of a thrust system across the older extensional basin and began thrusting older sediments above younger sediments through the Cuyama Valley (Davis et al., 1988). Older, inactive faults and rocks were buried by the deposition of the younger Morales Formation, Older Alluvium, and Younger Alluvium. Thrust and compression continued into the Quaternary (3 to 2.5 Ma) and uplifted the Caliente Range and thrusted Miocene-aged rocks of the Caliente Range southward over Quaternary alluvium on the Morales ~~F~~fault (USGS, 2013b; Ellis, 1994).



The Morales Formation and Older Alluvium are folded into synclines along the north and south margins of the valley near the bounding thrust faults (USGS, 2013b). The end of the Pliocene (around 2 Ma) marks the complete withdrawal of the sea from the area and the final sea regression marks the change in deposition of marine sediments to the continental clay, silt, sand, and gravel of the Morales Formation and alluvium (Singer and Swarzenski, 1970; Ellis, 1994). Fluvial deposits of claystone, sandstone, and conglomerate became the primary forms of sedimentation.

2.1.4 Geologic Formations/Stratigraphy

The Basin is composed of a sequence of unconsolidated to partly consolidated nonmarine deposits of Pliocene to Pleistocene age unconformably overly consolidated marine and nonmarine sedimentary rocks of late Cretaceous to middle Cenozoic age on top of Mesozoic crystalline granitic and gneissic bedrock (Davis et al., 1988). The unconsolidated to partly consolidated nonmarine deposits are the primary water-bearing units in the Basin and are described in further detail in Section 2.1.7. Individual geologic units found in the Basin are described in detail below, in order of youngest to oldest in deposition. Geologic units mapped at the surface are shown in [Figure 2-2](#). A generalized stratigraphic column of the Cuyama Valley is shown in [Figure 2-3](#).

Dibblee Geology Map Key

	Color	Code	Type
Alluvium	Light Blue	Qg	Surficial sediments
	Light Yellow	Qa	Surficial sediments
	Light Brown	Qoa	Older surficial sediments
	Dark Brown	Qog	Older surficial sediments
Morales Formation	Orange	QTp	Paso Robles formation
	Dark Orange	Tmo	Morales Formation
Basement Rocks	Light Brown	Tmou	Morales formation
	Light Green	Tql	Quatal formation
	Dark Green	Tc	Caliente Formation
	Yellow	Tsm	Santa Margarita Formation
	Orange	Tm	Monterey Formation
	Dark Orange	Tvl	Vaqueros formation
	Dark Brown	Tvq	Vaqueros formation
	Blue	Tss	Marine Sedimentary Rocks, Unnamed

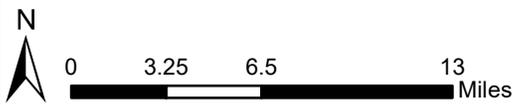
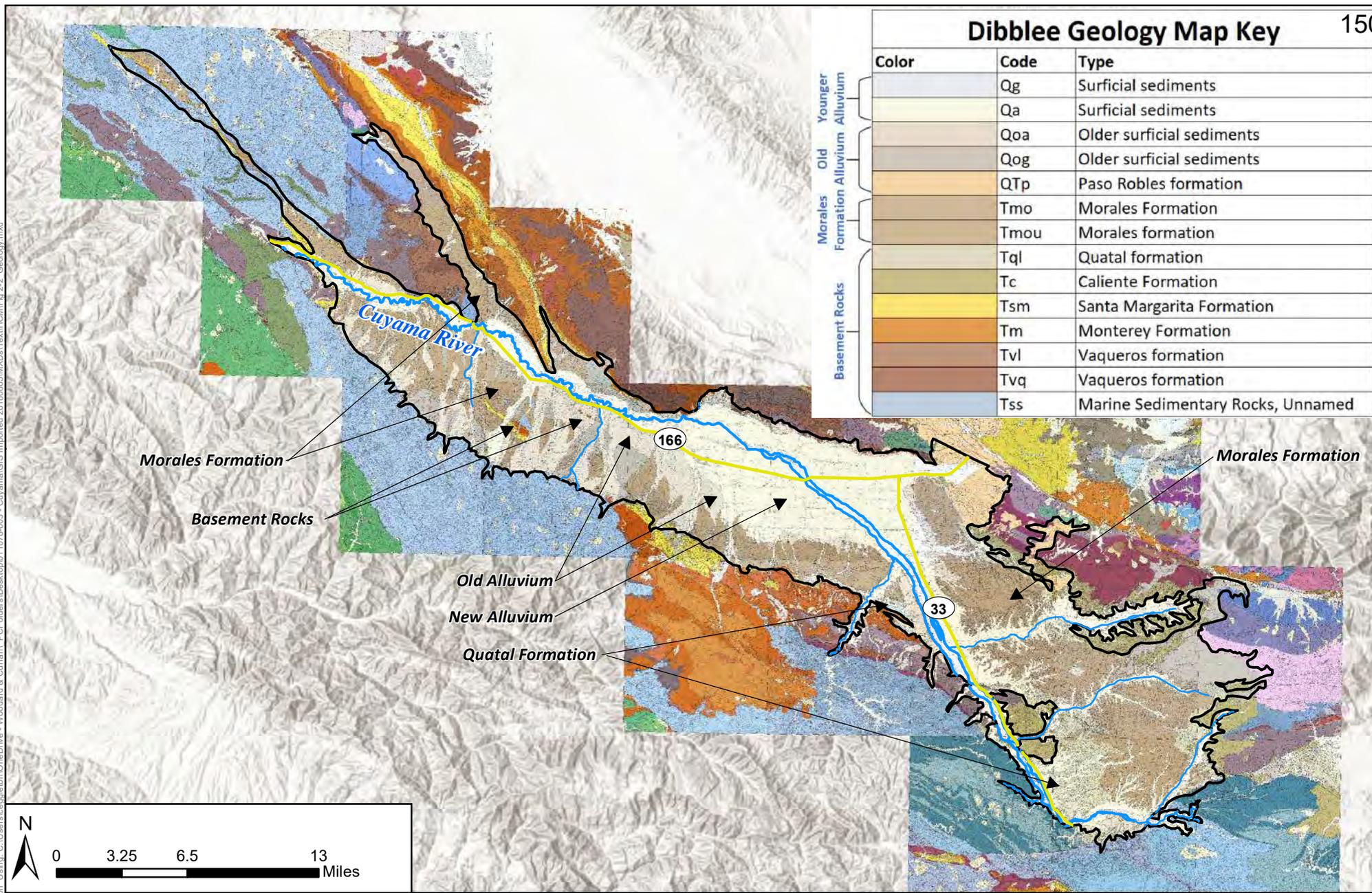


Figure 2-2: Geologic Map

Cuyama Basin Groundwater Sustainability Agency
 Cuyama Valley Groundwater Basin Groundwater Sustainability Plan
 December 2019

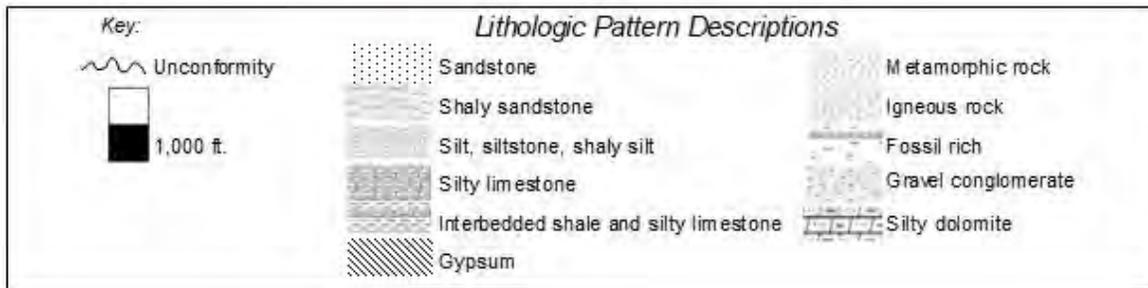
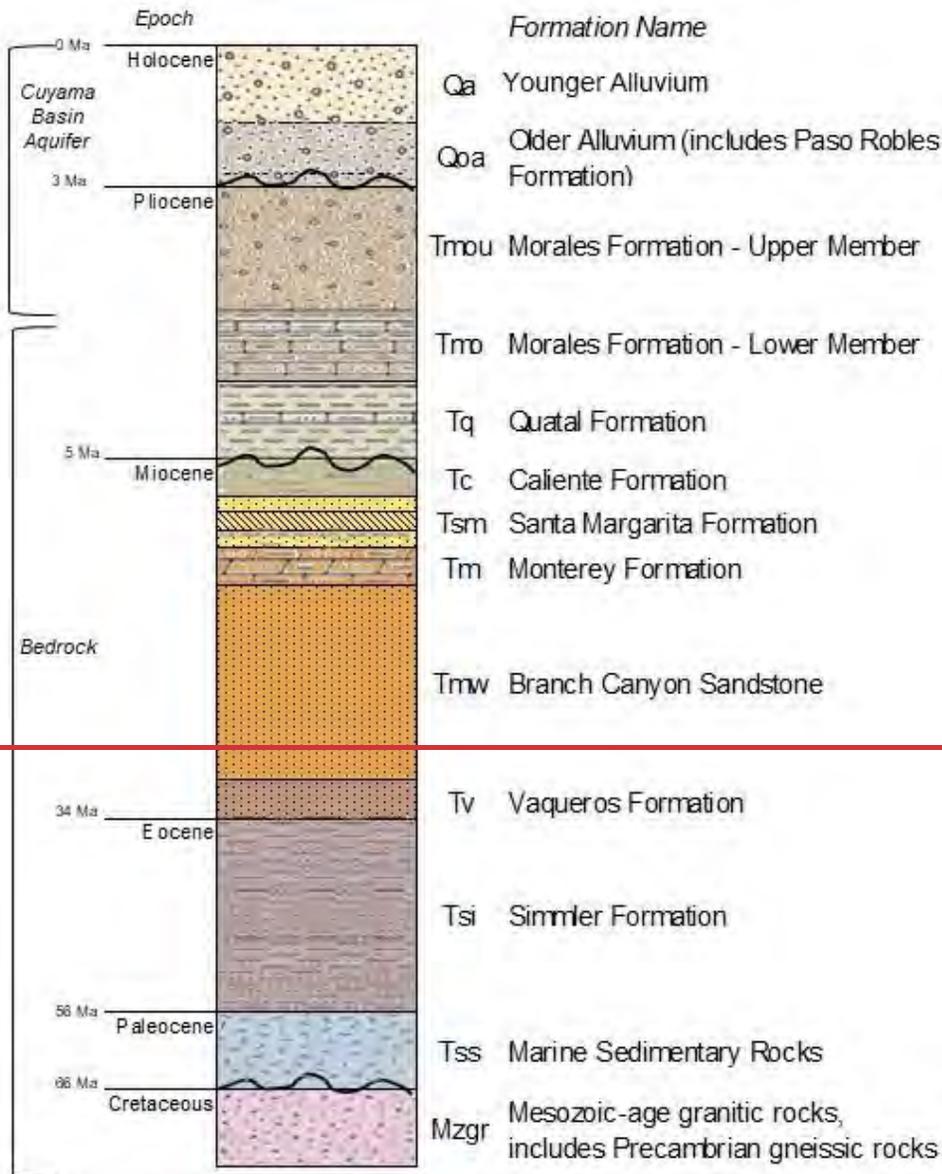


Legend

- Cuyama Basin
- Cuyama River
- Streams
- Highways

Data Source: Thomas W. Dibblee, Jr., Dibblee Foundation
 Released in June 2012, Purchased from AAPG as
 GeoTIF 28 March 2018.

Figure Exported: 8/21/2018 8: By: cersigleton Using: C:\Users\cersigleton\OneDrive - Woodard & Curran\PCF\Folders\Desktop\01078-003 - Cuyama.GIS Imported: 20180603MXDs\Text\TCM\Fig_2-2_Geology.mxd



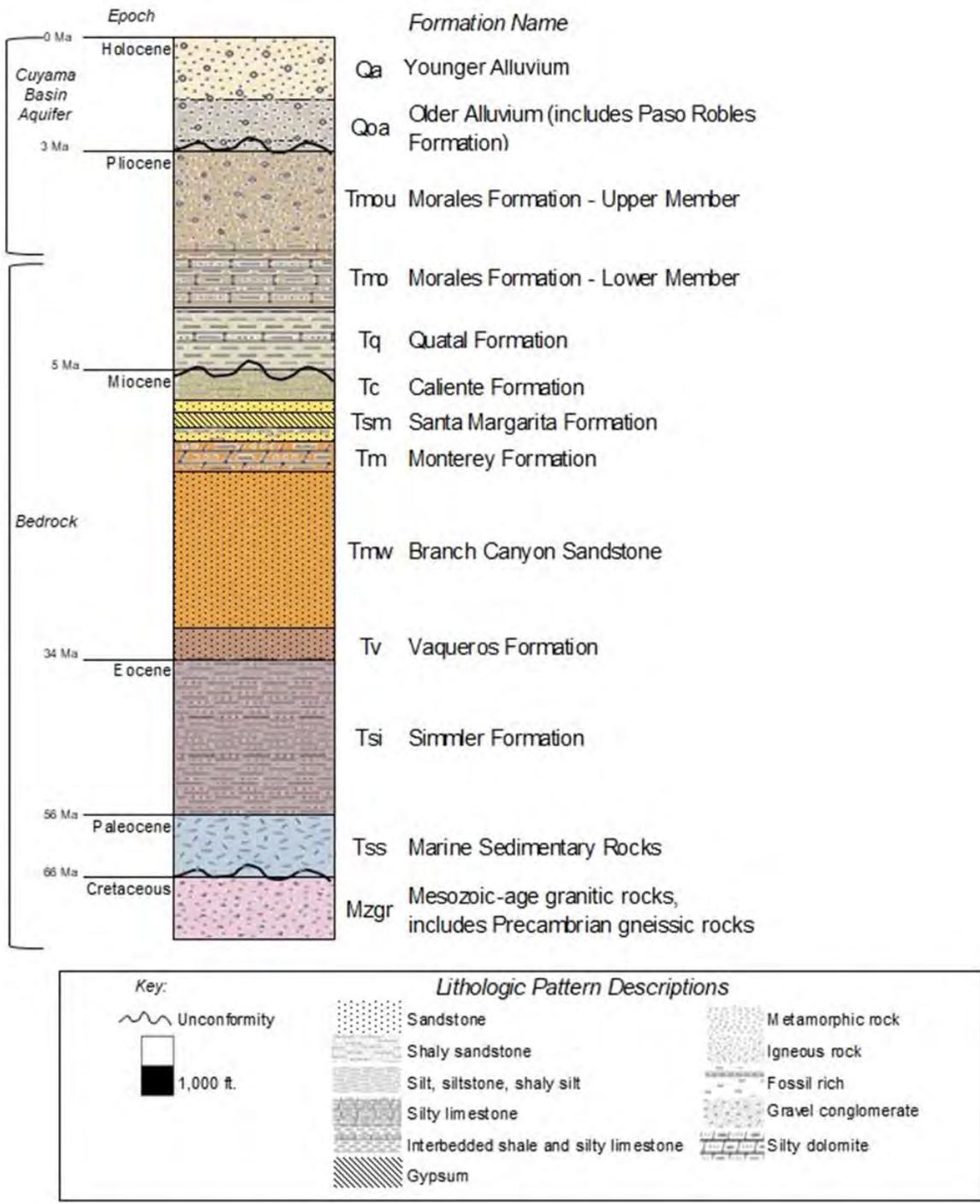
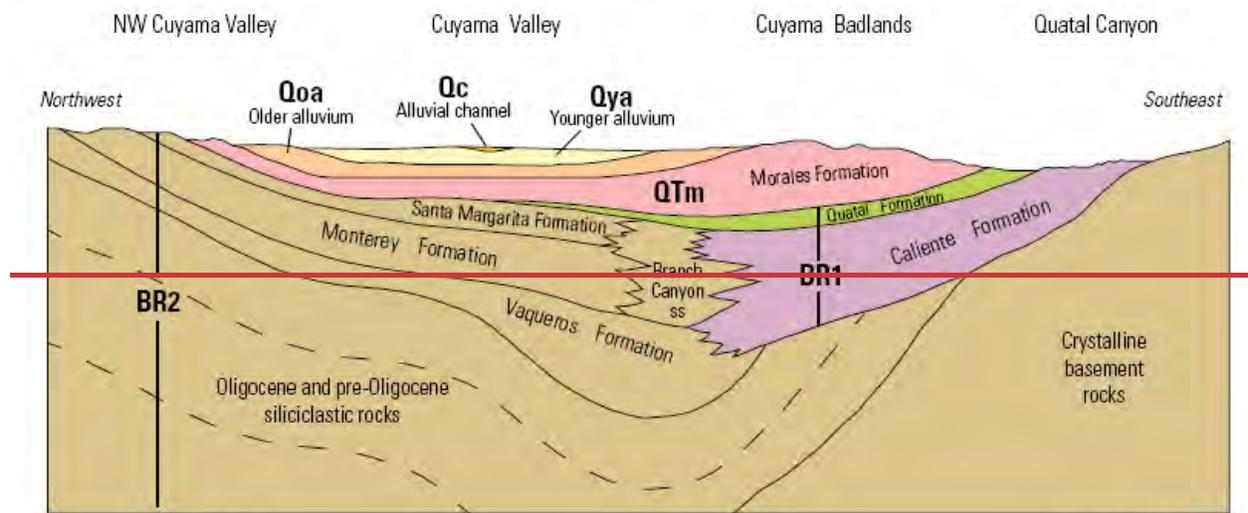


Figure 2-3: Generalized Stratigraphic Column of the Cuyama Valley



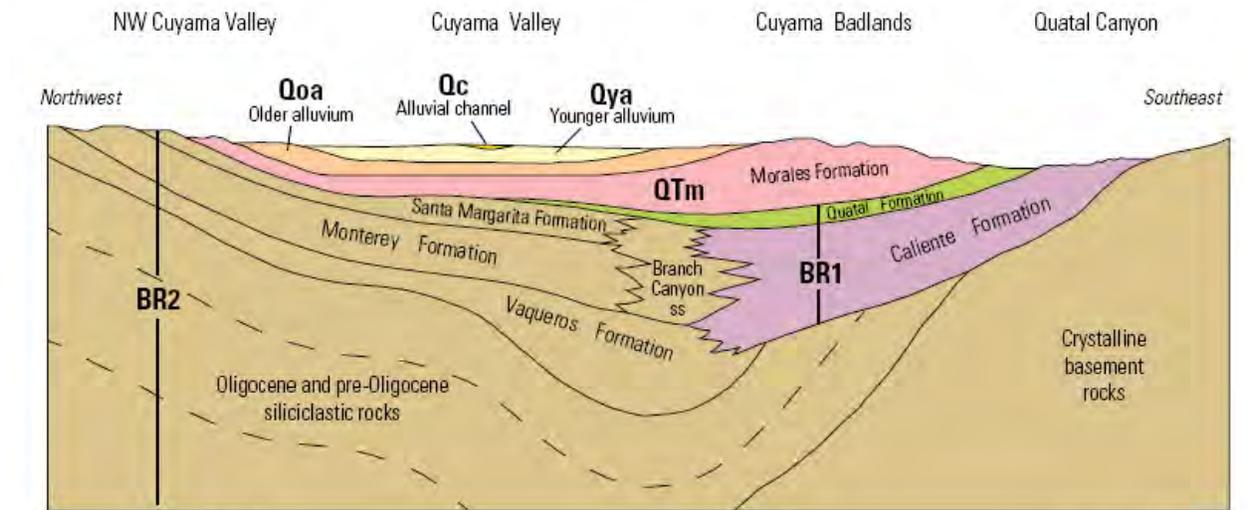
Stratigraphic Units of the Cuyama Basin Aquifer

Stratigraphic units in this section are presented in order from youngest to oldest. The USGS prepared a generalized stratigraphic diagram of the Basin and surrounding area in 2013 (2013a, Figure 2-4). The diagram shows the relationship of the Young Alluvium, Older Alluvium, Morales Formation, and basement rocks in and near the Basin. The diagram shows that the Morales formation is thicker to the east, and that the Caliente Formation is interfingered with a number of other basement rock formations (Santa Margarita, Monterey, Vaqueros) beneath the Basin (USGS, 2013a). This diagram shows the general relationship of formations in the Cuyama area and is not a precise representation of unit thickness.



DIAGRAMMATIC, NOT TO SCALE

Adapted from Dibblee (1995)



DIAGRAMMATIC, NOT TO SCALE

Adapted from Dibblee (1995)

Source: USGS, 2013a.



Figure 2-4: Generalized Stratigraphic Diagram

Recent and Younger Alluvium

The youngest deposit ~~of~~in the Basin is the Recent and Young aAlluvium. Recent alluvium is made up of active fluvial channel deposits associated with the Cuyama River and other active channels. Deposits include river-bed gravels and grain sizes rangeing from silt to boulder size and are found along active fluvial channels in the Basin. The Younger Alluvium is inactive fluvial deposits consisting of unconsolidated to partly consolidated sand, gravel, and boulders, with some clay deposited as part of stream channels, floodplains, alluvial fans, or stream terraces (USGS, 2013c). Younger Alluvium is exposed throughout the central portion of the Central Valley and along the active channels and flood plains of the Cuyama River and other streams. The deposits thicken to the east, typically ranging from 5 to 50 feet in the west and ~~thickening from 630 to~~ possibly as much as 1,100 feet in the east (Singer and Swarzenski, 1970). Recent and Younger aAlluvium are primarily Holocene in age, but the Younger aAlluvium can date back to the Pleistocene (USGS, 2013c). ~~The Younger and Recent alluvium are the principal water-bearing formations in the Basin.~~

Older studies do not distinguish Younger Alluvium from Older Alluvium (Upson and Worts, 1951; Singer and Swarzenski, 1970), but more recent studies (Kellogg et al., 2008) mapped the two alluvium units as distinguishable mappable units at the surface, and in 2013, the USGS identified differences in the two units using electric log signatures: (2013a). A greater degree of consolidation, dissection, and local deformation distinguishes the Older Alluvium deposits from the Younger aAlluvium.

Older Alluvium

Older Alluvium is primarily Pleistocene in age and is composed of unconsolidated to partly consolidated sand, gravel, and boulders with some clay (USGS, 2013a). The percentage of clay increases in the western part of the Cuyama Valley. Older Alluvium deposits are typically more consolidated and deformed than Younger aAlluvium deposits and contain a higher clay content. The Older aAlluvium is dissected alluvial fans, colluvial deposits and sediments on multiple terraces and alluvial surfaces and is found exposed on uplifted alluvial surfaces along the south side of the Cuyama Valley and on the caps of the Turkey Trap and Graveyard ridges (USGS, 2013a). Older Alluvium is typically 400 to 600 feet thick, but increases in thickness up to 1,000 feet near the axis of the Cuyama Valley and decreases in thickness west of the Russell ~~f~~Fault (USGS, 2013a; Cleath-Harris, 2018). The Older Alluvium overlies the Morales Formation unconformably, west of the Cuyama Badlands (Ellis, 1994).

Paso Robles Formation

The Paso Robles Formation is part of the Quaternary alluvium series and is commonly grouped with the Older Alluvium. The Paso Robles Formation is a gray, crudely bedded alluvial gravel derived from Miocene rocks and basement rocks of western San Emigdio Mountains east of San Andreas Fault (Davis



et al., 1988). The Formation is composed of pebbles, gravel, sand, and some cobbles. The Paso Robles Formation is sandwiched between two unconformities; it rests unconformably below the Older Alluvium and with angular discordance above the Morales Formation (Davis et al., 1988; Ellis, 1994). The Paso Robles Formation is present only in a small northeastern portion of the Basin.

Morales Formation

The Pliocene to Pleistocene-aged Morales Formation (Morales) is divided into two members, the upper and lower. The Morales Formation is the oldest formation to respond to the modern topography of the Basin, indicating its deposition simultaneous to acceleration of tectonic-driven subsidence (Yeats et al., 1989). The contact between the upper and lower members of the Morales is used to define the base of water-bearing units of the Basin (USGS, 2013a). The Younger and Older Alluvium, and Upper Morales Formation are the principal water-bearing formations in the Basin.

The Morales is massively bedded and ranges from 1,000 to 5,000 feet in thickness east of the Russell Fault and up to 1,200 feet thick west of the Russell Fault (USGS, 2013a; Cleath-Harris, 2018). ThicknessThe thickness of the Morales Formation is disputed amongst published references. In 1970, Singer and Swarzenski reported the Morales Formation to be up to 10,000 feet in thickness along the northern margin of the Valley (~~Singer and Swarzenski, 1970~~). The Morales Formation is found throughout the Valley and is widely exposed to the east of the Cuyama River near Ventucopa and the Cuyama Badlands. Its lateral extent is generally limited by faults. The Morales Formation is overlain unconformably by the older and Younger Alluvium (Hill, 1958).

Upper Morales

The upper member of the Morales is composed of partly consolidated, poorly sorted deposits of gravelly arkosic sand, pebbles, cobbles, siltstone, and clay of Pleistocene age (Davis et al., 1988). The upper Morales is a water-bearing unit and the base of this member marks the base of aquifer materials in the Basin. The upper Morales is thickest to the east near the Cuyama Badlands, approximately 2,200 feet, and shallows to the west, less than 800 feet west of the Russell Fault (Hill, 1958; Cleath-Harris, 2018). In the central portion of the Basin, south of the Cuyama River, the upper Morales is around 1,500 feet thick (Ellis, 1994). In some areas, such as near Ballinger Canyon, the Morales shows some degree of angular unconformity (Ellis, 1994).

Stratigraphic Units Below the Basin Aquifer

Lower Morales

The lower member of the Morales consists of clay, shale, and limestone with lacustrine clay beds with distinct coarse-grained intervals, boulder trains, and gravelly channel deposits (USGS, 2013a). The lower member of the Morales is finer grained than the upper Morales and is less permeable. The lower Morales is not considered a water bearing unit. South of the Cuyama River, the lower part of the Morales consists



of about 1,300 feet of gray, gypsiferous, lacustrine claystones (Hill, 1958). The lower Morales lies conformably on the Quatal Formation and, in western areas of the Basin, unconformably on other marine units (Ellis, 1994).

Quatal Formation

The Quatal Formation is a sequence of fluvial and lacustrine claystone, siltstone, and sandstone which unconformably underlies the Morales Formation. Near the Cuyama Badlands, the formation is up to 820 feet of gypsiferous claystone while in other areas the unit is nonmarine sandstones interbedded with the claystone (USGS, 2013a). The Quatal Formation thins to the west and pinches out to zero in thickness near the town of Cuyama. In the eastern and central parts of the Basin, the Quatal Formation is a distinct stratigraphic marker that defines the bottom of the Morales Formation (USGS, 2013a). The Quatal Formation is not a water bearing unit and is not considered a part of the Basin groundwater system.

Caliente Formation

The Caliente Formation is composed of nonmarine sandstones, claystones, and conglomerates of Miocene age (Davis et al., 1988). Layers of volcanic ash and basalt sills and dikes are commonly found in the formation and tertiary basalt is found interbedded with the formation in the Caliente Range (Davis, 1988; Dudek, 2016). The formation is exposed ~~on~~in the eastern half the Valley, along the Basin edge in the Caliente Ranges and in a footwall block of the Pine Mountain ~~f~~fault (Kellogg et al., 2008). The fluvial Caliente Formation was deposited in the east at the same time the marine Branch Canyon Sandstone and Santa Margarita Formation were being deposited to the west (Ellis, 1994). The Caliente Formation conformably overlies and interfingers with the marine sedimentary rocks of the Santa Margarita Formation and pinches out to zero thickness to the west (Kellogg et al., 2008; Davis et al., 1988).

Santa Margarita Formation

The Santa Margarita Formation is composed of shallow-marine, consolidated sandstones from the middle to late Miocene (USGS, 2013b). The formation contains a gypsum member and a sandstone-mudstone member. The gypsum member consists of a greenish-gray, medium to thin bedded gypsum, up to 82 feet thick (Kellogg et al., 2008). The sandstone and mudstone member consists of interbedded layers of arkosic sandstone, mudstone, and siltstone, up to 400 feet thick (Kellogg et al., 2008). The sandstone sequence is rich in shallow marine molluscan fossils. The formation unconformably underlies the Morales Formation in the northwest of the Valley and grades into the Caliente Formation to the east (Hill, 1958). Locally, the formation contains layers of volcanic ash, basalt sills, dikes and flow units (Davis et al., 1988). The Santa Margarita Formation is the youngest marine unit in the Basin and marks the final phase of marine sedimentation and sea transgression (Lagoe, 1981).



Monterey Formation

The Monterey Formation consists of intervals of dolomitic marine shale, mudstone, and siltstone. The formation is subdivided into two members: the upper Whiterock Bluff Shale member and the lower Saltos Shale member (Davis et al., 1988). The Whiterock Bluff Shale is a calcareous in the lower two-thirds and becomes gradually siliceous in the upper one-third and is found up to 1,200 feet in thickness (Bazeley, 1988; Hill, 1958). The Saltos Shale member is a calcareous shale with turbiditic sandstones and was deposited at the same time as the fluvial Caliente Formation, but in the western, bathyal portion of the Basin (Davis et al., 1988; USGS, 2013b). The Saltos Shale member is found up to 2,250 feet thick (Hill, 1958). The formation is middle Miocene in age and is cut with layers of volcanic ash and Miocene-age basalt sills (Davis et al., 1988). In the Caliente Mountain Range, Tertiary basalt is found interbedded with the Monterey Formation (Davis et al., 1988). To the east, the Monterey Formation grades into the Branch Canyon Sandstone. The formation is conformably overlain by the Santa Margarita Formation.

Branch Canyon Sandstone

The Branch Canyon Sandstone is Middle Miocene in age and is a shallow marine sandstone (Davis et al., 1988). Like the Monterey and Santa Margarita formations, the Branch Canyon Sandstone contains layers of volcanic ash and is cut by basalt sills and dikes (Davis et al., 1988). The sandstone grades into the Caliente Formation to the east and is up to 2,500 feet thick (Kellogg et al., 2008). The easternmost extent of the Branch Canyon Sandstone represents an early Miocene wave-dominated shoreline and is defined by the gradational change into the nonmarine Caliente Formation to the east (Davis et al., 1988; Bazeley, 1988).

Vaqueros Formation

Most of the oil produced in the Basin comes from the Vaqueros Formation. The formation is late Oligocene to early Miocene in age and is a marine clastic unit that is subdivided into three members: the upper, shallow-marine Painted Rock Sandstone member, the middle, bathyal Soda Lake Shale member, and the lower, shallow-marine Quail Canyon Sandstone member (Davis et al., 1988). The Vaqueros Formation represents a shallow-marine, high-energy, shoreface environment where the lower half represents a transgressive environment and the upper half represents a regressive environment (Bazeley, 1988). To the east, the Vaqueros Formation grades into the lower part of the nonmarine Caliente Formation. In the Cuyama Badlands, the Vaqueros Formation rests on the Simmler Formation and crystalline basement rocks, while in the central portion of the Basin, the Vaqueros Formation rests on Paleogene sedimentary rocks (Ellis, 1994). The Branch Canyon Sandstone and Monterey Formation are conformably above the Vaqueros Formation (Davis et al., 1988).

Simmler Formation

The Simmler Formation is a terrestrial sandstone, siltstone, and conglomerate of the Oligocene epoch (Davis et al., 1988). The Simmler Formation contains a shale member containing with intervals of



claystones and siltstones interbedded with coarse sandstones and a sandstone member containing sandstones interbedded with siltstones and claystones (Kellogg et al., 2008). The formation is as thick as 2,800 feet and overlies the Eocene-Oligocene unconformity (Kellogg et al., 2008). To the east, the Simmler Formation interfingers with a thin section of the marine Vaqueros Formation, marking the beginning of marine regression in the early to middle Miocene (Kellogg et al., 2008). Sediments of the Simmler Formation were sourced from the erosion of the Santa Barbara Canyon area and were deposited on a wide, delta plain (Bazeley, 1988). Though rare, the Simmler Formation can contain interbedded mafic volcanics (Yeats et al., 1989).

Marine Sedimentary Rocks

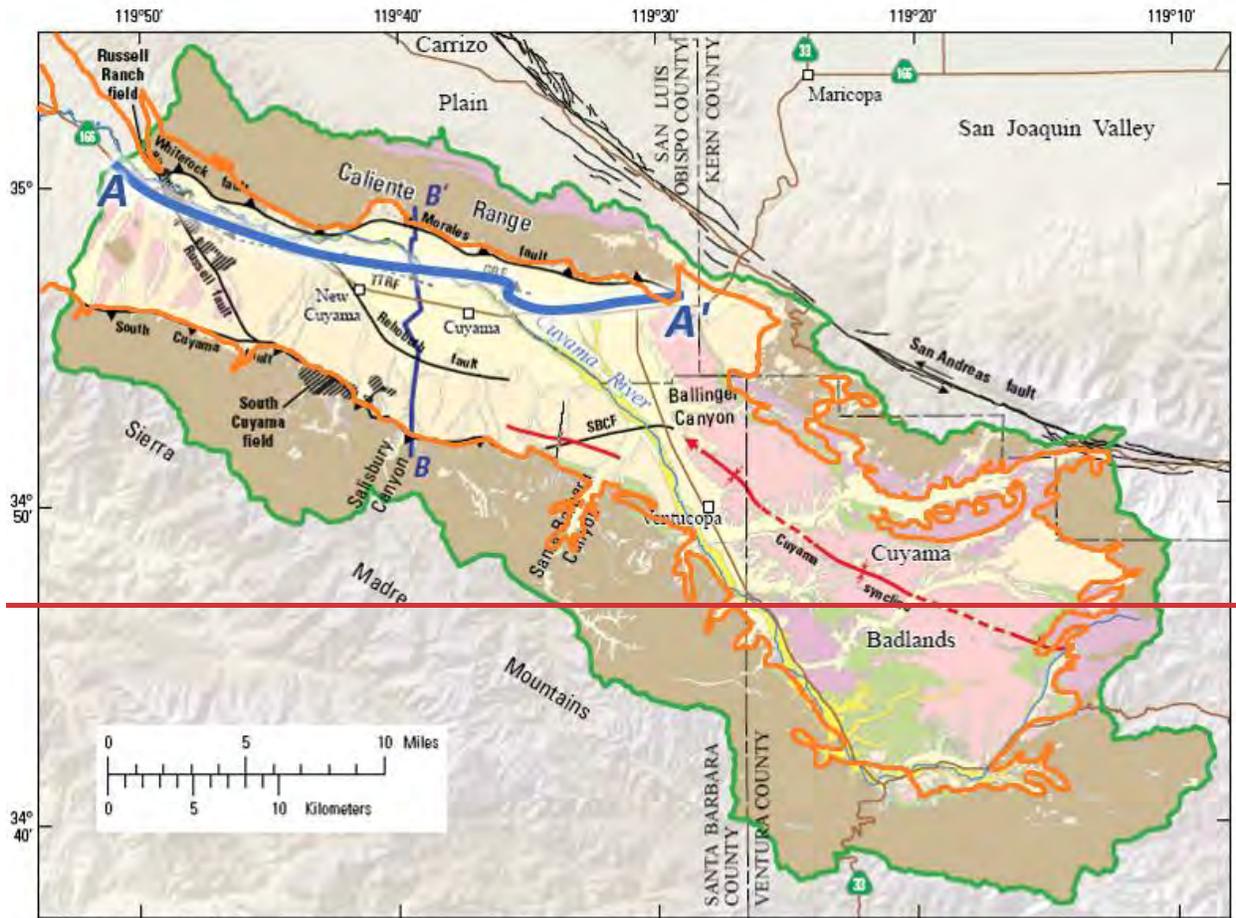
Late Cretaceous to Eocene marine rocks are unnamed but are part of the crystalline basement of the Cuyama Valley (Davis et al., 1988). The strata are unconformably overlain by a thick section of middle and upper Cenozoic rocks and are primarily exposed in the La Panza and Sierra Madres ranges and the hanging walls of the South Cuyama, La Panza, and Ozena faults (Davis et al., 1988).

Formations Older Than Marine Sedimentary Rocks

The crystalline rocks of the Cuyama Valley are composed of Mesozoic-age granitic rocks and Precambrian-age gneissic rocks (Davis et al., 1988). Cretaceous granitic rocks are exposed in the La Panza Range and near the San Andreas Fault, 12 to 18 miles southeast of the Cuyama Valley (USGS, 2013b). Precambrian granitic gneissic rocks outcrop east of the Cuyama Badlands and the La Panza Range (USGS, 2013b). Total thickness is unknown.

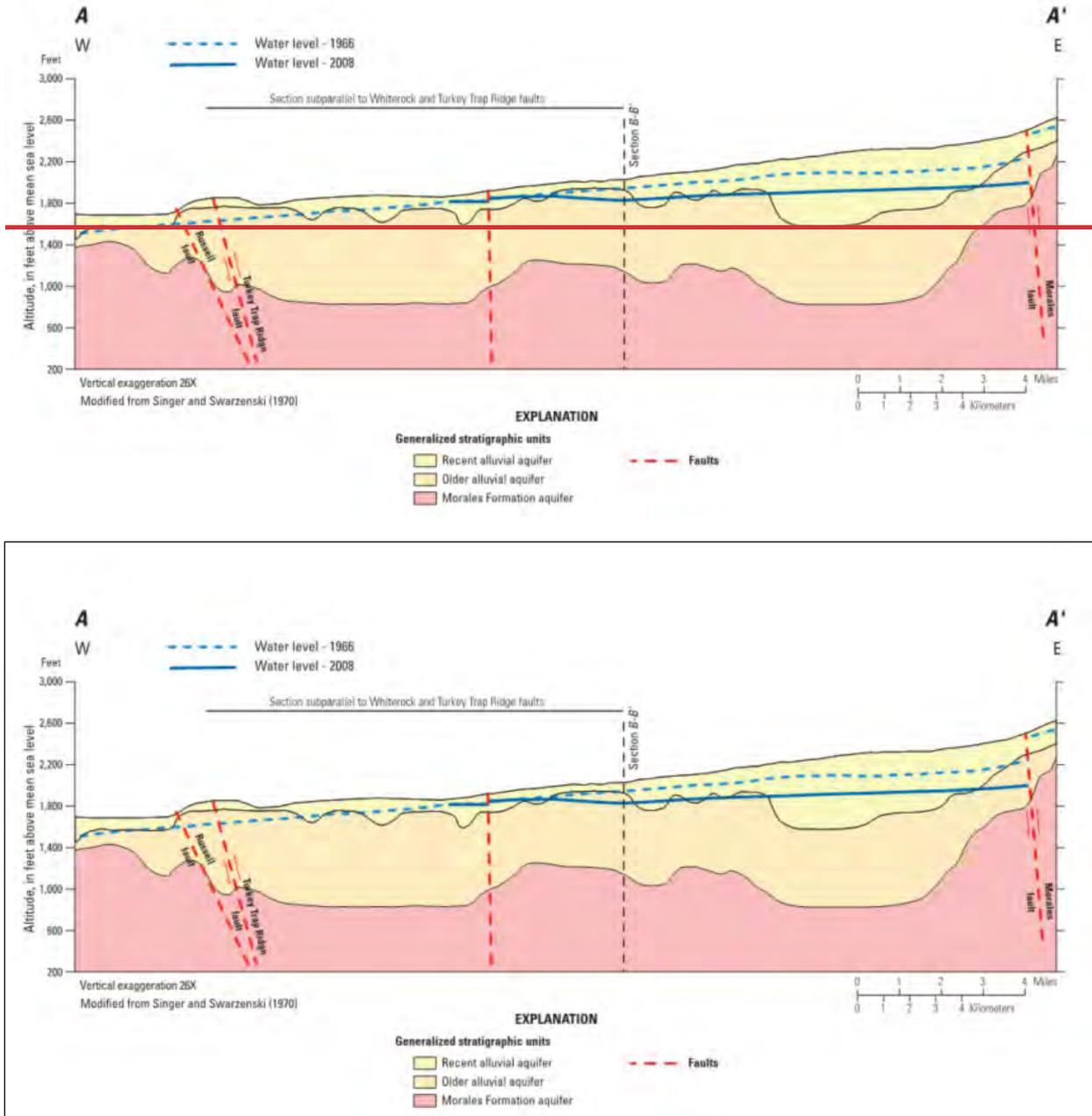
[Figure 2-5](#) shows the locations of cross sections across the central portion of the Basin prepared by the USGS in 2013. [Figure 2-5](#) shows a west-east cross section that runs near the towns of New Cuyama and Cuyama labeled A-A', and a south-north cross section labeled B-B'.

[Figure 2-6](#) shows the A-A' cross section and [Figure 2-7](#) shows the B-B' cross section. Cross-section A-A' shows the layering of Recent and Old alluvial aquifers and the Morales Formation aquifer. It also shows where the Russell Fault and Turkey Trap Ridge Fault cross the cross section, and shows groundwater elevation. [Figure 2-7](#) shows cross section B-B', which shows layering of the aquifers and the locations where the Rehoboth and Graveyard Ridge fault cross the cross section.



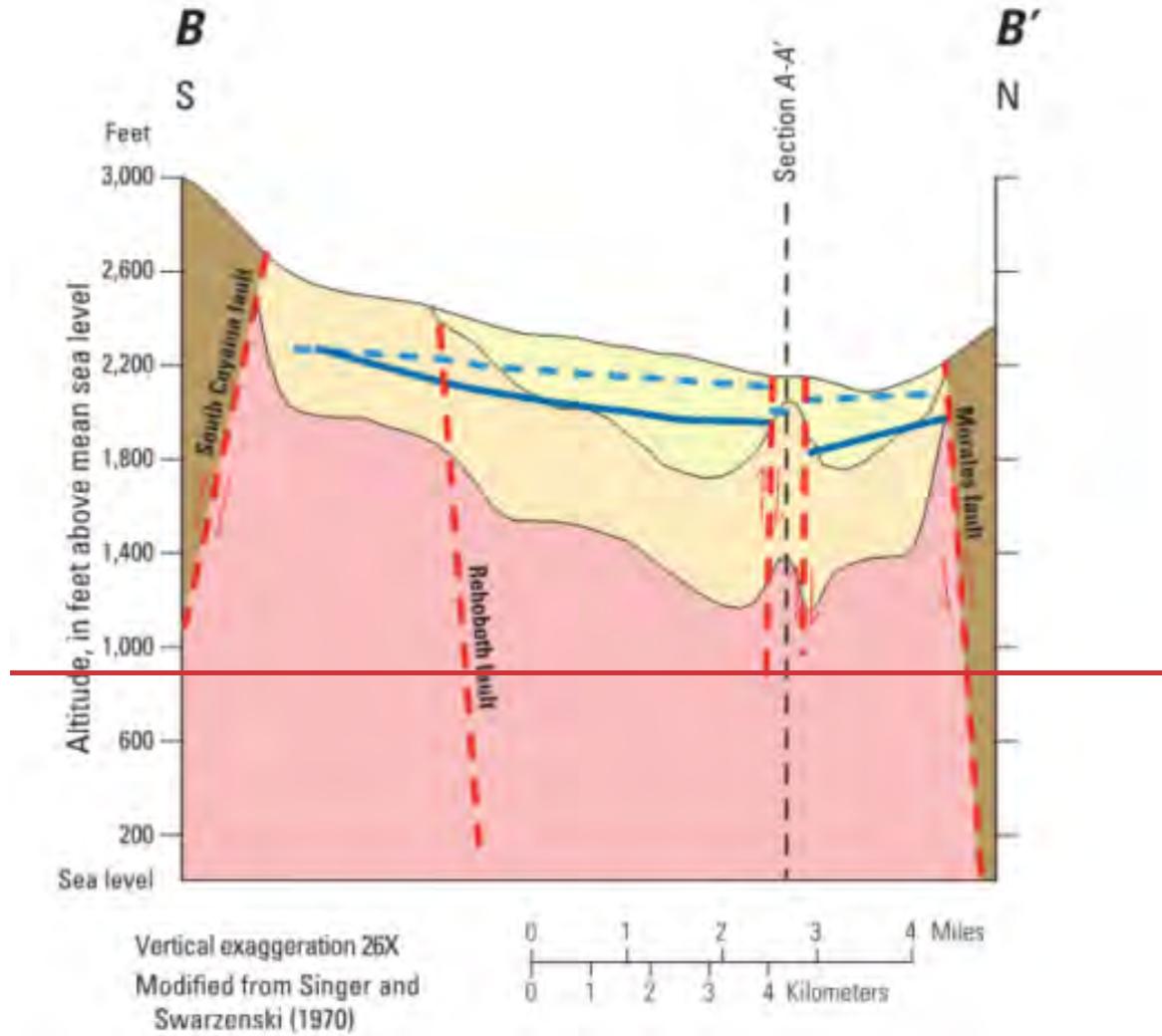
Shaded relief base created from 30-m digital elevation model from USGS National Elevation Dataset (NED); North American Vertical Datum 1983 (NAVD83)
 Hydrology sourced from 1:24,000-scale National Hydrography Dataset, 1974-2009
 Place names sourced from USGS Geographic Names Information System, 1974-2009
 San Andreas fault from Bryant (2005), Albers Projection, NAD83

<p>Generalized stratigraphic units</p> <ul style="list-style-type: none"> Qc, active channel Qya, young alluvium Qoa, older alluvium Qtm, Morales Formation BR1, Quatal Formation BR1, Caliente Formation BR2, bedrock unit 2 	<p>EXPLANATION</p> <ul style="list-style-type: none"> Normal fault Thrust fault Thrust fault, concealed Strike-slip fault Syncline, showing plunge direction Syncline, concealed Study-area boundary Oil field Line of section <p>GRF, Graveyard Ridge fault; SBCF, Santa Barbara Canyon fault; TTRF, Turkey Trap Ridge fault</p>
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Source: USGS, 2015

Figure 2-6: USGS Cross Section A-A'



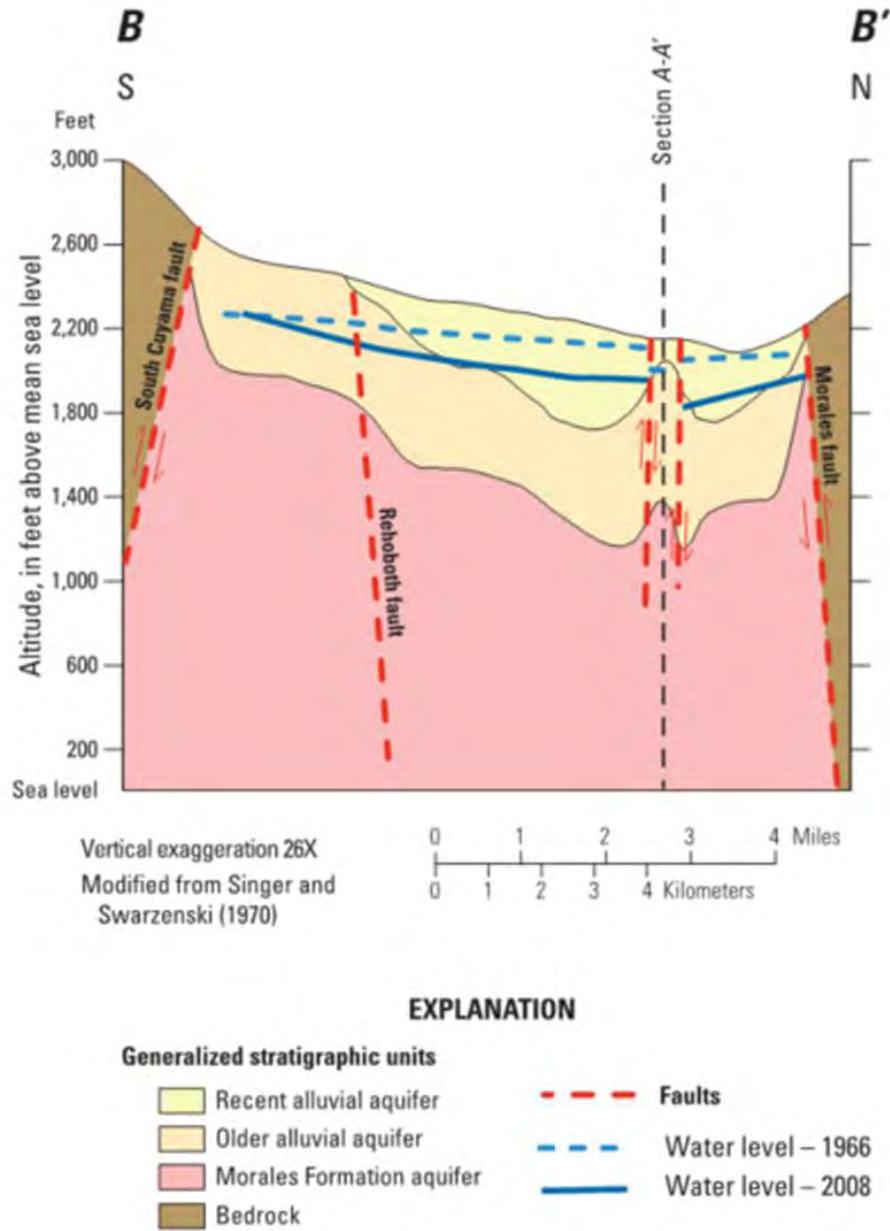
EXPLANATION

Generalized stratigraphic units

- Recent alluvial aquifer
- Older alluvial aquifer
- Morales Formation aquifer
- Bedrock

Faults

- Faults
- Water level – 1966
- Water level – 2008



Source: USGS, 2015

Figure 2-7: USGS Cross Section B-B'



2.1.5 Faults and Structural Features

The Basin is bounded by faults and contains a number of tectonic features including synclines, faults, and outcrops of basement rocks in the Basin. Major faults and synclines are shown in Figure 2-8. ~~Outerops~~ shows outcrops of basement rocks are shown on the geologic maps ~~(Figure 2-2 (and Figure 2-5 Figure 2-5)).~~

Synclines

There are a number of synclines in the Basin; they are generally oriented to the northwest/southeast consistent with how the majority of the Basin is oriented.

Cuyama Syncline

The Cuyama Syncline is located in the southeastern portion of the Basin. It stretches from the Ballinger Canyon south into the Cuyama Badlands, ending along the Cuyama River. The Cuyama Syncline plunges from the Ventucopa area northwestward to beneath the valley from the Ventucopa area to the southeast. The syncline is known from subsurface data from oil exploration wells beneath the valley and exposures near the town of Ventucopa and in the Cuyama Badlands. (USGS, 2013a). The axis of the syncline strikes roughly parallel to the San Andreas Fault (N50°W) and plunges to the northwest (13°NW) (Singer and Swarzenski, 1970; Ellis, 1994). The Cuyama syncline was a depocenter (a site of sediment accumulation) during the deposition of the Morales Formation (Ellis, 1994). The syncline has folded water and non-water bearing formations and is favorable to the transmission of water from the southeast end of the valley but otherwise has no pronounced effect on the occurrence of groundwater (Upson and Worts, 1951).

Syncline Near the Santa Barbara Canyon Fault

Near the Santa Barbara Canyon Fault, Aa syncline is indicated by the USGS ~~(2013a)~~. The syncline runs generally east-west and is roughly five miles long. It ends near the southern edge of the South Cuyama ~~fault (USGS, 2013a)~~ Fault.

Syncline in the ~~NSo~~ r ~~u~~ thwestern Portion of the Basin

There is a syncline in the western portion of the Basin that roughly follows a west-northwest direction near the southern border of the Basin, located southwest of the Russel ~~f~~ F fault, near an outcrop of the Santa Margarita formation (Cleath-Harris, 2018). The full extent of this syncline, and its length are not documented at this time, but likely extends 5 to 10 miles, which is the length of documented ~~f~~ F faults in the area, as mapped by Dibblee ~~(Dibblee, (2005)).~~



Major Faults

There are a number of faults within the Basin, many of which take the form of ‘fault zones’ where there are multiple individual faults close together oriented in the same direction. This section describes each major fault individually, with consideration that there are often additional small faults near each major fault. Major faults are shown in Figure 2-8.

Russell Fault

The Russell fault is a subsurface, right lateral, strike-slip fault that is ~~7~~seven miles long and runs roughly parallel to the Russell Ranch oil field through the western portion of the Basin.

The Russell fault offsets the top of bedrock by as much as 1,500 feet (Nevins, 1982), ~~and has had approximately 18 miles of right lateral offset documented on the~~. The NW-striking Russell fault in the northwestern part of the Cuyama Valley ~~has had approximately 18 miles of right-lateral offset that~~ occurred between 23 and 4 Ma (USGS, 2013a; Ellis, 1994). The fault is referred to as strike-slip by several authors, and normal fault by others, and is sometimes referred to as both strike-slip and normal ~~within fault in~~ the same document (USGS, 2013a). Water bearing units on the western (upthrown) side of the Russell fault become thinner to the west ~~of the Russell Fault~~ and become thicker to the east ~~of the Russell Fault~~ due to this uplift. Alluvium is generally limited to stream channels and the Cuyama River bed on the western side of the fault.

The Russell fault has been analyzed by a number of authors who have come to ~~different~~ conclusions regarding the fault’s potential to be a barrier to groundwater flow. In 1989, Yeats stated that “the base of the Morales Formation is not cut by the fault” (~~Yeats et al., 1989~~). Using tectonic activity and decreasing offset of younger beds, Yeats concluded that the Vaqueros Formation is primarily impacted as it was deposited during the fault’s most active period and that by the time the Morales Formation was deposited 19 million years later, activity on the fault had ceased (Yeats et al., 1989). ~~The USGS in 2008 initially concluded that the fault was not a barrier to flow (USGS, 2013c). The USGS in 2013~~ In 2013, the USGS studied the fault using interferometric synthetic-aperture radar (InSAR) data and concluded that “the Russell fault did not appear to be acting as a barrier to groundwater flow” (USGS, 2013c). In 2015, the USGS identified the Russell fault as a barrier to flow and used it as a no flow boundary in the Cuyama Valley Hydrologic Model (CUVHM) (USGS, 2015). Based on the conclusions of the USGS, Dudek stated that the fault has indicators that it obstructs groundwater flow due to truncation of older geologic formations and standing moisture near the fault and prepared a basin boundary modification request based on the conclusion that the fault is a barrier to flow (Dudek, 2016). In addition, Cleath-Harris ~~determined~~ Geologists concluded that the fault is a barrier to flow and prepared a technical memorandum to document their study of the fault’s behavior (Cleath-Harris, 2018). In 2016, DWR denied a request for a ~~Basin boundary modification~~ motivated by based on claims that the Russell fault is a barrier to groundwater flow and divides groundwater in the central portion of the Basin from groundwater in the west. ~~DWR rejected the Basin boundary modification request~~, citing a lack of hydrogeologic data that supported evidence of barrier. EKI Environment & Water, Inc. (EKI) reviewed the USGS’s work in 2017



and concluded the fault potential to be a barrier is not understood and recommended additional study to refine the fault's properties (EKI, 2017).



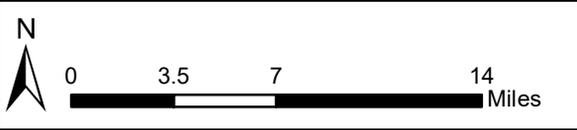
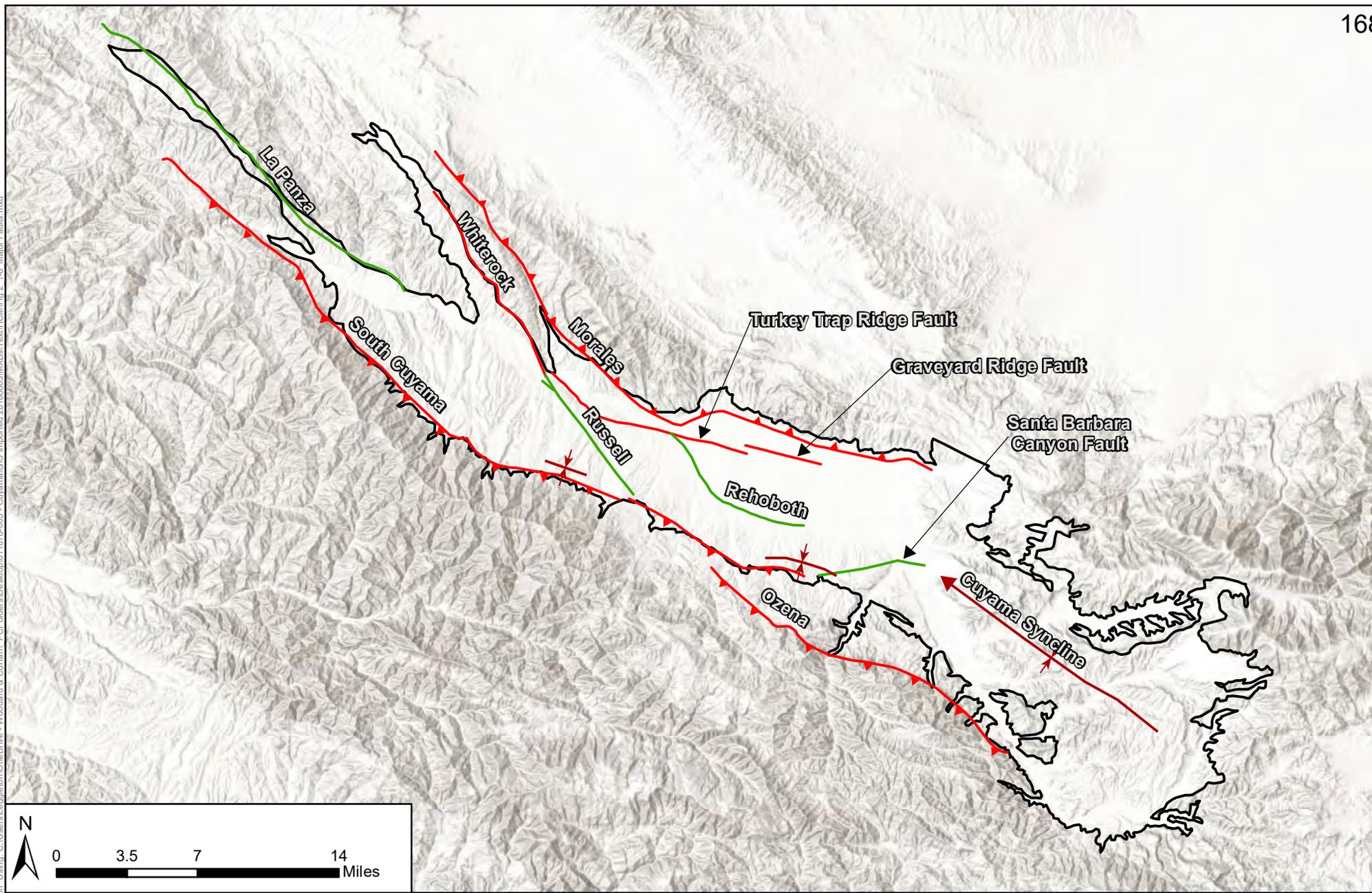


Figure 2-8: Major Faults

Cuyama Basin Groundwater Sustainability Agency
 Cuyama Valley Groundwater Basin Groundwater Sustainability Plan
 December 2019



Legend

Fault Types

- Normal
- with cross: Syncline
- Thrust
- - - Thrust Fault, Concealed

Cuyama Basin



Rehoboth Fault

The Rehoboth ~~f~~Fault is a normal, subsurface fault that bisects the central portion of the Basin. The fault is approximately ~~8~~eight miles long and trends to the ~~east~~-southeast. The USGS concluded that evidence of the fault is inferred based on water level-changes in the west-central part of the valley and offset of the Morales Formation (USGS, 2013b; USGS, 2013a). The top of the Morales Formation is offset 160 feet on the northeast side of the fault and the offset increases with depth (USGS, 2013a). Surface exposures of the Older Alluvium do not appear to be offset along the trace of the fault, indicating the motion of the Rehoboth ~~f~~Fault ceased prior to the deposition of the ~~e~~Older and Younger Alluvium (USGS, 2013a).

Despite stating that the Rehoboth ~~f~~Fault does not “have a discernible effect on the elevation” of the Older ~~Alluvium~~ and Younger Alluvium and that the fault was “not a significant barrier to groundwater flow” as symmetrical subsidence and uplift was observed on both sides of the fault, the USGS included the Rehoboth ~~f~~Fault as a leaky, horizontal barrier to groundwater flow in the CUVHM (USGS, 2013a; USGS, 2013b; USGS, 2015). In the CUVHM, the Rehoboth ~~f~~Fault impedes underflow in the Older Alluvium and Morales Formation along the Sierra Madre Foothills region (USGS, 2015). The USGS also listed the Rehoboth ~~f~~Fault as affecting the ~~y~~Younger and Older Alluviums and the Morales Formation in a summary table of “Geologic Units affected by Cuyama Valley faults” (USGS, 2013a).

Whiterock Fault

The Whiterock ~~f~~Fault is a surface and subsurface thrust fault that runs along the northern finger ~~in the western part~~ of the Cuyama Basin. The fault can be traced further south under the Basin near the Cuyama River and ~~the Russell Fault and~~ State Route (SR) 166, though it is ~~subsurfaceburied~~ (Calhoun, 1985). The fault dips northeast and is late Oligocene to early Miocene in age (Davis et al., 1988). The Whiterock ~~f~~Fault is exposed at the surface where it thrusts the Monterey Formation over the Morales Formation (Davis et al., 1988). Activity along the fault began after movement ceased on the Russell ~~f~~Fault and tectonically overrides the Russell ~~f~~Fault (Nevins, 1982; Calhoun, 1985). The fault cuts the Morales Formation south of the Cuyama River but does not affect the ~~y~~Younger or Older Alluviums (DeLong et al., 2011; Nevins, 1982).

Turkey Trap Ridge Fault and Graveyard Ridge Fault

The Turkey Trap Ridge ~~f~~Fault and the Graveyard Ridge ~~f~~Fault are normal, subsurface faults that trend slightly north of west in the ~~west-center part~~ of the Cuyama Valley (USGS, 2013a). The primary difference between the two faults is that the Turkey Trap Ridge ~~f~~Fault is 11 miles long and located southwest of the Graveyard Ridge ~~f~~Fault; the Graveyard Ridge ~~f~~Fault is ~~4~~four miles long. Both faults are located north of SR 166 and are oriented in a “left-stepping, echelon pattern” (USGS, 2013a). Seismic reflection profiles collected along the ridges indicate they are bounded by north-dipping, south-directed, reverse faults along the south sides (USGS, 2013a). Both faults are considered to be barriers to groundwater ~~flow~~. Evidence of the faults and their no-flow zones include springs and seeps along the base



of the faults in the 1940-50s and water-level changes across the faults of 80 to 100 feet in the area near these ridges (Upson and Worts, 1951; Singer and Swarzenski, 1970).



~~In 1970~~, Singer and Swarzenski (1970) reported that water removed by pumping from this region was slow to replenish because the faults restrict movement of water from neighboring areas. The impediment to flow could be related to the hydraulic properties of the faults themselves or fault juxtaposition of older, slightly less permeable Older Alluvium to the north against Younger Alluvium to the south of the faults (USGS, 2013a).

South Cuyama Fault

The South Cuyama ~~f~~Fault is a surficial, thrust fault that defines a 39-mile stretch of the Basin's southwestern boundary. The fault thrusts the Eocene-Cretaceous aged marine sediments against the Older Alluvium and Morales Formation and impedes groundwater flow across the fault zone.

Ozena Fault

The Ozena ~~f~~Fault is a 17-mile long surficial, thrust fault located ~~3~~three miles south of the Cuyama Basin and locally cuts through the southeastern canyons of the Basin. Less than ~~1~~one mile of the Ozena ~~f~~Fault is within the ~~Cuyama~~ Basin boundary. The fault trends west to northwest and runs parallel to the Basin boundary.

Santa Barbara Canyon Fault

The Santa Barbara Canyon ~~f~~Fault is a normal, subsurface fault ~~that runs 5 miles perpendicular to with a northeast strike near the opening of~~ the Santa Barbara Canyon. The fault ~~is east-west striking and~~ offsets ~~b~~Basin deposits with impermeable Eocene-Cretaceous marine rocks (typically the Simmler and Vaqueros Formations) (Bazeley, 1988). Evidence of the fault comes from reported seasonal springs, a steep hydraulic gradient in the southeastern part of the Cuyama Valley near the fault, and the truncation of distinct gravel beds (Singer and Swarzenski, 1970). ~~Water levels~~Groundwater elevations in the Ventucopa area have been reported ~~98~~110 feet higher than water levels to the north (Singer and Swarzenski, 1970). ~~The fault is considered a barrier to groundwater flow as it prevents groundwater flow from moving across~~In 2013, the ~~boundary bounded by the marine rocks~~ (USGS, 2015). The USGS in 2013 also concluded that the Santa Barbara Canyon ~~f~~Fault was a barrier to groundwater flow: “Relatively small amount of vertical offset in the Santa Barbara Canyon ~~f~~Fault indicates changes in water levels across the fault documented in previous studies are perhaps the result of distinct fault-zone properties rather than juxtaposition of units of differing water-transmitting ability” (USGS, 2013a). ~~In 2015, the USGS also considered the fault to be a barrier as it prevents groundwater flow from moving across the boundary bounded by the marine rocks~~ (2015).

La Panza Fault

The La Panza ~~f~~Fault is a surficial thrust fault that trends west to northwest along 22 miles of the western margin of the Basin (USGS, 2013b). The present day thrust fault is a reactivated Oligocene extensional fault that was once part of the same system with the Ozena ~~f~~Fault (USGS, 2013b; Yeats et al., 1989). The



fault defines the west-central margin of the Basin as it juxtaposes older non-water bearing Eocene to Cretaceous marine rocks and the Simmler Formation against the younger, water bearing alluvium and Morales Formation, impeding groundwater flow across the fault.

Morales Fault

The Morales fault is a 30-mile-long thrust fault that forms the boundary along the north-central portion of the Basin. The Morales thrust fault has a dip of approximately 30 degrees (Davis et al., 1988).

Unnamed Fault Near Outcrop of Santa Margarita Formation

A fault located southwest of the Russell fault runs southeast to northwest and is located next to an outcrop of the Santa Margarita Formation inside the Basin (Dibblee, 2005). The fault runs parallel to the long side of the outcrop and bounds the syncline that is to the south of the outcrop. The fault's extent is not well documented, and its surficial exposure is roughly five miles long.

Outcrops of Bedrock Inside the Basin

There are a number of outcrops of non-aquifer material within the Basin. The outcrops occur primarily in the eastern upland portion of the Basin and the western portion, near and to the west of the Russell Fault. Outcrops of basement rock in the western portion of the Basin occur in a different manner than those in the eastern portion, outcrops in the eastern portion are likely depositional contacts with the Morales Formation that were missed during basin delineation by DWR.¹ Outcrops in the western portion are likely tied to tectonic activity and faulting.

Outcrops of basement rock in the eastern upland portion of the Basin are shown in Figure 2-2. The Quatal Formation and the Caliente Formation are present within the Basin boundary near the edges of the Basin. The Quatal Formation is exposed at the surface near the Cuyama River, and at the higher elevation portions of the Basin, and in a band near the Quatal Canyon. The Caliente Formation is exposed at the surface within the Basin in the northeast portion of the Basin, near and along the Quatal Canyon. Another outcrop of Caliente Formation is present near the Cuyama River, but that outcrop has been excluded from the Basin during the Basin's delineation by DWR and is visible in Figure 2-2.

Figure 2-2_ Outcrops of basement rock in the western portion of the Basin are exposed at the surface in limited areas and are tied to tectonic activity in the area.

¹ DWR delineates basins based on the type of restrictions to groundwater flow. The boundaries of the Cuyama Basin were delineated by DWR because they were the boundary between permeable sedimentary materials (within the Basin) and impermeable bedrock (outside the Basin). DWR defines this boundary as "Impermeable bedrock with lower water yielding capacity. These include consolidated rocks of continental and marine origin and crystalline/or metamorphic rock."

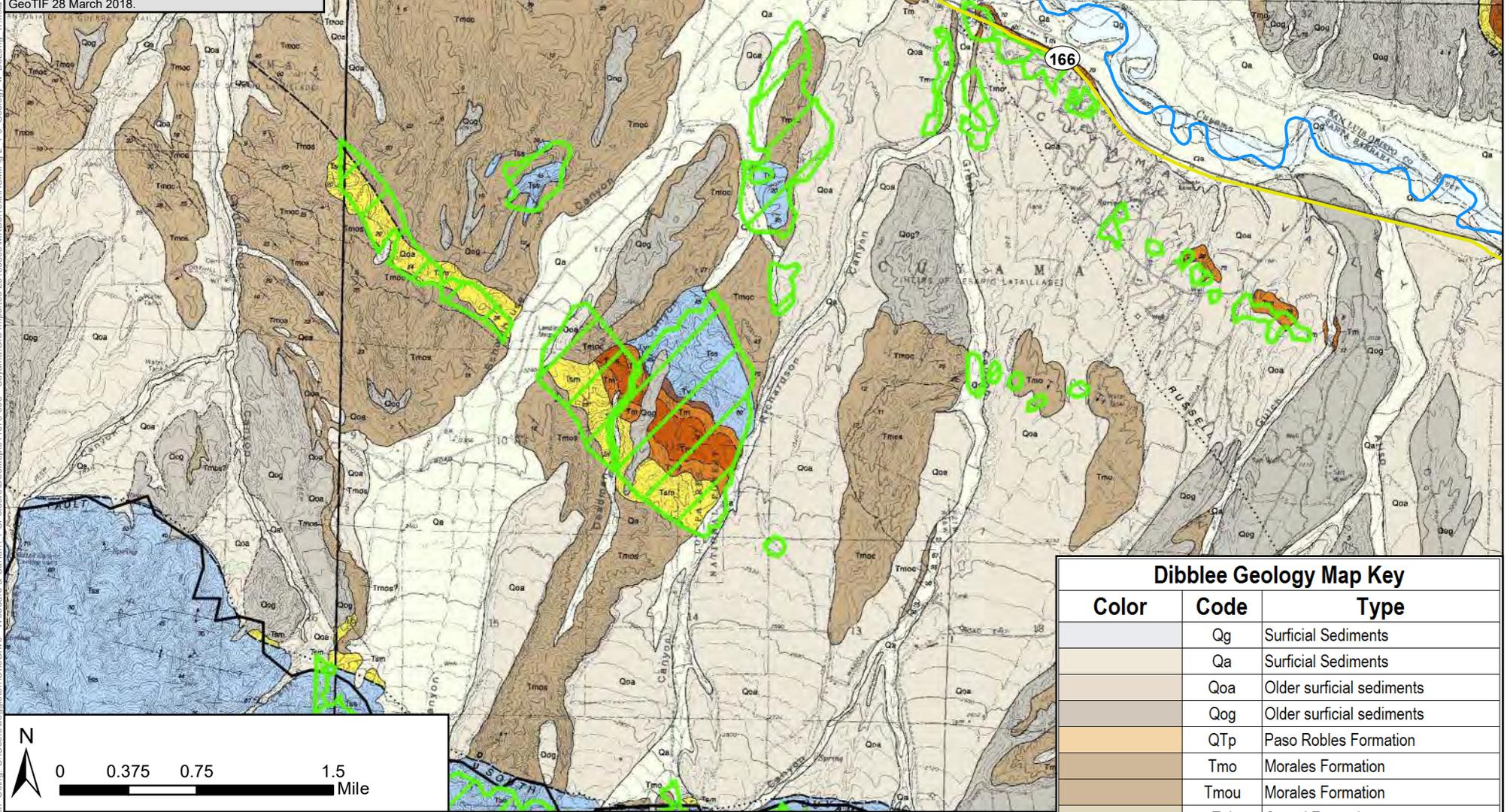


Figure 2-9 shows the outcrops of bedrock near the Russell Fault with an overlay of areas identified by DeLong as “Tr,” or out of basin bedrock, overlain on the geologic mapping performed by Dibblee. In general, the outcrops identified by DeLong and Dibblee largely overlap and indicate that in separate field study efforts, the outcrops were identified independently by different geologists. As shown in



~~Figure 2-9~~, Figure 2-9 outcrops of non-aquifer materials are present near the Russell Fault, next to the Cuyama River, as well as to the south of the Cuyama River, both in small outcrops that are partially linear in nature, and larger outcrops that are located next to faults, such as where the Santa Margarita, ~~and~~ Monterey ~~Formations~~ and Marine Sedimentary ~~Formations~~ ~~Rocks~~ are present. The presence of these non-aquifer materials in this area likely restricts groundwater movement by limiting the extent of permeable materials in this portion of the Basin.

Data Sources:
 De Long: Climate change triggered sedimentation and progressive tectonic uplift in a coupled piedmont-axial system: Cuyama Valley, California, USA. Stephen B. DeLong, Jon D. Pelletier, and Lee J. Arnold Earth Surface Processes and Landforms Earth Surf. Process. Landforms 33, 1033-1046 (2008) Published online 13 September 2007 in Wiley InterScience (www.interscience.wiley.com) DOI: 10.1002/esp.1600
 Dibblee: Thomas W. Dibblee, Jr., Dibblee Foundation, Released in June 2012, Purchased from AAPG as GeoTIF 28 March 2018.



Dibblee Geology Map Key

Color	Code	Type
	Qg	Surficial Sediments
	Qa	Surficial Sediments
	Qoa	Older surficial sediments
	Qog	Older surficial sediments
	QTp	Paso Robles Formation
	Tmo	Morales Formation
	Tmou	Morales Formation
	Tql	Quatal Formation
	Tc	Caliente Formation
	Tsm	Santa Margarita Formation
	Tm	Monterey Formation
	Tvl	Vaqueros Formation
	Tvq	Vaqueros Formation
	Tss	Marine Sedimentary Rocks,



Figure 2-9: Geology with De Long "Tr" Overlay

Cuyama Basin Groundwater Sustainability Agency
 Cuyama Valley Groundwater Basin Groundwater Sustainability Plan
 December 2019



Legend

- Cuyama Basin
- De Long Geology "Tr" - Out of Basin Bedrock
- Highways
- Cuyama River

Figure Exported: 8/21/2018 8:00 AM Using: C:\Users\scapleton\OneDrive - Woodard & Curran\PCF\Projects\Geoplot\OneDrive - Woodard & Curran\GIS\Imported\20180803\MXD\Text\Tr.tif Fig 2 1-9 Geology w DeLong Tr.mxd



Additional Analysis Since GSP was submitted

Airborne Electromagnetic Surveys

In order to better characterize the subsurface hydrogeology in the Basin, DWR coordinated a regional Airborne Electromagnetic Survey (AEM). This survey was performed in August 2021 and involved scanning the Basin with helicopter-mounted geophysical equipment to measure electrical resistivity at depths of up to 1,500 feet bgs. Twenty-three survey lines were performed with one line run generally parallel to the Cuyama River and the remaining lines running perpendicular to the river valley in order to generate a 3-D cross sectional model of the basin. Figure 2-10210 shows the distribution of AEM survey flights over the Basin.

The resulting raw survey data was processed by Ramboll on behalf of DWR and provided to the public. The released data was provided in cross sectional resistivity as well as interpreted ratios of sand vs fines. Woodard & Curran staff analyzed the public AEM data in both formats to generate a more refined conceptual model of the Basin. The AEM data were used to improve the design of the layering in the CBWRM Model, as well as model parameterization and calibration. Lithology data gathered from well logs were correlated with the AEM data as well as general knowledge of the geology of the Basin from previous USGS work was also used. Faults were also identified in the AEM survey and were taken into consideration in refining model layering and hydraulic conductivity. Figure 2-11214 shows several flight lines in the southeastern portion of the Basin as red lines on an aerial photograph. The figure also shows the 3D representation of resistivity along those lines to the depth of investigation. The resistivity scale indicates low readings in blue and high readings in red.

CBGSA Investigation of Russell and Santa Barbara Canyon Faults

The CBGSA authorized Woodard & Curran to conduct a streamlined investigation of the Santa Barbara Canyon Fault in the southeastern portion of the Basin and the Russell Fault in the western portion of the Basin. These faults have been analyzed by a number of authors who have come to different conclusions regarding the potential of the faults to be a barrier to groundwater flow, particularly the Russell Fault. The investigation consisted of several components with surface geophysical surveys being the primary component. Spectrum Geophysics of Huntington Beach, California was retained to conduct the surveys and analyze the data.

The surface geophysical surveys were designed to evaluate the depth of the buried faults since both are reportedly inactive and buried by alluvium after movement ceased, the orientation and historic movement (i.e., normal, strike-slip, or thrust), the juxtaposition of formations with different water transmitting capacities resulting from past movement, and evidence of the presence of groundwater on both sides of the faults and flow across them.

The study consisted of two transects (or lines) across the mapped locations of the faults with lengths of 3,000 to 3,600 feet to achieve investigation depths of 600 to 800 feet bgs. The linear transects were laid out roughly perpendicular to the faults, subject to land access (private and government) and terrain.



Electrodes were attached to steel stakes that were spaced 10 meters (roughly 30 feet) apart and driven about 18 inches into the ground. The surveys were conducted using direct current (DC) electrical resistivity (ER) and induced polarization.

The transects for the Santa Barbara Canyon Fault are shown in Figure 2-12. Line 1 was oriented southeast to northwest and located on the east side of Highway 33 in the right-of-way. The work was conducted under an encroachment permit from Caltrans. Line 2 was oriented south to north and located in the floodplain and bed of the Cuyama River. The work was conducted pursuant to a Categorical Exemption from the U.S. Bureau of Land Management. Profiles of ER for Line 1 and Line 2 are shown in Figure 2-13. Similarly, profiles of induced polarization for both lines are shown in Figure 2-14.

The ER data on Line 1 shows relatively laterally continuous lithology across the profile. The inferred location of the fault by the USGS was not present. Depth to groundwater was about 600 feet bgs based on information from monitoring well MW-H (Opti 915 and 916) that was recently constructed within Line 1. In contrast, the ER data on Line 2 shows abrupt lateral changes that are interpreted to be faults. The Santa Barbara Canyon Fault was identified as a vertical/subvertical north-dipping fault near the mid-point of the transect at a depth of about 212 feet bgs. A younger, unnamed south-dipping thrust fault was detected a short distance to the south. This younger fault appears to be thrusting Lower Morales over the Upper Morales. Depth to groundwater south of this fault is 50 to 100 feet bgs and markedly lower to the north. Water bearing zones were not observed north of the buried Santa Barbara Canyon Fault to the investigation depth of about 600 feet bgs.

The locations of these faults are shown in Figure 2-12. It appears the Santa Barbara Canyon Fault extends further to the northeast rather than bend distinctly to the east as reported. Interpretation of this data set indicates that the fault zone/system offsets both the Lower and Upper Morales as well as deep alluvium, contrary to published literature.

The transects for the Russell Fault are shown in Figure 2-15. Locations were restricted to avoid bedrock outcrops, the deeply incised and meandering Cuyama River channel, and oil field operations immediately east of the fault. Line 1 and Line 2 were oriented southeast to northwest oblique to the mapped location of the fault. The transects extended from the Russell Ranch east of the fault to the North Fork Ranch to the west. Natural vegetation was more extensive on the North Fork Ranch. Cultural interferences included a barbed wire fence between the private properties, oil wells, and pipelines. The ER profiles for Line 1 and Line 2 are shown in Figure 2-16. The induced polarization profile for Line 1 is shown on Figure 2-17.

The ER data on Line 1 shows abrupt lateral changes in resistivity that are interpreted to be faults. The vertical anomaly at the mid-point of the transect is interpreted to be the vertical Russell Fault that extends upward to a depth of 50 feet bgs. A likely younger, apparent east-dipping thrust fault east of the Russell Fault is interpreted to be the Turkey Trap Ridge Fault. This interpretation is consistent with mapping of the Russell, Turkey Trap Ridge, and Whiterock faults in this area by the USGS (2015). The Lower Morales has been mapped east of the Russell Fault. A similarly very low resistivity unit is interpreted to be the Lower Morales west of the fault overlying the older Monterrey Formation. The younger Turkey



Trap Ridge Fault appears to be thrusting the older Monterrey Formation over the Lower Morales west of the fault. Groundwater appears to be about 50 feet bgs across the profile. The extent of saturated alluvium is greater east of the fault zone/system.

Abrupt lateral changes in resistivity are also observed on Line 2. The vertical Russell Fault and apparent east-dipping thrust fault east of the Russell Fault interpreted to be the Turkey Trap Ridge Fault are shown. Another thrust fault appears to be thrusting the Lower Morales over the more deeply buried Russell Fault and Monterrey Formation west of the fault. Groundwater appears to be about 40 feet bgs across Line 2 which is closer to the Cuyama River.

The locations of these faults are shown in Figure 2-15. Interpretation of this data set indicates that the Russell Fault offsets the Morales and deep alluvium, contrary to published literature. The Turkey Trap Ridge Fault offsets both the Upper and Lower Morales and deep alluvium. Similar to the investigation of the Santa Barbara Canyon Fault, this geophysical survey identified a more complex fault system than previously reported in published literature.

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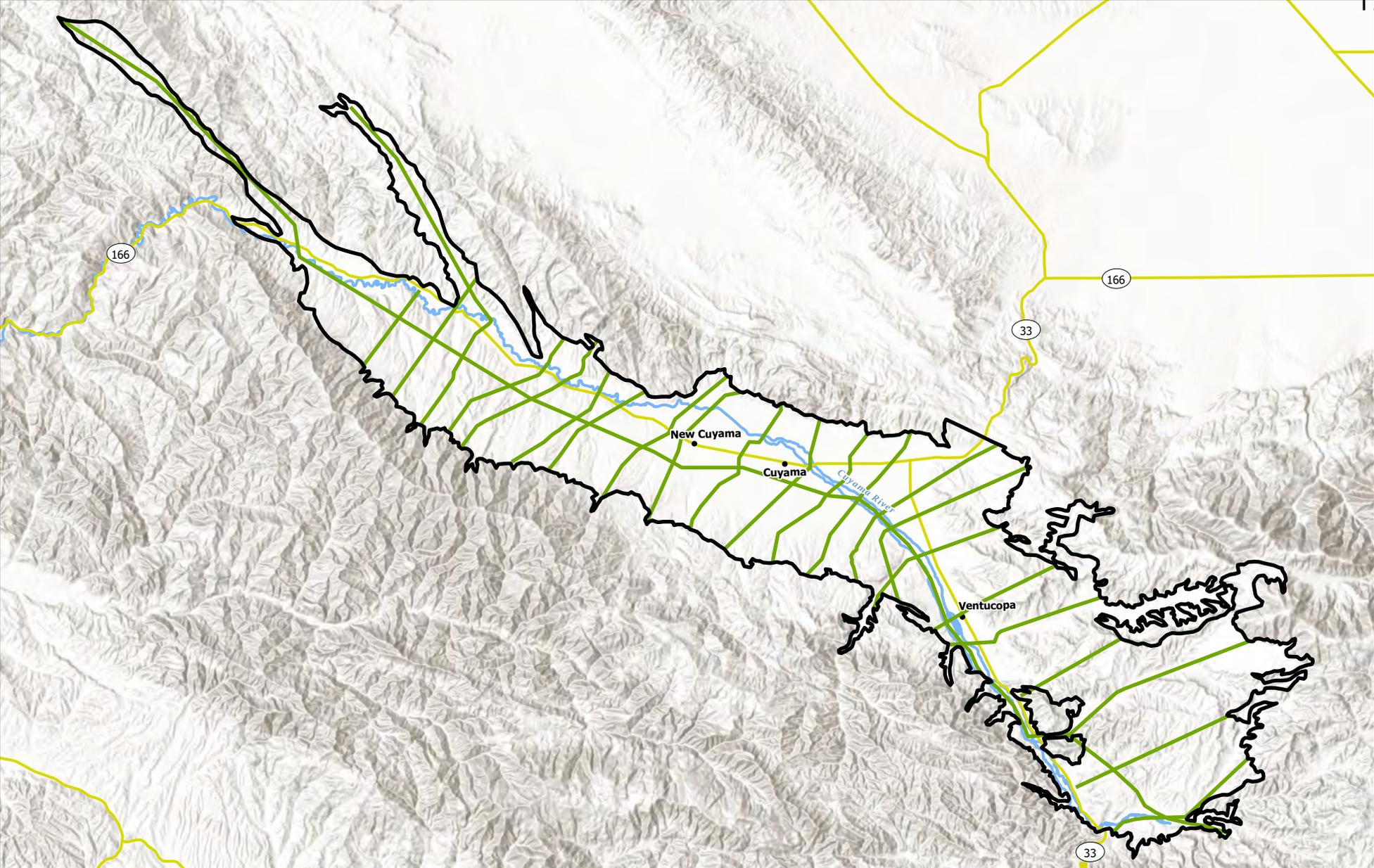


Figure 2-10: Distribution of AEM Flight Lines

Cuyama Valley Groundwater Basin

Legend

- Highway
- Cuyama River
- Cuyama Basin
- AEM Flight Lines
- Town



0 1.75 3.5 7 Miles

Map Created: July 2024

Third Party GIS Disclaimer: This map is for reference and graphical purposes only and should not be relied upon by third parties for any legal decisions. Any reliance upon the map or data contained herein shall be at the users' sole risk. **Data sources: CA DWR, Esri, USGS**

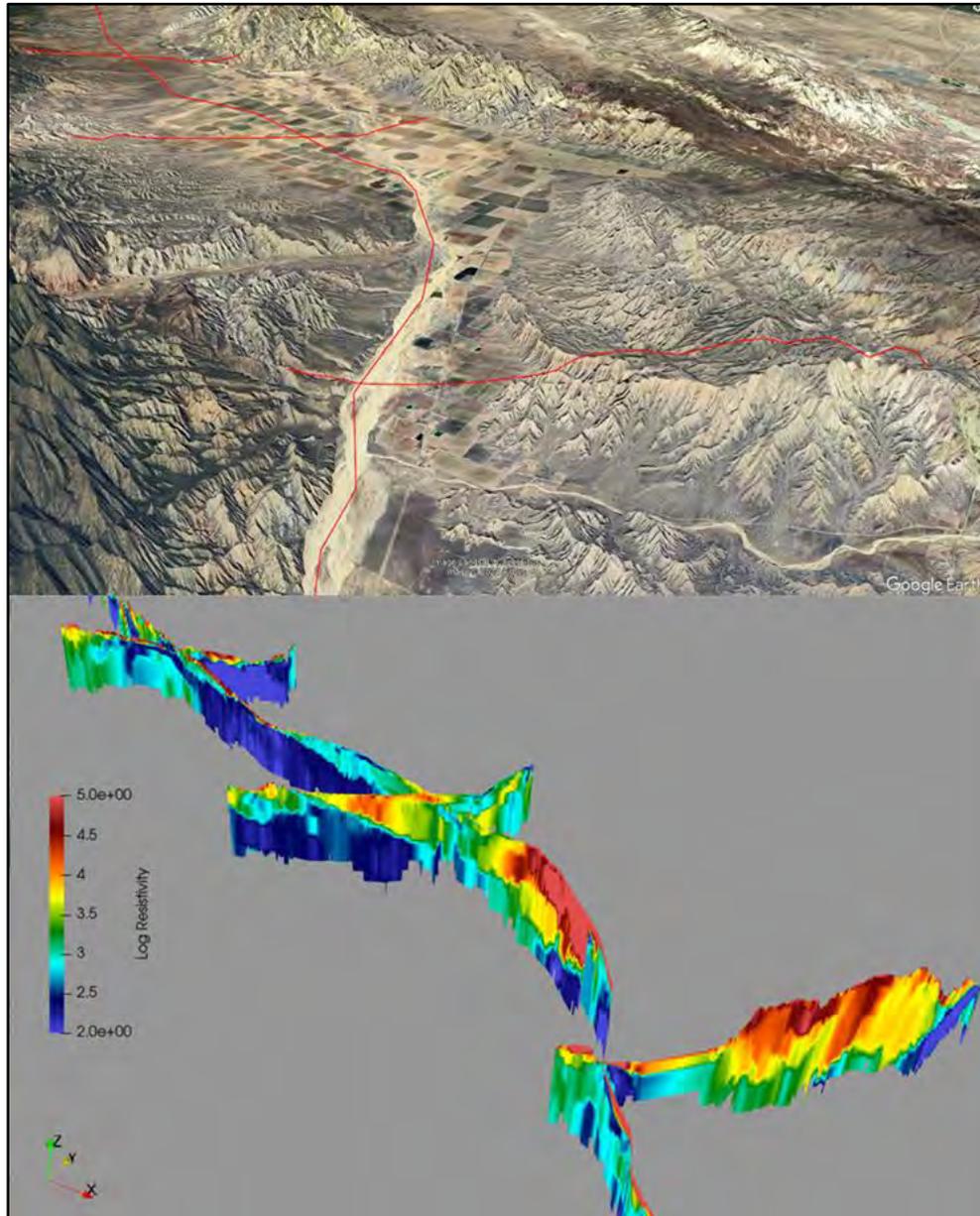


Figure 2-11: DWR AEM Survey Transect

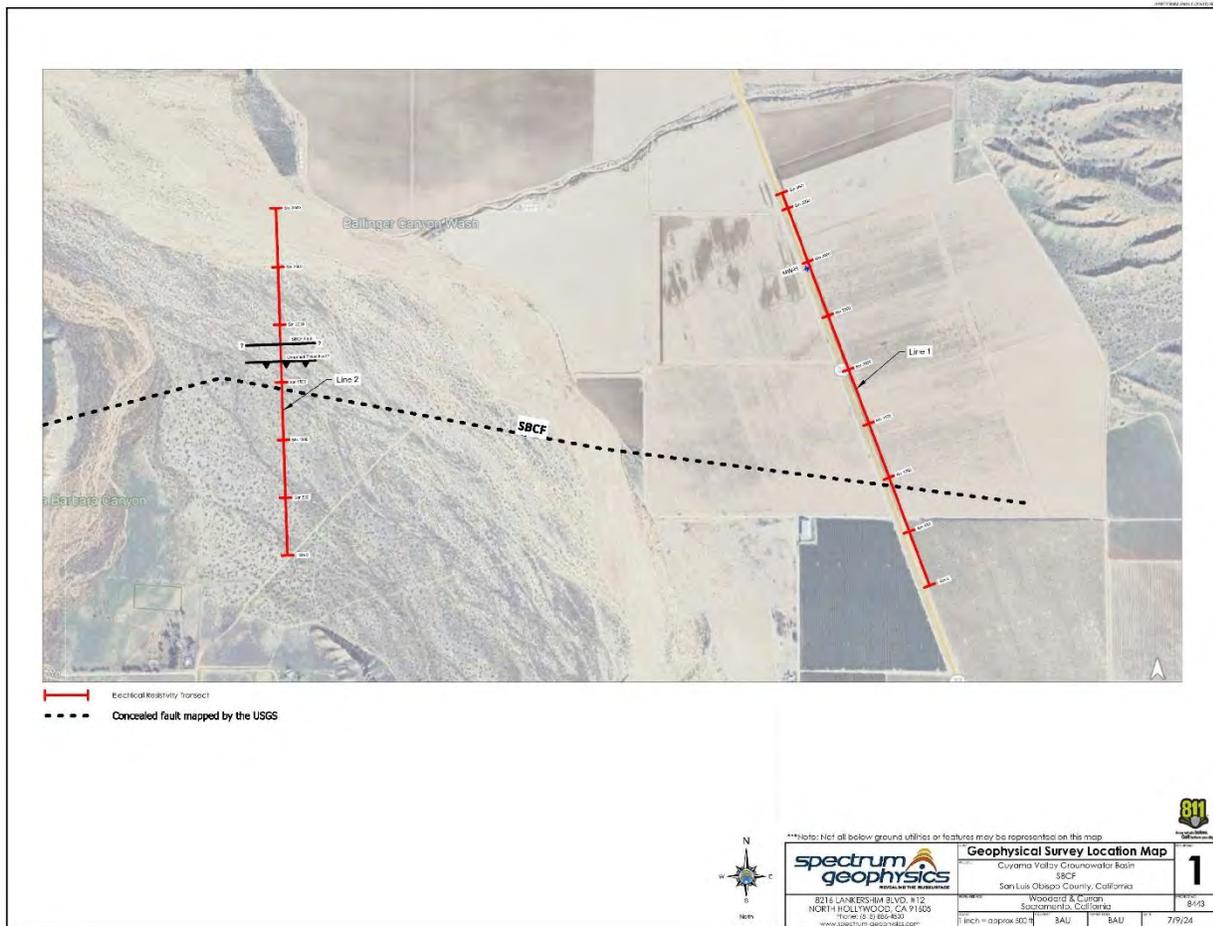


Figure 2-12: Location of Transects for Santa Barbara Canyon Fault

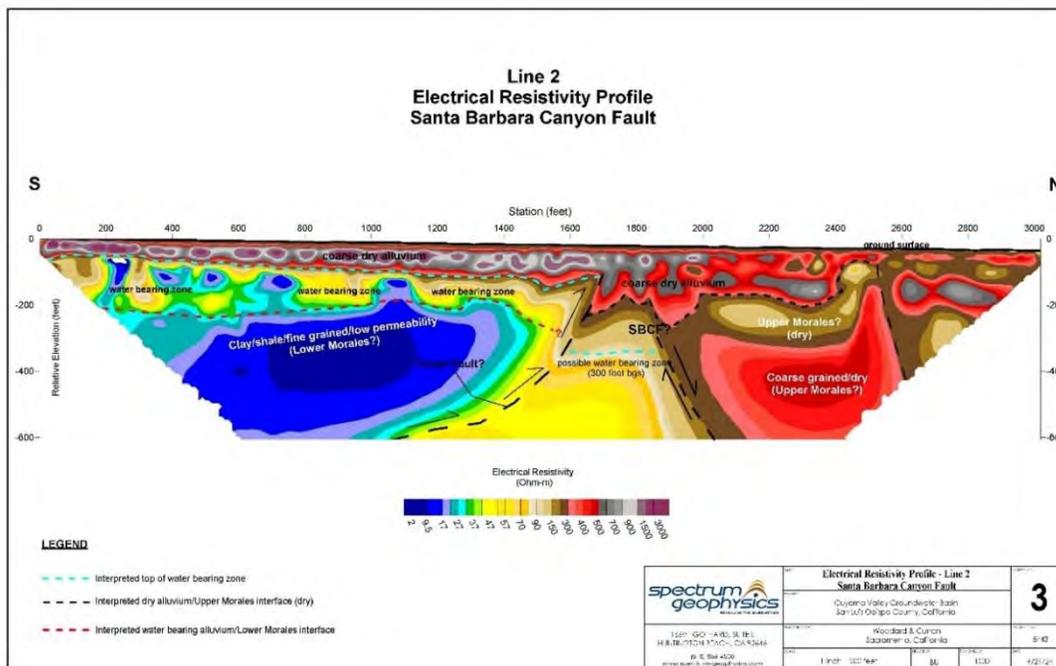
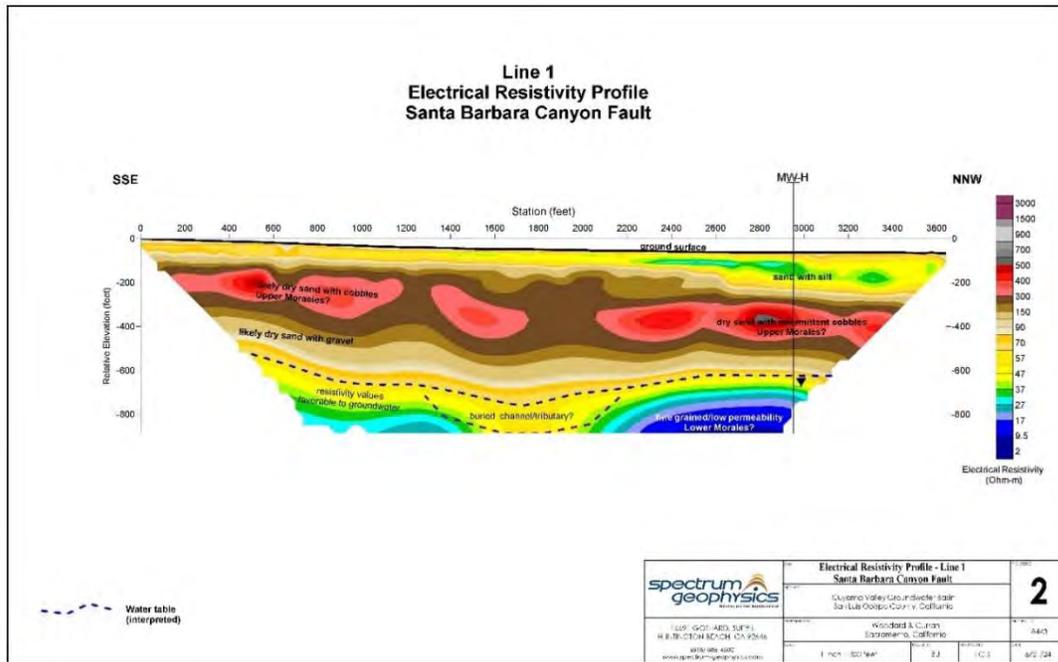


Figure 2-13: Resistivity Profiles for Santa Barbara Canyon Fault

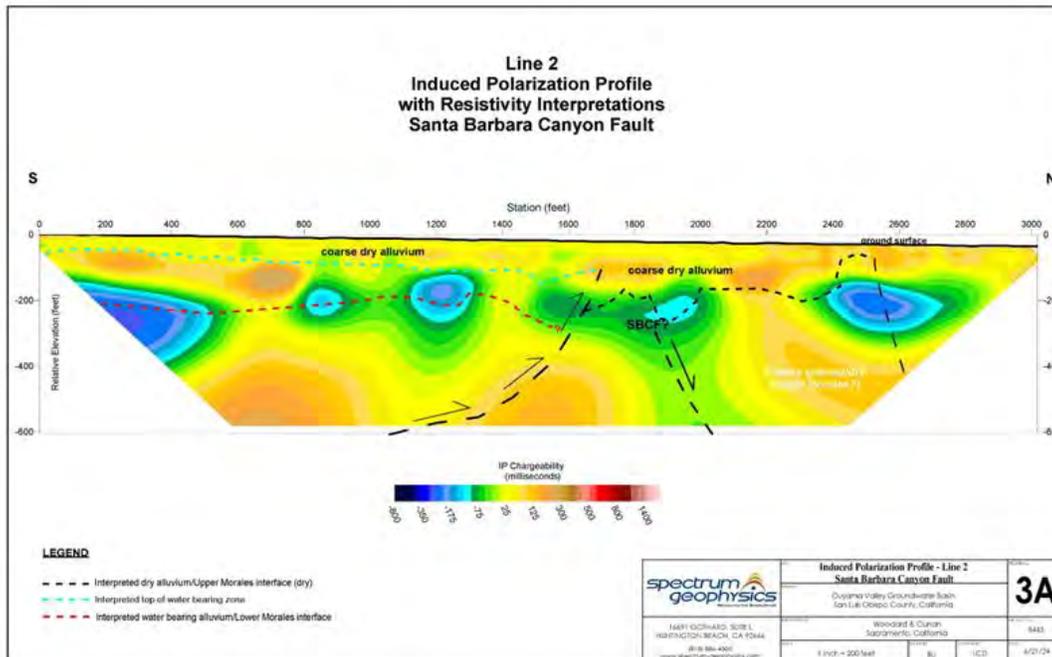
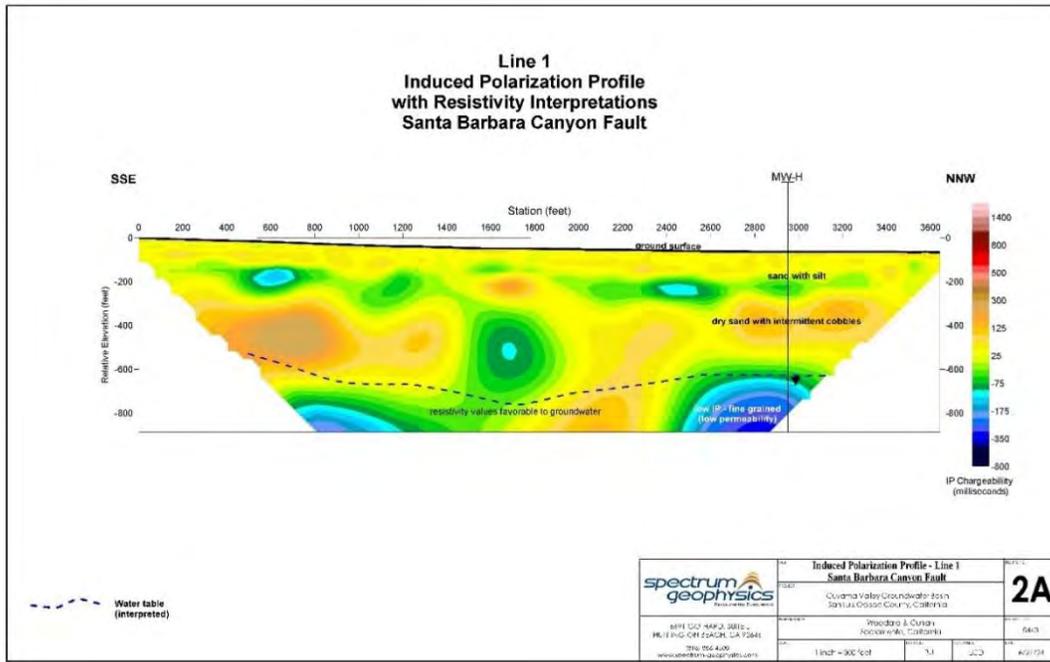


Figure 2-14: Induced Polarization Profile for Santa Barbara Canyon Fault

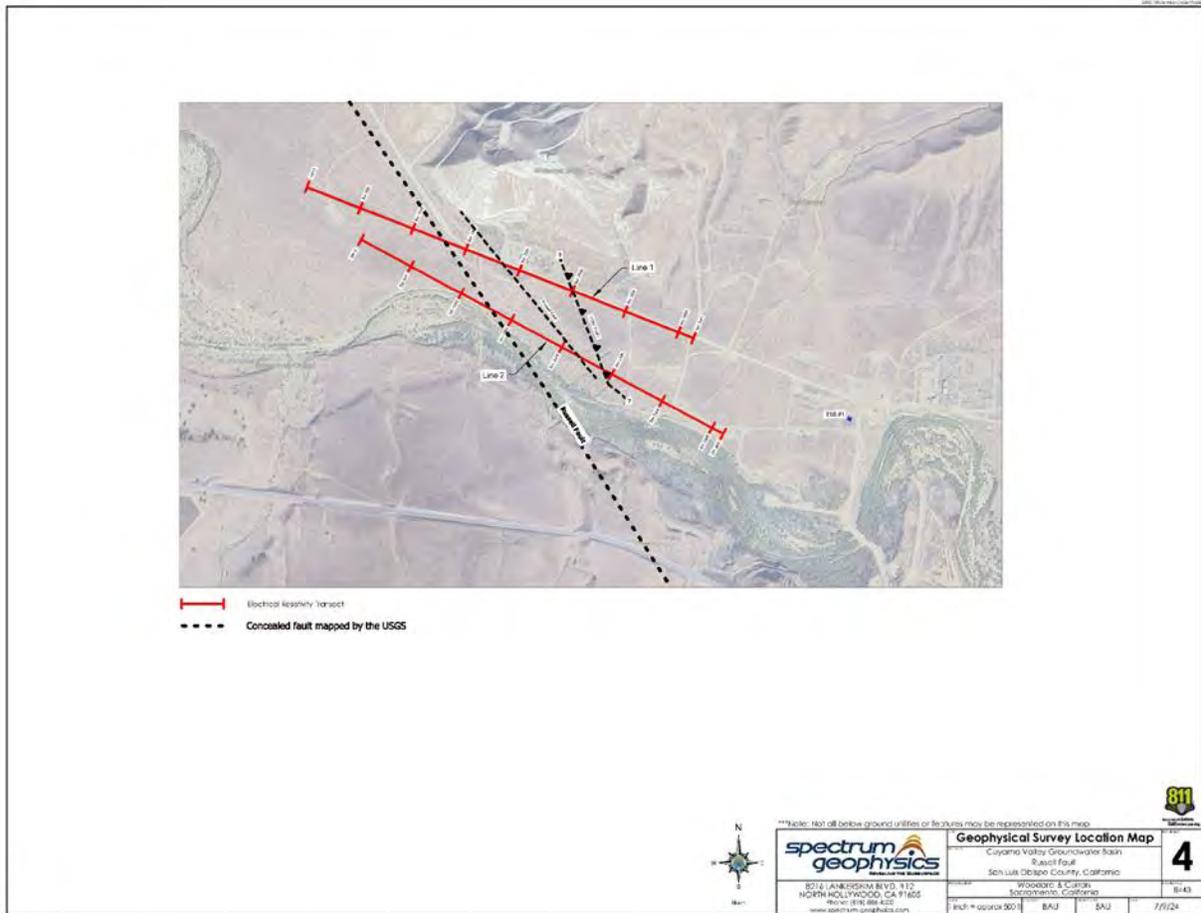


Figure 2-15: Location of Transects for Russell Fault

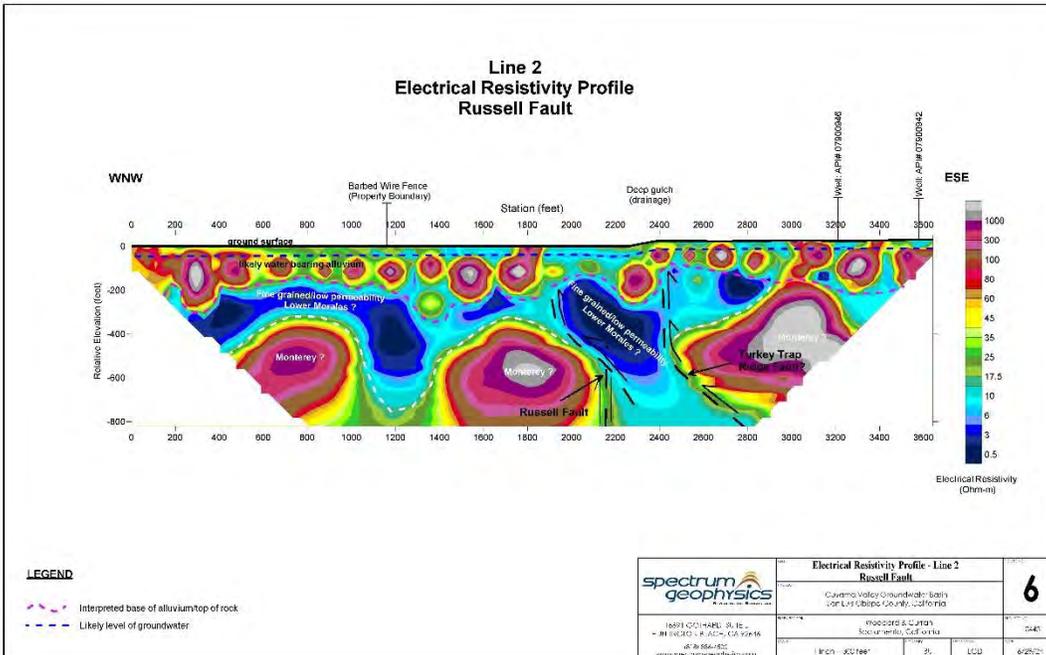
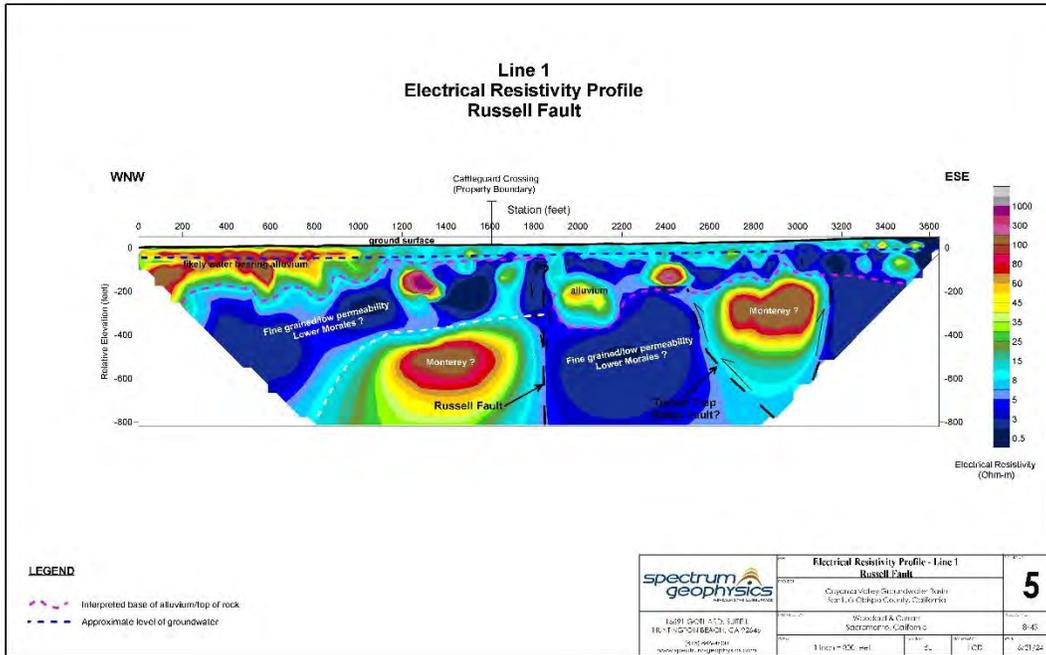


Figure 2-16: Resistivity Profiles for Russell Fault

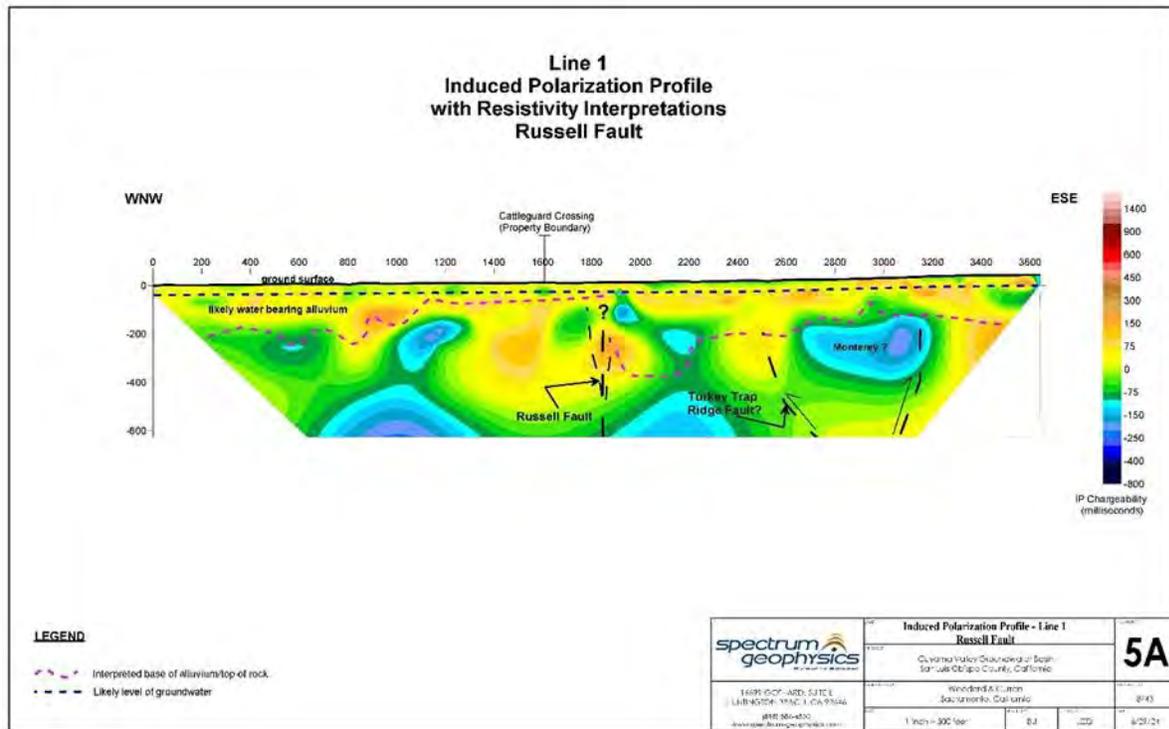


Figure 2-17: Induced Polarization Profile for Russel Fault



2.1.6 Basin Boundaries

The Basin has multiple types of basin boundaries. The majority of the boundaries are in contact with impermeable bedrock and faults, and a small portion is bounded by a groundwater divide between this Basin and the Carrizo Plain groundwater basin.

Lateral Boundaries

The Cuyama Basin is geologically and topographically bounded; to the north by the Morales and Whiterock faults and the Caliente Range, to the west by the South Cuyama and Ozena faults and the Sierra Madre Range, to the east within the Los Padres National Forest and Caliente Range, and to the south by the surface outcrops of Pliocene and younger lithologies, which are surrounded by Miocene and older consolidated rocks (Dudek, 2016). The boundaries of the Cuyama Basin were delineated by DWR in Bulletin 118 because they were the boundary between permeable sedimentary materials and impermeable bedrock. DWR defines this type of boundary as, “Impermeable bedrock with lower water yielding capacity. These include consolidated rocks of continental and marine origin and crystalline/or metamorphic rock” (DWR, 2003). The thrust faults bounding the Cuyama Basin juxtapose younger, water-bearing lithologies against older, impermeable rocks. The consolidated continental and marine rocks and shales of the bordering mountain ranges mark a transition from the permeable aquifer sediments to impermeable bedrock.

Boundaries with Neighboring Subbasins

The Cuyama Basin shares a boundary to the east with the Carrizo Plain Groundwater Basin (Carrizo Plain Basin) and the Mil Potrero Area Groundwater Basin, ~~as shown in Figure 1-3.~~ The Cuyama and Carrizo Plain basins share a 4-mile boundary along the Caliente Ranges, which is a groundwater divide basin boundary. DWR defines this type of boundary as, “A groundwater divide is generally considered a barrier to groundwater movement from one basin to another for practical purposes. Groundwater divides have noticeably divergent groundwater flow directions on either side of the divide with the water table sloping away from the divide” (DWR, 2003).

The Cuyama and Mil Potrero basins ~~are share a~~ less than ~~1 a~~ one mile boundary along the San Emigdio Canyon. The division between the Cuyama and Mil Potrero basins is also a groundwater divide basin boundary.



Bottom of the Cuyama Basin

The bottom of the Basin is generally defined by the base of the upper member of the Morales Formation (USGS, 2015). The lower member of the Morales Formation is composed of clay, shale, and limestone and is less permeable than the upper member of the Morales Formation (USGS, 2013a). The USGS describes the Morales Formation (both the upper and lower member combined) as up to 5,000 feet thick (USGS, 2013a). The top of the Morales Formation is generally encountered 750 feet below ground surface (bgs) but ranges up to 1,750 feet bgs in the Sierra Madre Foothills (USGS, 2013a). When referring to the Morales Formation in the context of the Cuyama aquifer, ~~this is a reference to~~ only the upper member of the Morales Formation is considered.

2.1.7 Principal Aquifers and Aquitards

There is one principal aquifer in the Basin ~~composed of the Younger Alluvium, Older Alluvium, and the Morales Formation~~. DWR's *Groundwater Glossary* defines an aquifer as "a body of rock or sediment that is sufficiently porous and permeable to store, transmit, and yield significant or economic quantities of groundwater to wells and springs" and an aquitard as "a confining bed and/or formation composed of rock or sediment that retards but does not prevent the flow of water to or from an adjacent aquifer." Most of the water pumped in the valley is contained in the ~~y~~Younger and Older Alluviums. These two units are indistinguishable in the subsurface and are considered, hydrologically, one unit. There are no major stratigraphic aquitards or barriers to groundwater movement, amongst the alluvium and the Morales Formation. The aquifer is considered to be continuous and unconfined with the exception of locally perched aquifers resulting from clays in the formations.

Aquifers

The aquifers making up the principal aquifer in the Cuyama Basin are Younger Alluvium, Older Alluvium, and the Upper Member of the Morales Formation. These units consist of unconsolidated to partly consolidated sand, gravel, silt, clay, and cobbles within alluvial fan and fluvial deposits and in total range from 3,000 to 4,000 feet in thickness (Upson and Worts, 1951). Rocks older than the upper Morales Formation are generally considered either non-water bearing or contain water, ~~but the water that~~ is released too slowly or of quality that is too poor for domestic and irrigation uses (USGS, 2013a). ~~Historically, most of the water pumped in the Cuyama Valley has been extracted from the Younger and Older alluvium.~~



Recent and Younger Alluvium

Historically, most of the water pumped in the Cuyama Basin was sourced from the saturated portions of the Younger and Older alluvium (Singer and Swarzenski, 1970). Groundwater is found in the permeable Holocene alluvial fill and in the underlying, less permeable, Pliocene-Pleistocene continental alluvial deposits. Younger Alluvium deposits thicken to the east, typically ranging from 5 to 50 feet in the west and thicken from 630 to 1,100 feet in the east (Singer and Swarzenski, 1970).

The Younger Alluvium varies compositionally across the Basin (Upson and Worts, 1951). The Recent and Younger aAlluvium is the primary source of groundwater on the western side of the Basin. In the west, Younger Alluvium consists of interbedded layers of sand and gravel and thick beds up clay (ranging from 1 to 36 feet thick) (Upson and Worts, 1951). Clay beds, found 100 to 150 feet bgs, define the base of the Younger Alluvium (Upson and Worts, 1951). Wells in the western part of the Basin that are screened in the Younger Alluvium are shallow but have moderately large yields, as the sands and gravels have high permeabilities (Singer and Swarzenski, 1970).

In the south-central part of the Basin, the alluvium contains more gravel and is less fine-grained compared to western alluvium. The alluvium is predominantly sand and silt with some beds of gravel and clay, though no continuous layers of any material exist (Upson and Worts, 1951).

Older Alluvium

Older Alluvium consists of unconsolidated to partly consolidated sand, gravel, boulders, and some clay. Similar to the Younger Alluvium, clay content increases to the west (Upson and Worts, 1951). Like the Younger Alluvium, historically most of the water pumped in the Cuyama Basin was sourced from the saturated portions of the yYounger and Older Alluvium (Singer and Swarzenski, 1970). More wells are perforated in the Older Alluvium in the western portion of the Basin than to the east (USGS, 2013c). In most regions of the Basin, the top of the saturated zone (the water table) is either deep in the alluvium or below its base (Upson and Worts, 1951).

Upper Morales Formation

The Pliocene to Pleistocene-aged Morales Formation is divided into two members, the upper and lower. The upper member of the Morales Formation is composed of partly consolidated, poorly sorted deposits of gravelly arkosic sand, pebbles, cobbles, siltstone, and clay and is considered water bearing (USGS, 2013a). Water bearing properties of the Morales Formation are not well defined, but available data indicate that the hydraulic conductivity of the formation varies greatly laterally and with depth (USGS, 2013c). ~~Permeabilities of the upper Morales Formation vary greatly laterally and with depth; the~~ The highest values occur in the syncline beneath the central part of the valley and decrease to the west (Singer and Swarzenski, 1970). In the east and southeastern parts of the valley where the Morales Formation crops out, the formation is coarse grained and moderately permeable, but land is topographically unsuited to agricultural development and few wells have been installed.



Aquifer Properties

The highest yielding wells are screened in the alluvium and located in the north-central portion of the Basin. Pumping in the alluvium also occurs in the eastern part of the Cuyama Valley, along the Cuyama River and its tributary canyon as far as a few miles upstream from Ozena (Singer and Swarzenski, 1970).

Hydraulic Conductivity

DWR defines hydraulic conductivity as the “measure of a rock or sediment’s ability to transmit water” (DWR, 2003). ~~The hydraulic~~ **Hydraulic** conductivity is variable within the principal aquifer, varying laterally, vertically, and amongst the three aquifer formations. In general, **hydraulic** conductivity is highest near the center of the Basin and decreases to the west and east with the highest values associated with the Younger Alluvium and the **Upper** Morales Formation with the lowest. ~~Conductivity~~ **Hydraulic conductivity** data are widely available for the central portion of the Basin (near the towns of New Cuyama and Cuyama) and near the western vineyards; ~~but~~ data are sparse elsewhere.

Available data from field tests (including pump and slug tests) were reviewed from the following sources:

- ~~3~~ **Three** multi-completion USGS wells (USGS, 2013c)
- 51 PG&E wells (USGS, 2013c)
- 66 private landowner wells in the central portion of the Basin
- ~~2~~ **Two** private landowner wells in the western portion of the Basin

Figure 2-18 shows the locations of these wells. Dates of field tests range from 1942 (PG&E tests) to ~~2018 (Grapevine Capital tests), and~~ **2022 (Woodard & Curran test)**. **Test** wells are screened in all three of the main aquifer formations, including the Younger Alluvium, Older Alluvium, and **Upper** Morales Formation. Additional sources **of hydraulic conductivity** include the ~~USGS’s 2015~~ **Hydrologic Models and Analysis of Water Availability in Cuyama Valley, California, (USGS, 2015)**, which describes conductivity values used in the CUVHM, along with Singer and Swarzenski (1970), and a ~~2011~~ **USGS study, (2011)**. The CUVHM characterizes the ~~Recent~~ **and Younger Alluvium** as having the highest hydraulic conductivity of ~~all the three~~ **aquifer units/formations** (USGS, 2015). ~~Conductivity~~ **Hydraulic conductivity** values calculated from field tests ~~for the wells~~ are used to characterize ~~each~~ **these** aquifer formation, as described below and summarized in ~~Table 2-1~~ **Table 2-1**.



Recent and Younger Alluvium —As shown in

Table 2-1, shows wells screened exclusively in the Younger Alluvium in the central portion of the Basin have hydraulic conductivities ranging from 1 to ~~31.9 feet~~32 feet per day and with a median conductivity value of ~~9.5~~about 10 feet per day. Wells screened in both the ~~y~~Younger and Older Alluvium in the central portion of the Basin had a higher comparable median conductivity of 10.1 feet per day value. Field tests are lower than those reported by the USGS ~~in (2015, which reported hydraulic conductivity for)~~. For the ~~R~~Recent and Younger Alluvium ~~range from 5.2, the range is about~~ 5 to 85 feet per day (USGS, 2015). Within the Recent and Younger Alluvium, the highest horizontal conductivity is estimates are at wells constructed near the Cuyama River. Vertical Calculations of vertical hydraulic conductivity ranges from 0.2 feet per day in tributaries crossing the ~~a~~Alluvium in areas west of the Russell ~~f~~Fault up to 49 feet per day in near the Cuyama River in the Ventucopa Uplands (USGS, 2015).

In March 2022, Woodard & Curran conducted a 72-hour constant rate test on a private agricultural well located several miles south of Ventucopa. Estimated values of hydraulic conductivity at the pumping well and several observation wells ranged from 145 to 407 feet per day with a geometric mean of 278 feet per day. These values are within the range of hydraulic conductivities for coarse sand and gravel.

Older Alluvium –

In the central portion of the Basin, hydraulic conductivity in the Older Alluvium ranges ~~from 0 up to~~ about 81.2 feet per day, with a median hydraulic conductivity of 16 feet per day. Field tests are also higher than those reported by the USGS ~~in (2015, which reported conductivity for the Older Alluvium ranges and 2011) that~~ range from 0.3 to 28 feet per day in the central Basin (USGS, 2015; USGS, 2011). West of the Russell ~~fault, Fault, near the vineyards,~~ hydraulic conductivity reportedly ranges from about 0.778 to 1.798 feet per day with a median value of 1.24 feet per day in areas west of the Russell Fault, near the vineyards. Conductivity generally decreases with depth. Field data show that ~~while~~ the range in hydraulic conductivity for wells screened in both the Older Alluvium and Morales Formation is lower than wells screened exclusively in the Older Alluvium ~~(ranging from 0. Estimates range up to 61.2 feet per day), the~~ with a median value is higher at 21.4 feet per day. The USGS calculated the median hydraulic conductivity for the Older Alluvium (15 feet per day) to be about five times the estimated value for the Morales Formation (i.e., 3.1 feet per day) (USGS, 2013e).

Morales Formation –

The Upper Morales Formation has the lowest hydraulic conductivity of ~~all the~~ the aquifer units. In the central portion of the Basin, the hydraulic conductivity ~~for at~~ wells exclusively only screened in the Morales Formation ranges from 1.6 to ~~9.9~~10 feet per day, with a median value of ~~3.4~~5.2 feet per day. Two wells were interpreted to be screened exclusively only in the Morales Formation west of the Russell ~~fault, Fault,~~ The hydraulic conductivity for these wells ranges from 1.6 ~~—1.98 to 2~~ feet per day. The hydraulic conductivity of the Upper Morales Formation decreases with depth ~~and the lower member of the formation (the clay and limestone unit) has a lower conductivity than the upper member (sandstone).~~



highest values of hydraulic conductivity in the Morales Formation occur in the central portion of the valley Basin and decrease to the west (Singer and Swarzenski, 1970).


Table 2-1: Summary of Hydraulic Conductivities in Aquifer Formations

Well Owner	Number of Wells	Formation(s) Well is Screened In	Conductivity Range (feet/day)	Median Conductivity (feet/day)
USGS	6 ^a	Older Alluvium	1.5 – 18.1	15
	6 ^a	Upper Morales Formation	1.6 – 9.9	3.15
PG&E ^b	22	Younger Alluvium	1 - 30	9
	19	Younger and Older Alluvium	0.1 - 37	4.5
	8	Older Alluvium	0.1 – 17	4
	2	Older Alluvium and Upper Morales Formation	0.1 – 4	2
Private Landowners, Central Portion of the Basin ^c	2	Younger Alluvium	28.9 – 31.9	30.4
	19	Younger Alluvium and Older Alluvium	3.9 – 68.6	17.1
	6	Younger Alluvium and Upper Morales Formation	1 – 21.3	12
	16	Older Alluvium	3.2 – 81.2	17.15
	23	Older Alluvium and Upper Morales Formation	3.6 – 61.2	23
Private Landowners, Western Portion of the Basin ^c	4	Older Alluvium	0.77 – 1.79	1.47
	6	Older Alluvium and Upper Morales Formation	0.64 – 1.59	1.22
	2	Upper Morales Formation	1.6 – 1.98	1.79
<u>Private Landowners, Southeast Portion of the Basin^c</u>	<u>1</u>	<u>Younger Alluvium and Older Alluvium</u>	<u>145 - 407</u>	<u>278</u>

Notes:
^aThree wells with four completions each; each well completion is reported as a single well.

^bConductivity estimated using transmissivity field tests.

^cConductivity estimated using specific capacity field tests.



Specific Yield

DWR defines specific yield as the “amount of water that would drain freely from rocks or sediments due to gravity and describes the portion of groundwater that could actually be available for extraction” (DWR, 2003). Specific yield is a measurement ~~specific that applies only~~ to unconfined aquifers, ~~such as which is~~ the primary aquifer in the Cuyama Basin.² The ~~dewatered alluvium~~ Alluvium has an average specific yield of 0.15 (Singer and Swarzenski, 1970). The USGS estimated the specific yields of the three aquifer formations during CUVHM calibration, ~~calculating that the recent alluvium~~. The Recent and Younger Alluvium had the lowest specific yield ranging from 0.02 to 0.14, the Older Alluvium has d a specific yield ranging from slightly higher range of 0.05 to 0.19, and the Morales Formation has d the highest specific yield ranging from 0.06 to 0.25 (USGS, 2015).

Specific Capacity

Specific capacity is defined as “the yield of the well, in gallons per minute, divided by the pumping drawdown, in feet” (Singer and Swarzenski, 1970). Specific capacity ~~in of~~ the aquifer varies laterally and vertically but is typically highest in the Younger Alluvium and lowest in the Morales Formation. Wells ~~perforated screened~~ in the Younger Alluvium have a median specific capacity of 60 gallons per minute (gpm) per foot (USGS, 2013c). Wells ~~perforated screened~~ in both the Younger and Older alluvium have a lower median specific capacity of 40 gpm per foot ~~(USGS, 2013c)~~. Wells ~~perforated screened~~ in the Older Alluvium have a median specific capacity of 20 gpm per foot (USGS, 2013c). The silt and clay content of the Older Alluvium increases to the west and corresponds to a decrease in specific capacity ~~in the alluvium~~; specific capacities are less ~~on~~ in the western half portion of the valley Basin compared to the eastern half portion. However, a greater percentage of wells in the western portion are ~~perforated screened~~ in the Older Alluvium (USGS, 2013c). The specific capacity of the Morales Formation also varies laterally but is generally less than the specific capacity of the Younger and Older Alluvium. In the western part of the valley Basin, the Morales Formation has a specific capacity ranging from 5 to 25 gpm per foot. In the north to north-central portion of the Basin the specific capacity increases to 25 to 50 gpm per foot (Singer and Swarzenski, 1970).

² For confined aquifers, the measurement of “storativity” is used instead of specific yield.



Transmissivity

DWR defines transmissivity as the “aquifer’s ability to transmit groundwater through its entire saturated thickness” (DWR, 2003). Using aquifer tests ~~from 63~~ at the 64 wells (shown in Figure 2-18), estimates of transmissivity ranged from 560 to 163,400 gallons per day per foot (gpd/foot) and decreased with depth (USGS, 2013c). Among the aquifer units, wells screened in the Younger Alluvium had the highest transmissivity, with a median value of 15,700 gpd/foot (USGS, 2013c). The aquifer test conducted by Woodard & Curran in 2022 provided an estimated range of 100,000 to 270,000 gpd/foot.

Wells screened in Older Alluvium had a transmissivity three times ~~less~~ lower than the Younger Alluvium wells, ~~at~~ with a median value of 5,000 gpd/foot (USGS, 2013c). Wells screened in both the ~~y~~ Younger and ~~alluvium~~ Older Alluvium had a median transmissivity of 11,300 gpd/foot (USGS, 2013c). ~~Data from the 61 wells were not available for the Morales Formation, but a~~ Estimates of transmissivity ~~estimate~~ from two wells screened in both the Older Alluvium and Morales Formation averaged 4,900 gpd/foot (USGS, 2013c). No values are available for only the Morales Formation. Using groundwater level contours, Singer and Swarzenski (1970) determined the range of transmissivity values in the Morales Formation ~~to~~ change much ~~are~~ more variable than ~~the~~ transmissivity values ~~of~~ for the ~~y~~ Younger and Older Alluvium; ~~i~~ n general, values of transmissivity are highest in the central portion of the ~~valley~~ Basin and decline to the west as the thicknesses of the ~~y~~ Younger and Older Alluvium ~~become more shallow~~ decreases.

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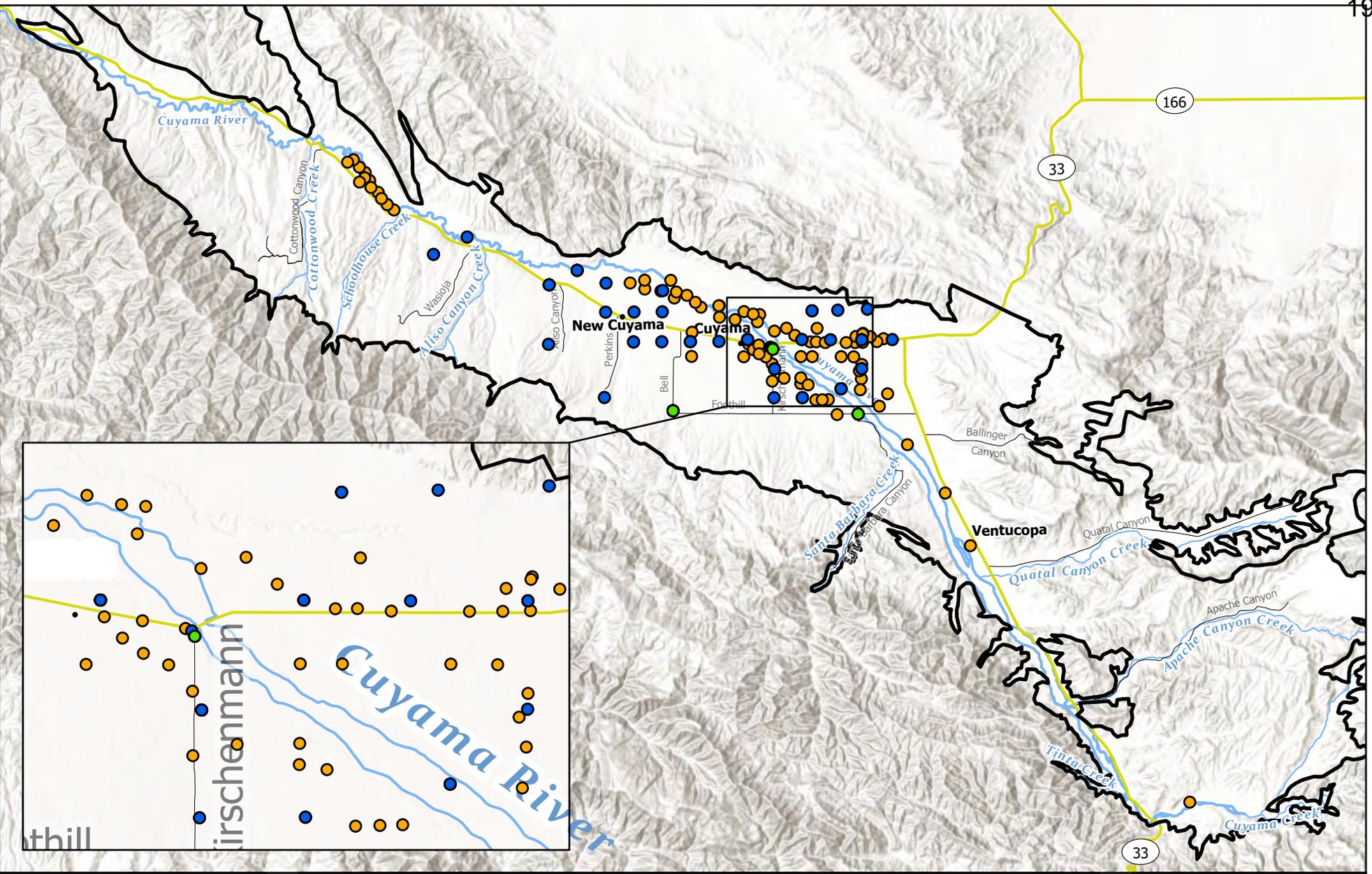


Figure 2-18: Location of Aquifer Testing Wells

Cuyama Valley Groundwater Basin

Legend

- USGS
- PG&E
- Privately Owned
- Highway
- Local Road
- Town
- Creek
- Cuyama River
- Cuyama Basin



0 1.25 2.5 5 Miles

Map Created: March 2024

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2.1.8 Natural Water Quality Characterization

Water quality in the Basin has historically had a high level of TDS and sulfates. High concentrations of other constituents, such as nitrate, arsenic, sodium, boron, and hexavalent chromium are localized (USGS, 2013c). Locations where water quality measurements were taken by the USGS are shown in ~~Figure 2-11~~. Figure 2-19

Singer and Swarzenski studied groundwater in the Basin in 1970. Groundwater ranged from hard to very hard and is predominantly of the calcium-magnesium-sulfate type (Singer and Swarzenski, 1970). Averages of concentrations include 30 milligrams per liter (mg/L) chloride, 0.20 mg/L of boron, and 1,500 to 1,800 mg/L TDS (Singer and Swarzenski, 1970). Along the periphery of the Basin, groundwater quality is variable. Along the southern boundary and near the eastern badlands, the groundwater quality reflects the recharge from springs and runoff from the Sierra Madre Mountains; TDS concentrations range from 400 to 700 mg/L and most of the water is sodium calcium bicarbonate (Singer and Swarzenski, 1970). Along the eastern edge of the valley, near the Caliente Range, water quality declines as concentrations of sodium, chloride, TDS, and boron increase. Concentrations of boron range up to 15 mg/L, concentrations of chloride increase up to 1,000 mg/L, and TDS concentrations range from 3,000 to 6,000 mg/L (Singer and Swarzenski, 1970).

Singer and Swarzenski in 1970 also concluded that the Basin's water quality potentially results from the mixing of water from the marine rocks: "This water quality presumably results from the mixing of water from the marine rocks of Miocene age with the more typical water from the alluvium and is characterized by increased sodium, chloride, and boron. Although chloride and boron concentrations commonly are less than 30 and 0.20 mg/L, respectively, in the central part of the valley, the water from many wells ~~is~~ close to the Caliente Range contains several hundred to nearly 1,000 mg/L of chloride and as much as 15 mg/L of boron." (Singer and Swarzenski, 1970). Singer and Swarzenski did not provide a map showing their sampling locations.

In 2011, the USGS published the *Kirschenmann Road Monitoring Well Site Open File Report* (USGS, 2011), which included analysis of major-ion composition for samples collected from the multiple-well monitoring site CVKR, and samples from selected water supply and irrigation wells in the Cuyama Valley. Figure 2-20 shows a Piper diagram of the major-ion analysis. Figure 2-20 shows that groundwater in the central portion of the Basin shares similar major-ions, and is largely chloride, fluoride, sulfate and calcium magnesium type water. Figure 2-21 shows the locations USGS sampled to perform this analysis.

In 2017 EKI compiled water quality data contained in the appendices of the USGS report *Geology, Water-Quality, Hydrology, and Geomechanics of the Cuyama Valley Groundwater Basin, California, 2008-12* (USGS 2013c). and prepared a Piper diagram with the data (Figure 2-22). The locations of the data used in this Piper diagram are shown in Figure 2-23. The Piper diagram shows the majority of samples indicate that water in the Basin can be characterized as calcium-magnesium sulfate waters, which agrees with conclusions made by USGS in 2013.

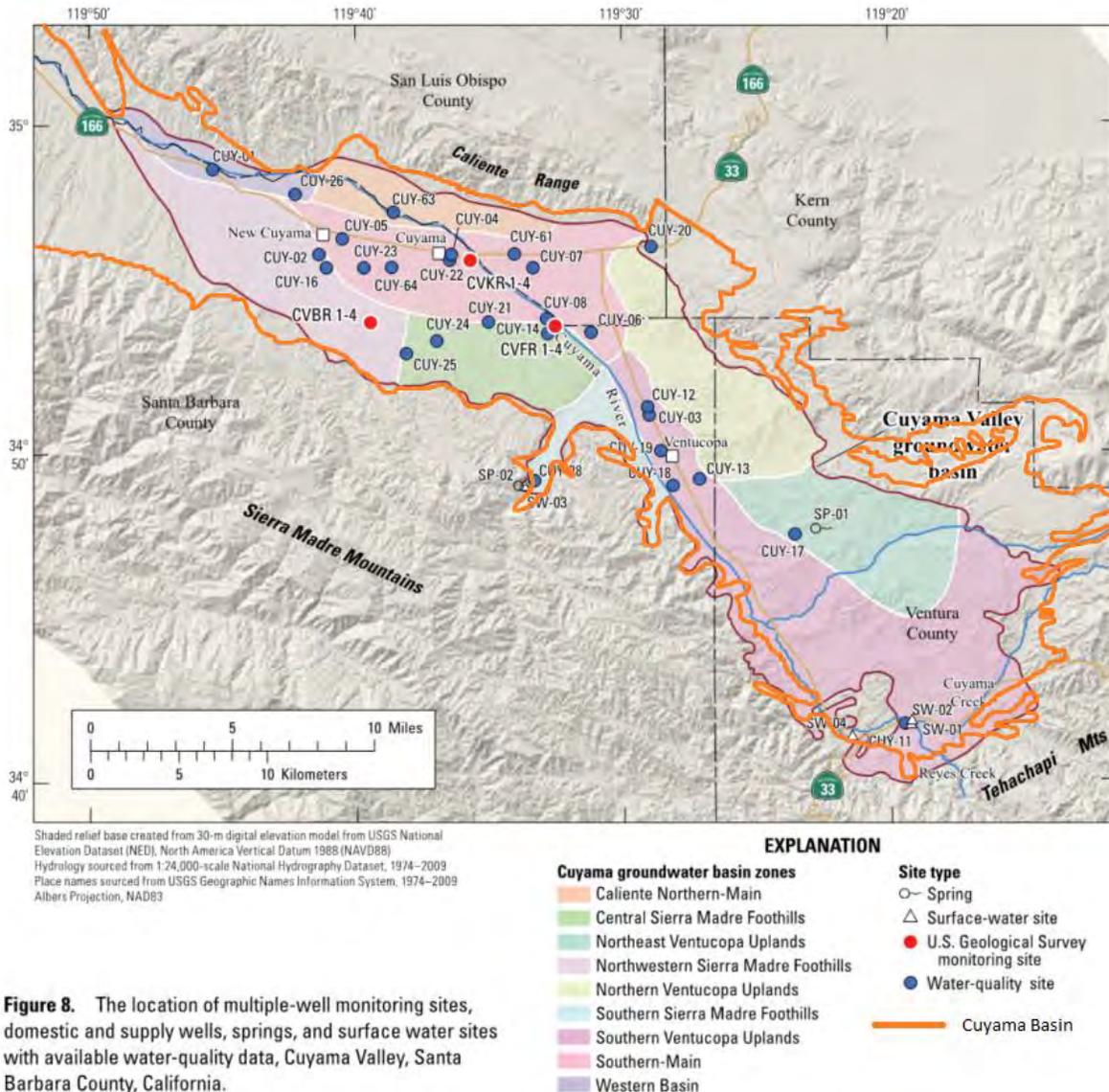
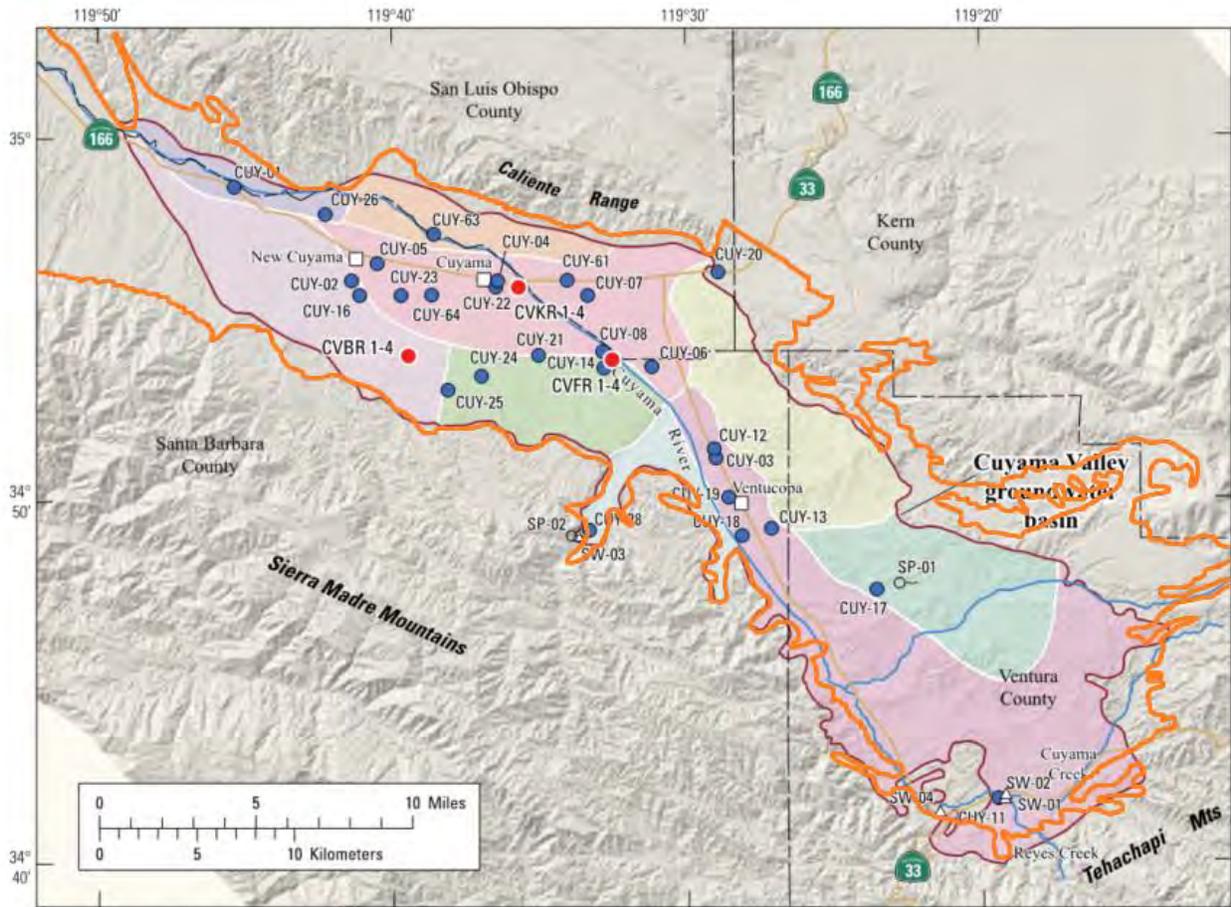


Figure 8. The location of multiple-well monitoring sites, domestic and supply wells, springs, and surface water sites with available water-quality data, Cuyama Valley, Santa Barbara County, California.



Shaded relief base created from 30-m digital elevation model from USGS National Elevation Dataset (NED), North America Vertical Datum 1988 (NAVD88)
 Hydrology sourced from 1:24,000-scale National Hydrography Dataset, 1974–2009
 Place names sourced from USGS Geographic Names Information System, 1974–2009
 Albers Projection, NAD83

EXPLANATION	
Cuyama groundwater basin zones	Site type
Caliente Northern-Main	○ Spring
Central Sierra Madre Foothills	△ Surface-water site
Northeast Ventucopa Uplands	● U.S. Geological Survey monitoring site
Northwestern Sierra Madre Foothills	● Water-quality site
Northern Ventucopa Uplands	
Southern Sierra Madre Foothills	
Southern Ventucopa Uplands	
Southern-Main	
Western Basin	
	— Cuyama Basin

Figure 8. The location of multiple-well monitoring sites, domestic and supply wells, springs, and surface water sites with available water-quality data, Cuyama Valley, Santa Barbara County, California.

Source: USGS, 2013c.

Figure 2-19: Location of USGS 2013 Groundwater Quality Sampling Sites

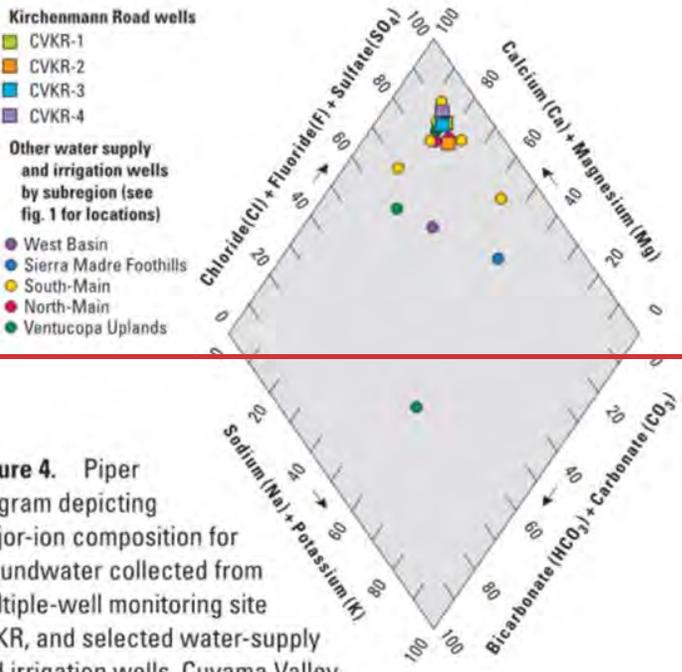


Figure 4. Piper diagram depicting major-ion composition for groundwater collected from multiple-well monitoring site CVKR, and selected water-supply and irrigation wells, Cuyama Valley, California.

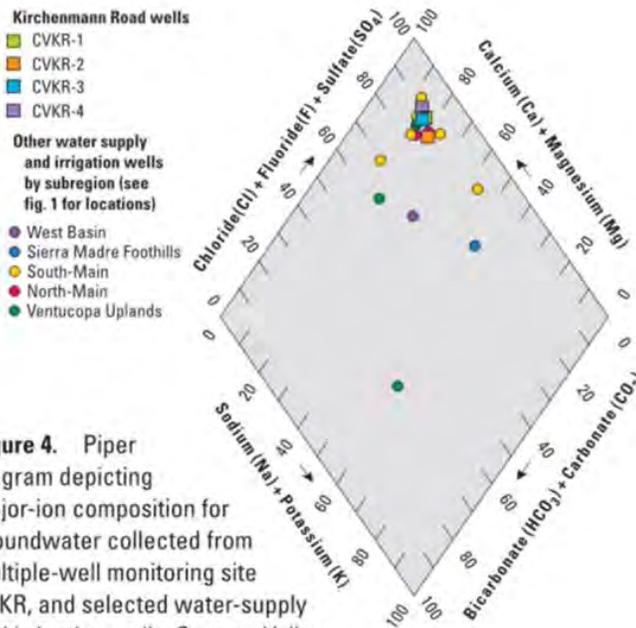


Figure 4. Piper diagram depicting major-ion composition for groundwater collected from multiple-well monitoring site CVKR, and selected water-supply and irrigation wells, Cuyama Valley, California.

Figure 2-20: Piper Diagram for Well CVKR1-4

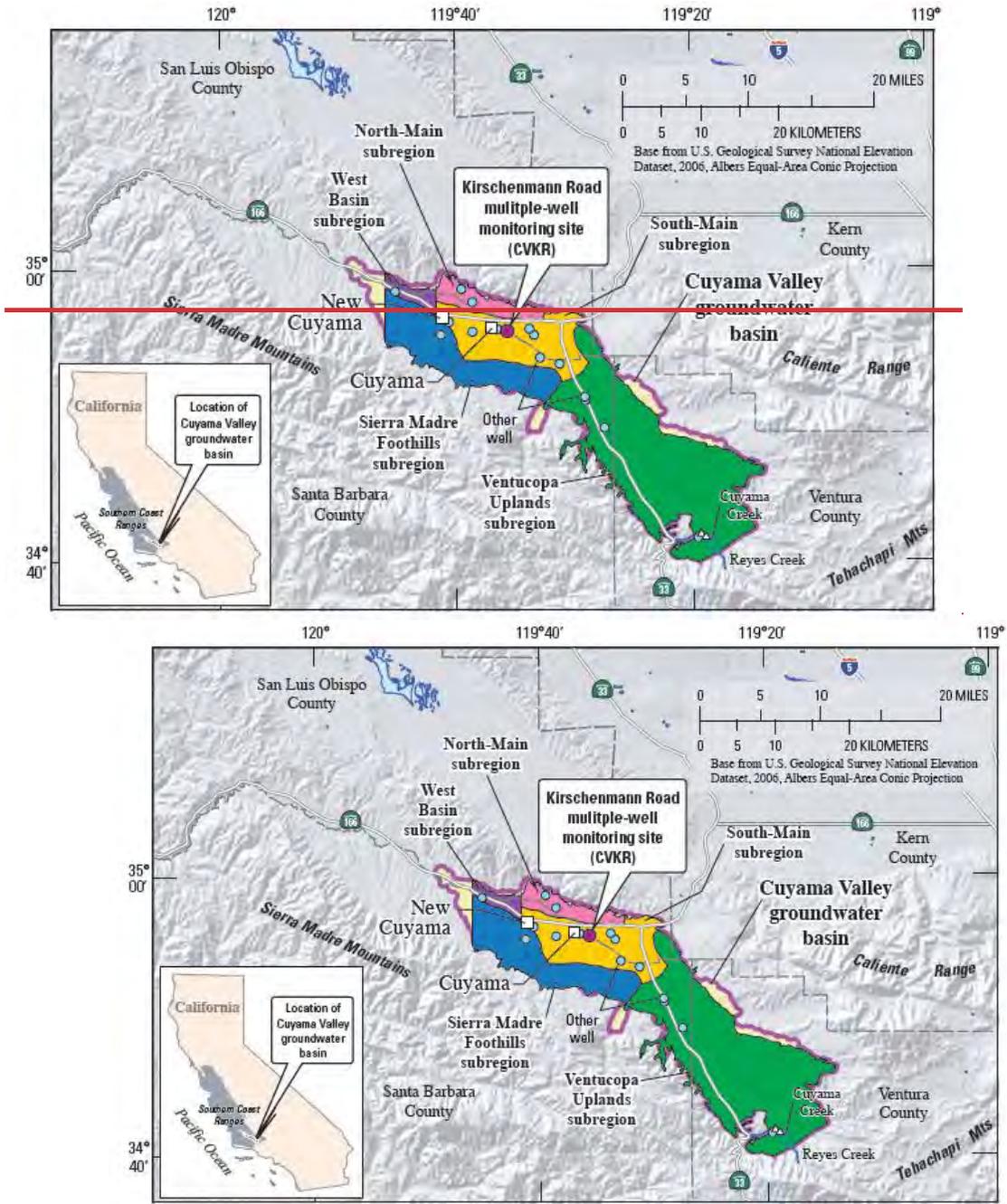


Figure 2-21: Location Map for Samples Used in Figure 2-20

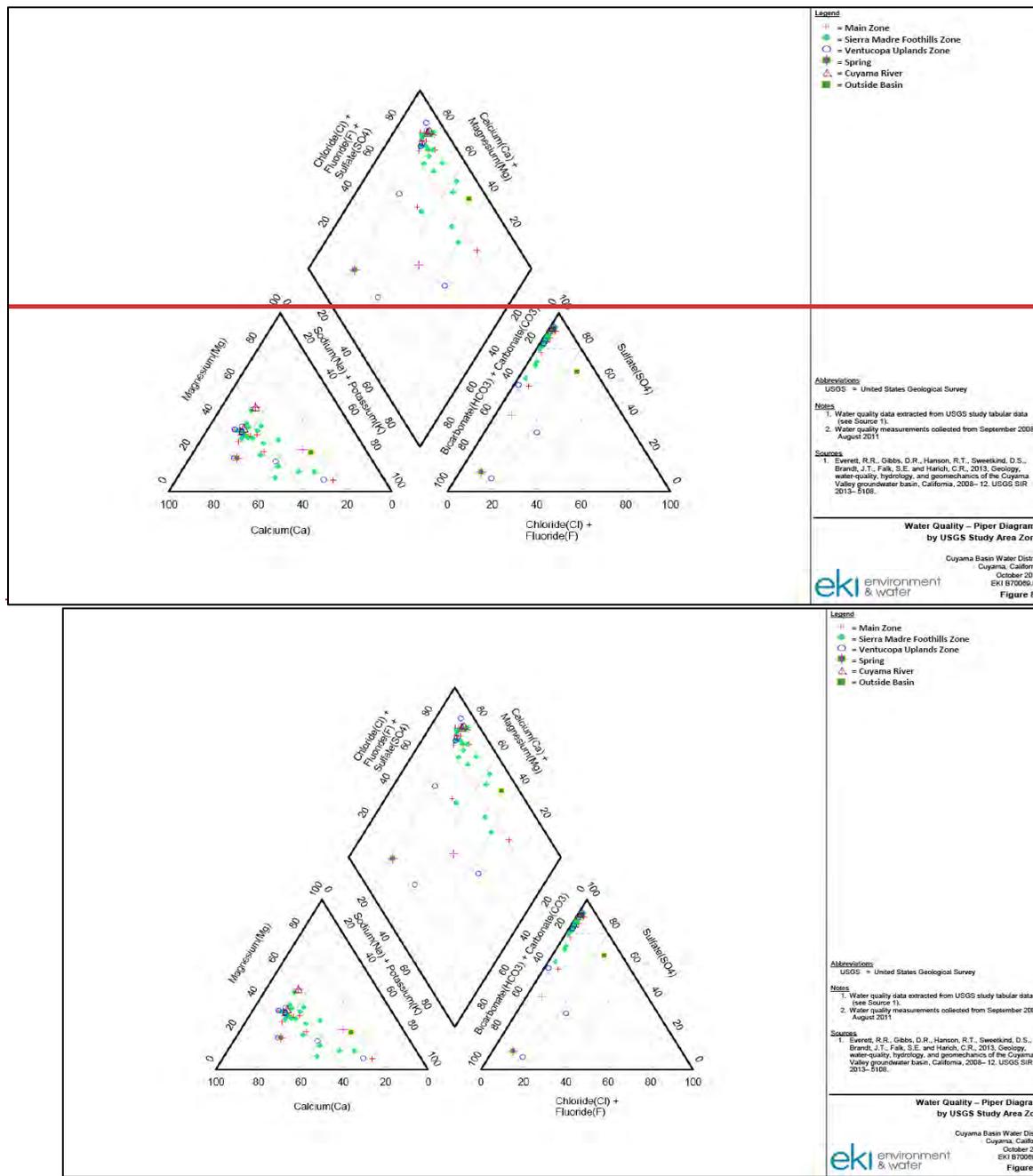


Figure 2-22: Piper Diagram of USGS 2013 Water Quality Sampling

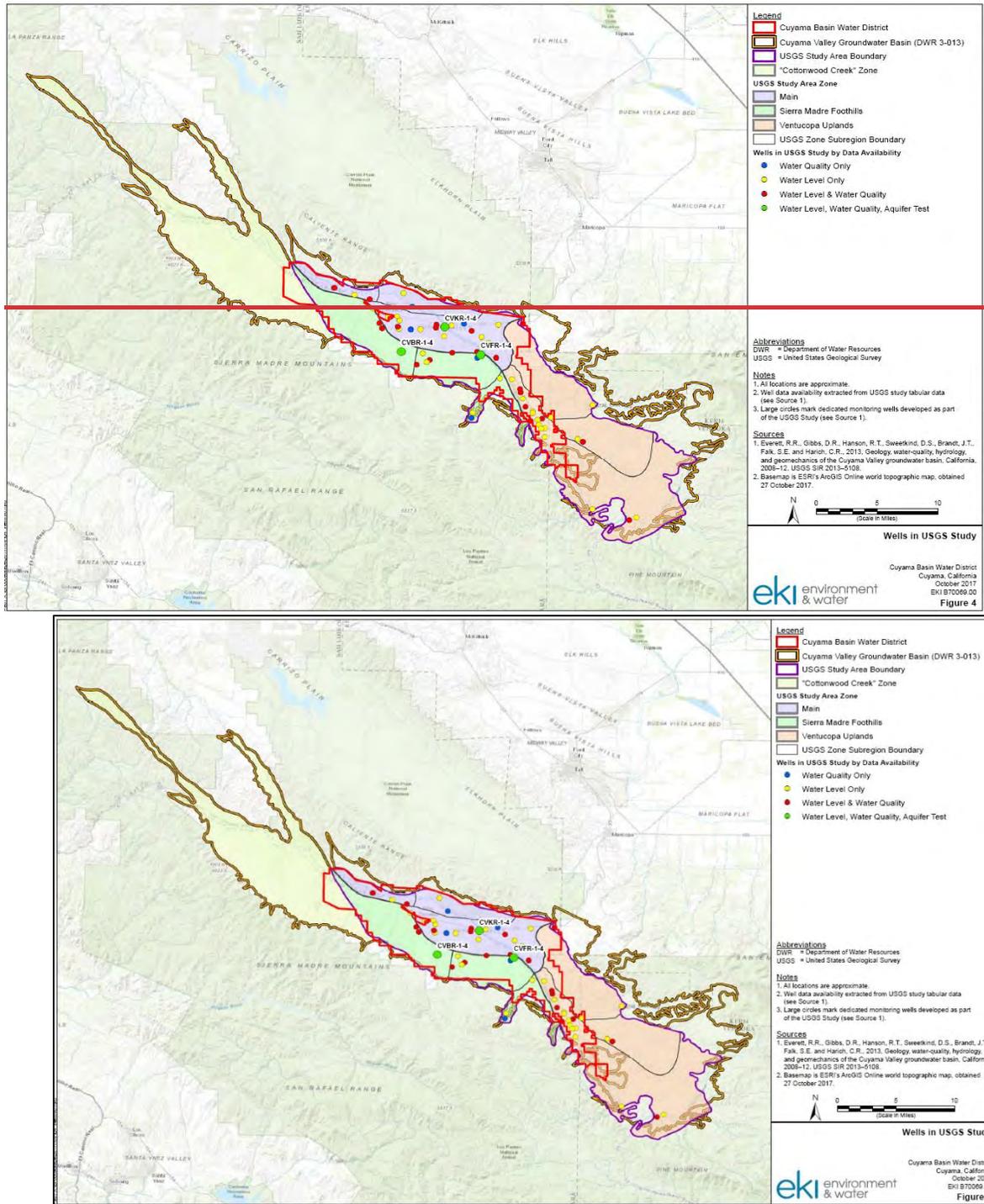


Figure 2-23: Location Map of USGS 2013 Sampling



Aquifer Use

The Cuyama Valley is dependent on groundwater as its sole source of supply. Groundwater is used for irrigation, domestic and municipal use (USGS, 2013c). The majority of agricultural activity occurs between the New Cuyama and Ventucopa areas, and west of the Russell ~~fault near the north fork~~ Fault.

2.1.9 Topography, Surface Water and Recharge

This section describes the topography, surface water, soils, and groundwater recharge potential in the Basin. There are no imported water supplies to the Cuyama Basin and are not discussed in this section.

Topography

The Basin is lowest in the northwest, and highest in the southeast. The lowest elevation in the Basin is located at the west edge where the Cuyama River exits at approximately 1,300 feet, while the highest point is approximately 7,250 feet on the eastern boundary. Figure 2-24 shows the topographic characteristics of the Basin. The south facing northern slopes of the valley are generally steeper than the north facing south slopes. The eastern portion of the Basin along the valley walls becomes steep, characterized by mountainous runoff-cut topography.

Surface Water Bodies

The Cuyama River is the primary surface water feature in the valley and flows from an elevation of 3,800 feet on the eastern side to ~~the west of the Basin to~~ 1,300 feet at the western outlet of the Basin. The Cuyama River travels approximately 55 miles through the Basin and has a slope ratio of approximately 1:125. The river is perennial, with most dry seasons seeing little to no flows. Large flows usually occur in flashes due to the small watershed and storms that provide precipitation onto the surrounding Coastal Range Mountains. Peak flows through the Cuyama River, dated between 1929 and 2017~~23~~, range from approximately 6,000 cubic feet per second to the highest recorded flow of 15,500 cubic feet per second on February 18, 2017 (National Watershed Information System [NWIS], 2018). There are approximately four main perennial streams that feed the Cuyama River: Aliso Canyon Creek, Santa Barbara Creek, Quatal Canyon Creek, and Cuyama Creek. However, during precipitation events many more smaller streams flow from the valley walls and surrounding mountains. Figure 2-25 shows the locations of surface water bodies in the Basin.

Downstream on the Cuyama River lies Twitchell Reservoir, however this is an artificial body of water outside of the Basin.

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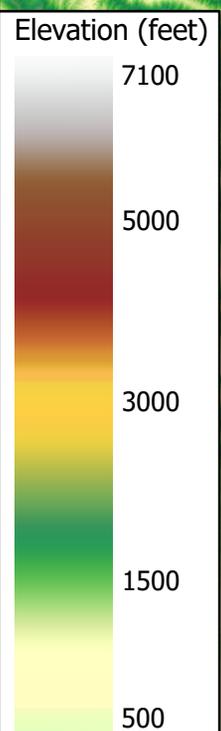
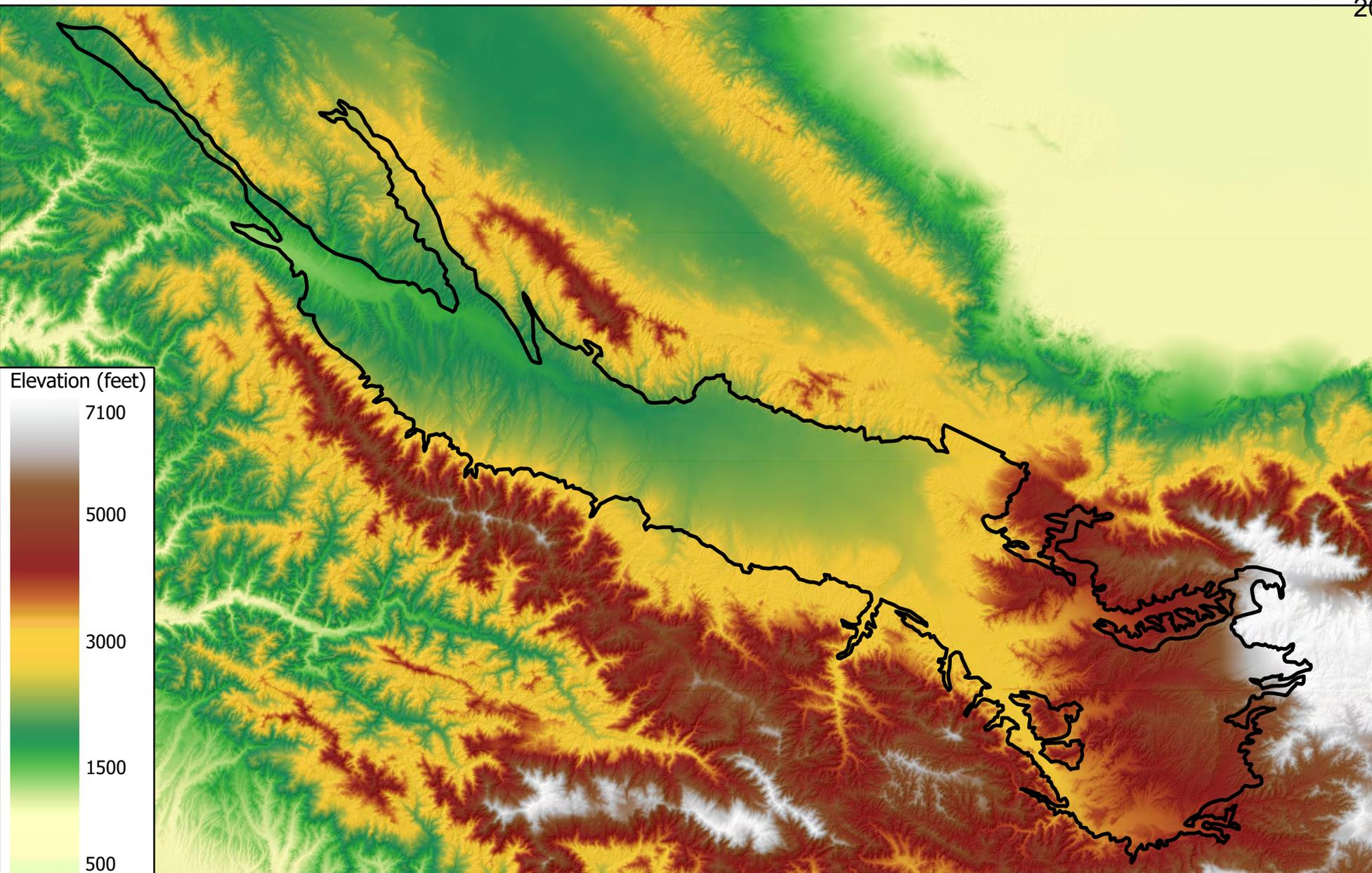


Figure 2-24: Topography

Cuyama Valley
Groundwater Basin

Legend

 Cuyama Basin



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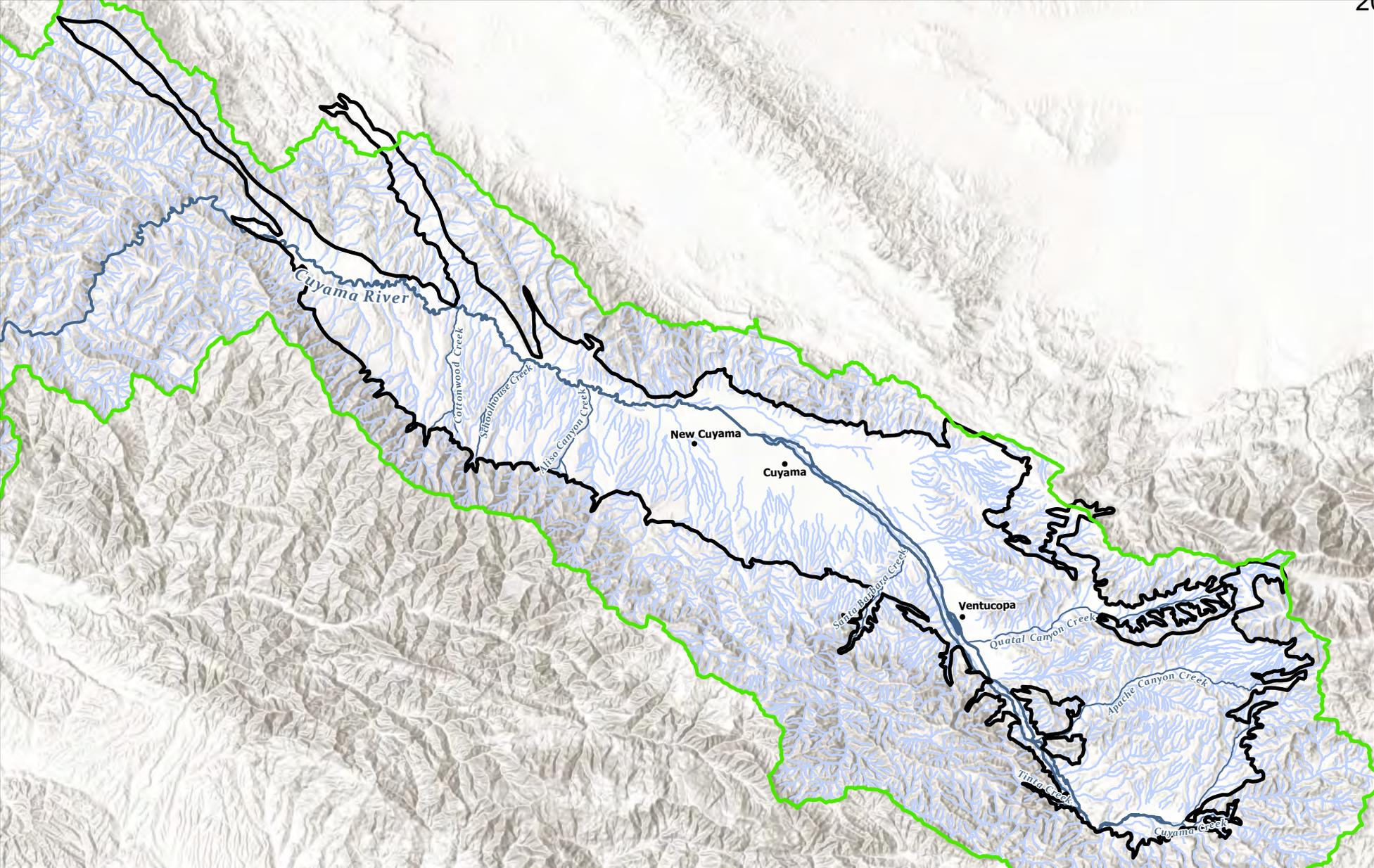


Figure 2-25: Surface Water

Cuyama Valley Groundwater Basin

Legend

-  Cuyama River
-  Notable Creeks
-  NHD Flowlines
-  Town
-  Cuyama Watershed (HUC8)
-  Cuyama Basin





0 1.75 3.5 7 Miles

Map Created: April 2024

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Areas of Recharge, Potential Recharge, and Groundwater Discharge Areas

Areas of recharge and potential recharge lie primarily within the central and low-lying areas of the Cuyama Valley. Agricultural and open space lands are considered areas of potential recharge.

Figure 2-26

Figure 2-26 shows areas with their potential for groundwater recharge, as identified by the Soil Agricultural Groundwater Banking Index (SAGBI). SAGBI provides an index for the groundwater recharge for agricultural lands by considering deep percolation, root zone residence time, topography, chemical limitations, and soil surface condition. SAGBI data categorizes 22,675 acres out of 37,568 acres (60 percent) of agricultural and grazing land within the Basin as moderately good, good, or excellent for groundwater recharge (University of California, Davis, 2018). SAGBI data shown in

Figure 2-26

Figure 2-26 is derived from “modified” SAGBI data. “Modified” SAGBI data show higher potential for recharge than unmodified SAGBI data because the modified data assume that the soils have been or will be ripped to a depth of 6 feet, which can break up fine grained materials at the surface to improve percolation. Groundwater discharge areas are identified as springs located within the Basin. Figure 2-26 shows the location of historical springs identified by the USGS (NWIS, 2018). The springs shown represent a dataset collected by the USGS and are not a comprehensive map of springs in the Basin.

~~Groundwater discharge areas are identified as springs located within the Basin.~~

~~Figure 2-18 shows the location of historical springs identified by the USGS (NWIS, 2018). The springs shown in represent a dataset collected by the USGS and are not a comprehensive map of springs in the Basin.~~

Soils

Soils in the Basin were categorized by the National Resource Conservation Service (NRCS). The Basin is comprised mostly of fine- to coarse-loamy soils (NRCS STATSGO2, 2018). As shown in Figure 2-27, the valley bottom and primary soil surrounding the Cuyama River and its tributaries is primarily fine-loamy soils, while the northern boundary of the Basin has coarse-loamy soils.

Figure 2-28 shows soils by hydrologic soil group. Hydrologic soil groups were calculated by the NRCS on a by-county basis. As shown in Figure 2-28, interpretations of soil groups varied by county in each study. In general, hydrologic soil groups are sorted by permeability, with class A being the most permeable and class D being the least permeable. Figure 2-28 shows that in general most of the soils in the Basin have lower permeabilities and are listed as class C or D, with higher permeabilities being located near streams and rivers.



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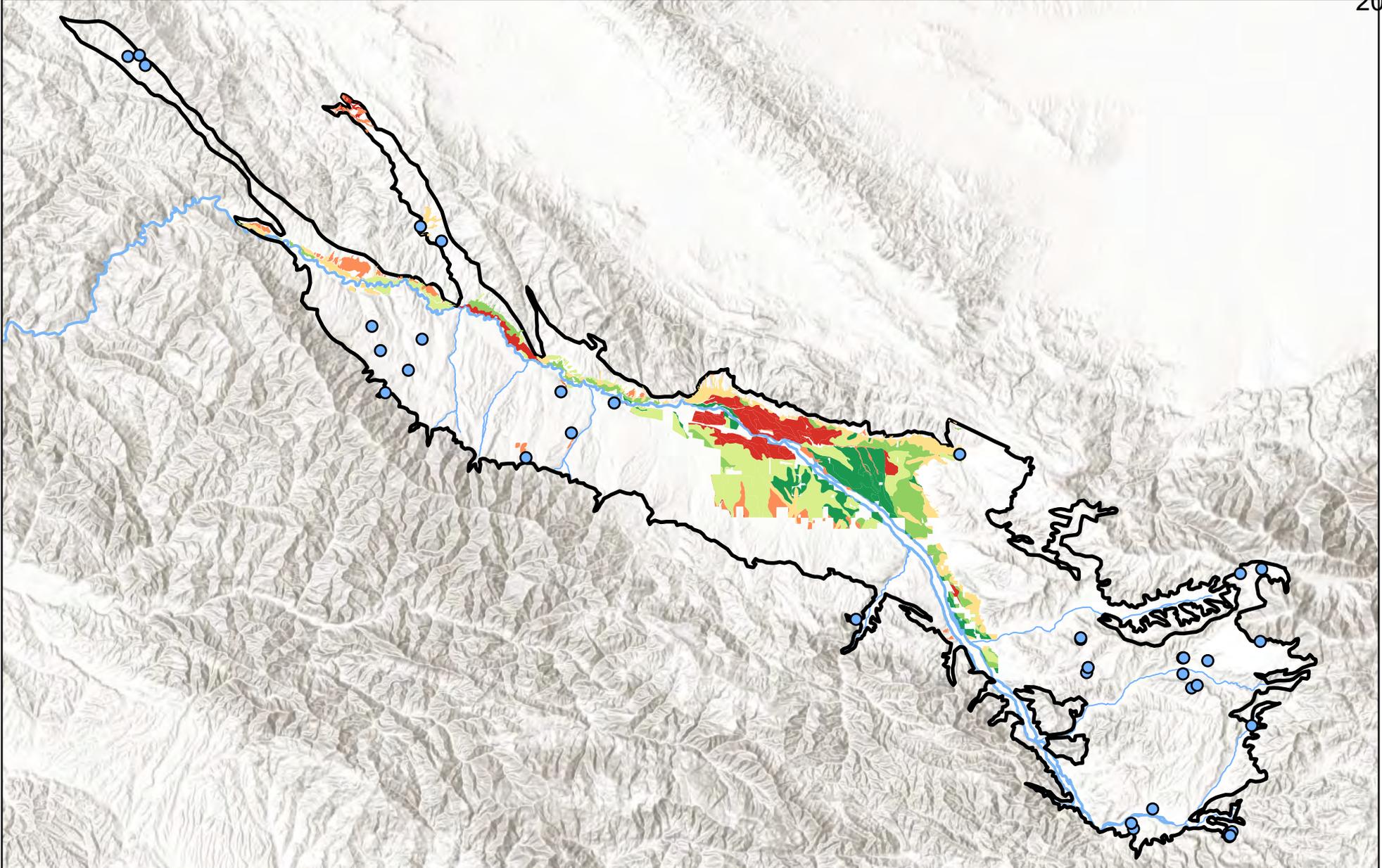


Figure 2-26: Recharge Areas, Springs, and Seeps

Cuyama Valley Groundwater Basin

Legend

- | | | |
|---------------------------|---------------------------|-----------------------|
| Modified SAGBI Score | Moderately Poor (49 - 29) | NHD Springs and Seeps |
| Excellent (100 - 85) | Poor (29 - 15) | Creek |
| Good (85 - 69) | Very Poor (15 - 0) | Cuyama River |
| Moderately Good (69 - 49) | | Cuyama Basin |



Woodard & Curran



0 1.75 3.5 7 Miles

Map Created: February 2024

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STATSGO2 Soils

- Nacimiento-Los Osos-Balcom-Ayar (s897) - Fine-loamy
- Shedd-Gaviota (s922) - Fine-silty, loamy
- Xerothents-Pleasanton-Elder-Botella (s924) - Fine-Loamy
- Stutzville-Panoche-Metz (s925) - Fine-loamy
- Wasioja-Panoza (s928) - Fine/coarse-loamy
- Semper-Rock outcrop-Panzoa (s931) - Coarse-loamy
- Kilmer-Beam-Badland (s932) - Fine-loamy
- Millsholm-Millerton-Lodo (s933) - Loamy
- Modjeska family-Coarsegold-Aramburu variant (s934) - Loamy
- Marpa-Hilt-Arrastre (s935) - Fine/coarse/skeletal-loamy
- Los Gatos-Gamboa (s936) - Fine/skeletal-loamy
- Xerofluvents-Oak Glen-Dotta (s937) - Coarse/fine-loamy
- Panzoa-Kilmer-Hillbrick-Beam (s977) - Loamy
- Yeguas variant-Rock outcrop-Gaviota-Franciscan-Bellyache variant (s978) - Fine-loamy

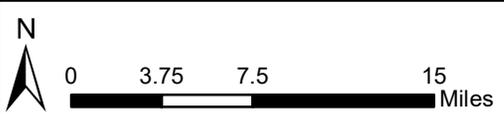
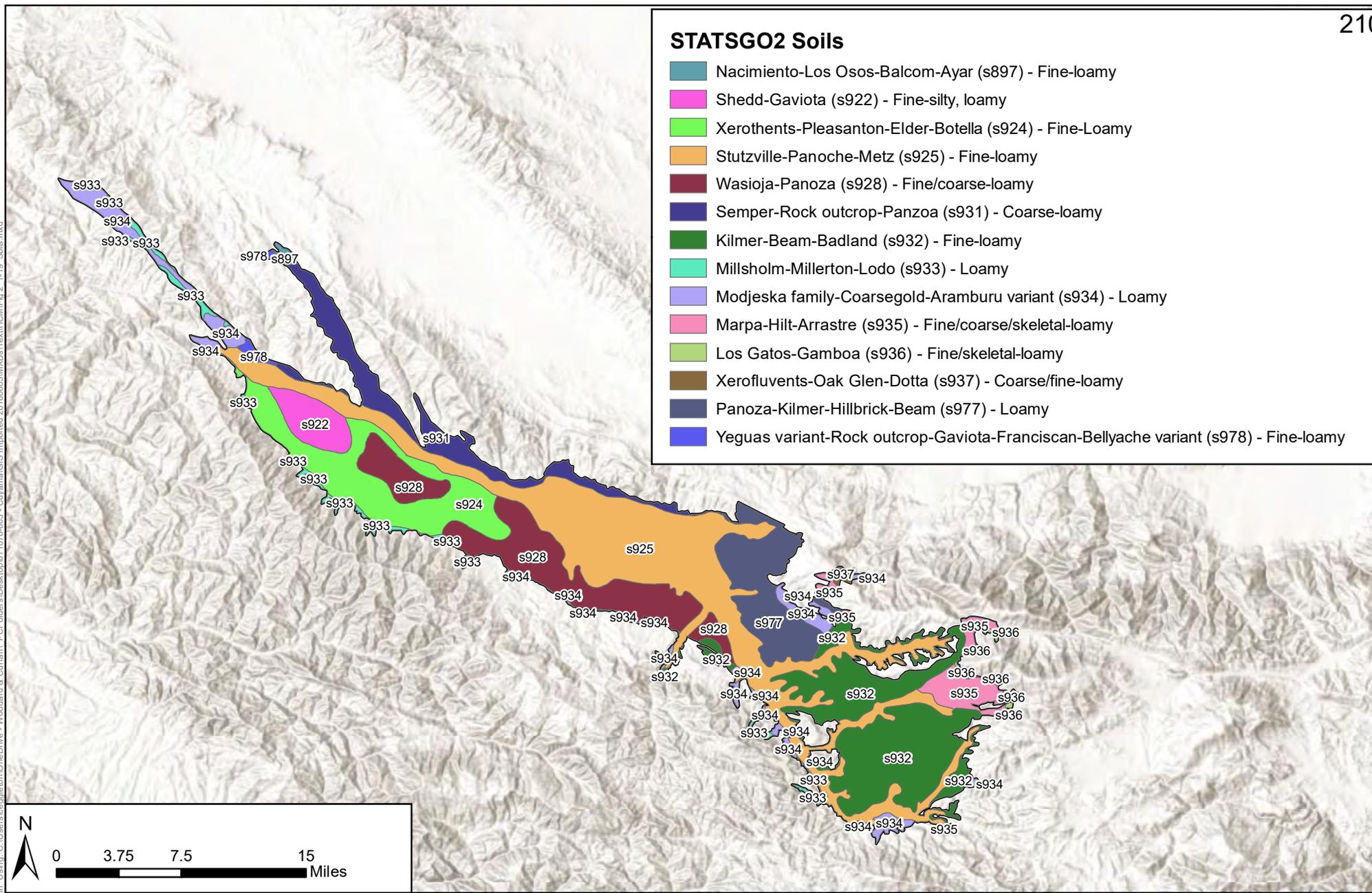


Figure 2-27: Soils

Cuyama Basin Groundwater Sustainability Agency

Cuyama Valley Groundwater Basin Groundwater Sustainability Plan

December 2019



Legend

Cuyama Basin

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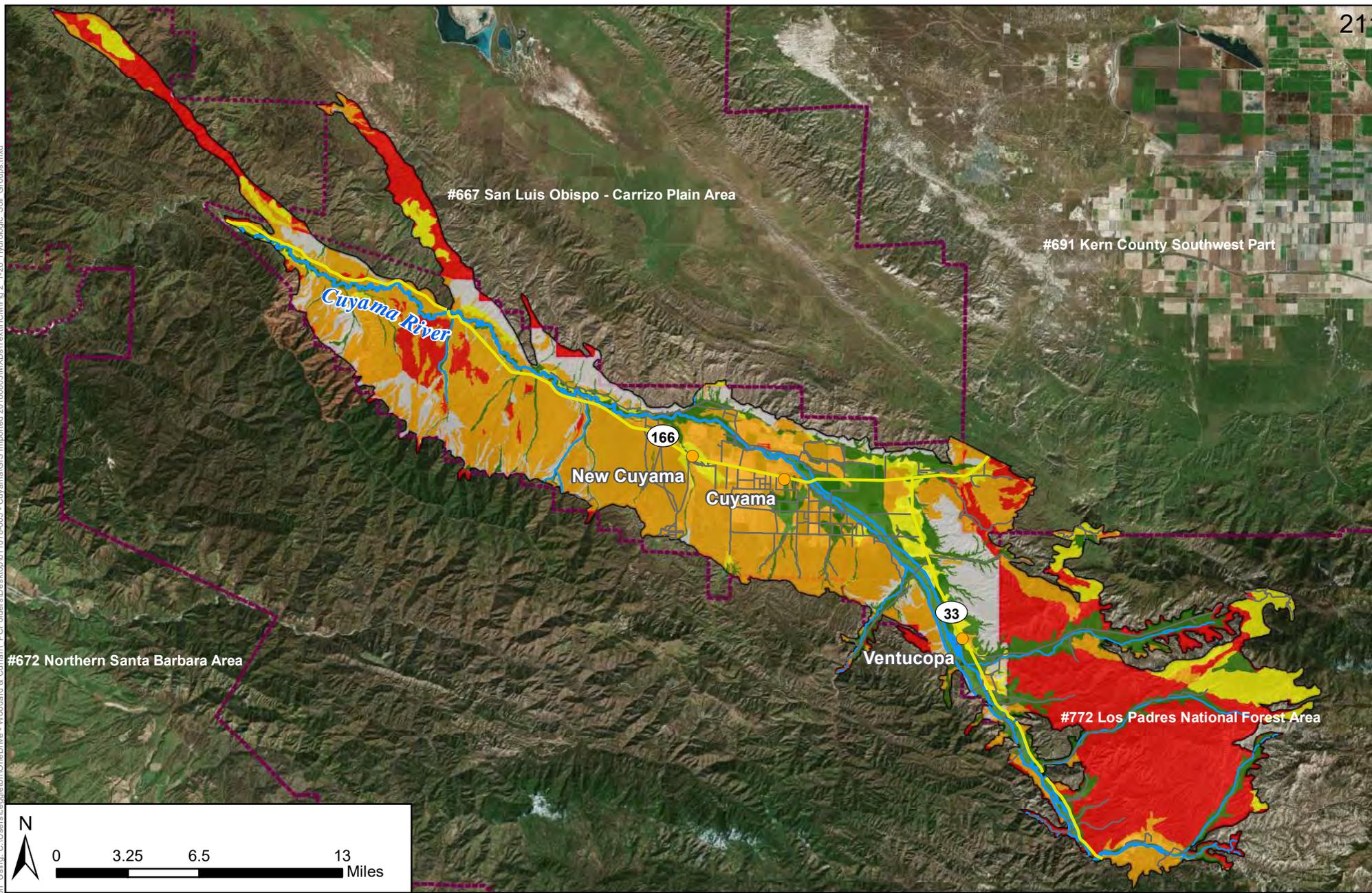


Figure 2-28: Hydrologic Soil Groups

Cuyama Basin Groundwater Sustainability Agency

Cuyama Valley Groundwater Basin Groundwater Sustainability Plan

December 2019



Legend

- Cuyama Basin
- Cuyama River
- Streams
- Towns
- Highways

Hydrologic Soil Group

- A
- B
- C
- D
- Not classified

- Soil Survey Boundary

Soil Survey Key:

- #772 Los Padres National Forest Area
- Soil Survey Number
- Survey Name



2.1.10 Hydrogeologic Conceptual Model Data Gaps

The following are the HCM data gaps that were identified during the development of this GSP. ~~There is no consensus about whether faults are barriers to flow amended GSP. The surface geophysical survey of the subsurface Santa Barbara Canyon Fault confirmed its presence in the Basin, and if so, at what depth are they a barrier to flow. There is Cuyama River channel near its inferred location. The survey also confusion about whether smaller faults and confirmed the fault splays are barriers does not extend to the east as reported. It is uncertain whether the fault extends to the northeast from the location identified by the geophysical survey and, if so, where it crosses SR 33 to flow. Aquifer the north of Line 1. However, the possible northeast extension of the fault would not resolve the significant change in groundwater elevations that occurs further to the south of Line 1, namely between TSS #3 and MW-H (i.e., Opti wells 903-905 and 915 and 916). These data gaps may be resolved with an additional surface geophysical survey with transects extending to the north and to the south of Line 1 on or near SR 33. A continuing data gap is aquifer properties in areas where aquifer testing has not been conducted. These aquifer properties are not well defined, and are estimated. The connection between groundwater levels upstream of Ventucopa and in the Ventucopa region are not well understood; additionally, it is not well understood if Lastly, the extent of brackish groundwater flows are channelized discovered in the Ventucopa and upland regions. Lastly, connectivity between the alluvium west TSS #1 wells east of the Russel Fault and areas in upland areas is unknown and potential impacts to nearby groundwater is not agreed upon understood.~~ Other data gaps may be discovered during implementation of the GSP.



2.2 Basin Settings: Overview

This Cuyama Valley Groundwater Basin (Basin) Settings chapter contains three main sections as follows:

- Hydrogeologic Conceptual Model (HCM) – The HCM section (Section 2.1) provides the geologic information needed to understand the framework that water moves through in the Basin. It focuses on geologic formations, aquifers, structural features, and topography.
- Groundwater Conditions – The Groundwater Conditions section (Section 2.2) describes and presents groundwater trends, levels, hydrographs and level contour maps, estimates changes in groundwater storage, identifies groundwater quality issues, addresses subsidence, and addresses surface water interconnection.
- Water Budget – The Water Budget section (Section 2.3) describes the data used to develop the water budget. Additionally, this section discusses how the budget was calculated, provides water budget estimates for historical conditions, and current conditions and projected conditions.

2.1.112.2.1 Basin Settings: Groundwater Conditions

This section of Chapter 2 satisfies Section 354.8 of the SGMA regulations, and describes the historical and current groundwater conditions in the Basin. Water budget components follow in Section 2.3.

As defined by the SGMA regulations, this section does the following:

- Defines current and historical groundwater conditions in the Basin
- Describes the distribution, availability, and quality of groundwater
- Identifies interactions between groundwater, surface water, groundwater-dependent ecosystems, and subsidence
- Establishes a baseline of groundwater quality and quantity conditions that will be used to monitor changes in the groundwater conditions relative to measurable objectives and minimum thresholds
- Provides information to be used for defining measurable objectives to maintain or improve specified groundwater conditions
- Supports development of a monitoring network to demonstrate that the Cuyama Basin Groundwater Sustainability Agency (CBGSA) is achieving Basin sustainability goals

The majority of published information about groundwater in the Basin is focused on the central part of the Basin, roughly from an area a few miles west of New Cuyama to roughly Ventucopa. The eastern uplands and western portion of the Basin have been studied less, and consequentially, fewer publications have been written about those areas, and less historical information is available in those areas.



The groundwater conditions described in this section are intended to convey the present and historical availability, quality, and distribution of groundwater and are used elsewhere in the GSP to define measurable objectives, identify sustainability indicators, and establish undesirable results.

Groundwater conditions in the Basin vary by location. To assist in discussion of the location of specific groundwater conditions, ~~Figure 2-21~~ Figure 2-29 shows selected landmarks in the Basin to ~~assist~~support ~~the~~ discussion of the location of specific groundwater conditions. ~~Figure 2-21~~ Figure 2-29 shows major faults in the Basin in red, highways in yellow, towns as orange dots, and canyons and Bitter Creek in purple lines that show their location. The map calls out the Russell Ranch and South Cuyama oil fields in red.

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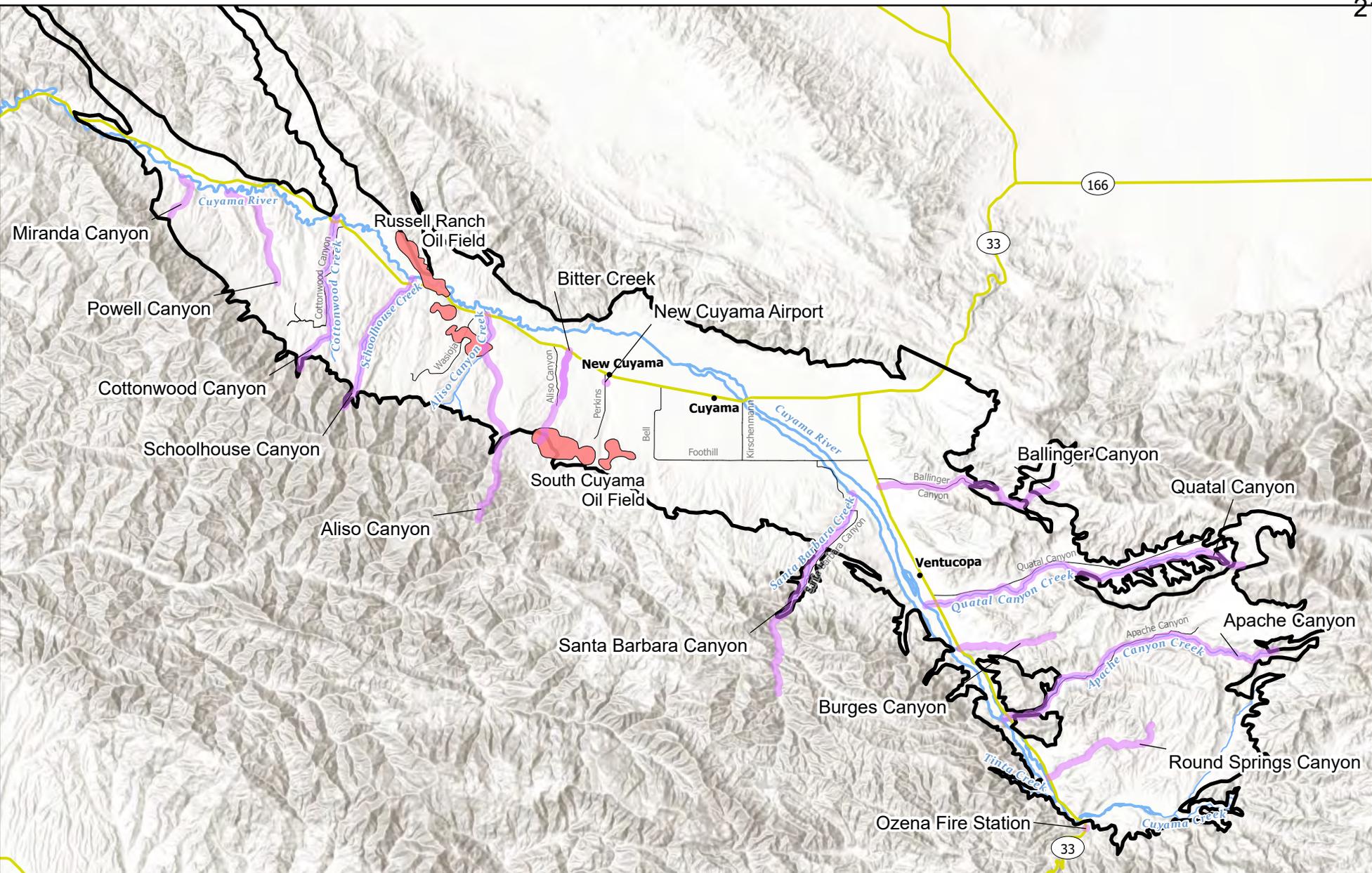


Figure 2-29: Landmarks

Cuyama Valley Groundwater Basin

Legend

- Oil Field
- Highway
- Creek
- Landmark
- Local Road
- Cuyama River
- Town
- Cuyama Basin



0 1.5 3 6 Miles

Map Created: April 2024

Third Party GIS Disclaimer: This map is for reference and graphical purposes only and should not be relied upon by third parties for any legal decisions. Any reliance upon the map or data contained herein shall be at the users' sole risk. Data sources: CA DOC, CA DWR, Esri, USGS



2.1.122.2.2 Useful Terms

This section of Chapter 2 includes descriptions of the amounts, quality, and movement of groundwater, among other related components. A list of technical terms and their definitions are below. These definitions are given to guide readers through the section and are not a definitive definition of any term.

- **Depth to groundwater** – This is the distance from the ground surface to groundwater, typically reported at a well.
- **Horizontal gradient** – The horizontal gradient is the slope of groundwater from one location to another when one location is higher, or lower than the other. The horizontal gradient is shown on maps with an arrow showing the direction of groundwater flow in a horizontal direction.
- **Vertical gradient** – A vertical gradient describes the movement of groundwater perpendicular to the ground surface. Vertical gradient is measured by comparing the elevations of groundwater in wells that are of different depths. A downward gradient is one where groundwater is moving down into the ground, and an upward gradient is one where groundwater is upwelling towards the surface.
- **Contour map** – A contour map shows changes in groundwater elevations by interpolating groundwater elevations between monitoring sites. The elevations are shown on the map with the use of a contour line, which indicates that at all locations that line is drawn, it represents groundwater being at the elevation indicated. There are two versions of contour maps shown in this section as follows:
 - Elevation of groundwater above mean sea level, which is useful because it can help identify the horizontal gradients of groundwater, and
 - Depth to water (i.e. the distance from the ground surface to groundwater), which is useful because it can help identify areas of shallow or deep groundwater.
- **Hydrograph** – A hydrograph is a graph that shows the changes in groundwater elevation over time for each monitoring well. Hydrographs show how groundwater elevations change over the years and indicate whether groundwater is rising or descending over time.
- **Maximum contaminant level (MCL)** – An MCL is a standard set by the State of California regarding drinking water quality. An MCL is the legal threshold on the amount of a substance that may appear in public water systems. MCLs are different for different constituents in drinking water.
- **Elastic land subsidence** – Elastic land subsidence is the reversible and temporary fluctuation in the earth's surface in response to seasonal periods of groundwater extraction and recharge.
- **Inelastic land subsidence** – Inelastic land subsidence is the irreversible and permanent decline in the earth's surface resulting from the collapse or compaction of the pore structure within the fine-grained portions of an aquifer system.



2.1.132.2.3 Historical Groundwater Elevation Data Processing

Groundwater Prior to GSP adoption in January 2020 groundwater well information and groundwater level monitoring data were compiled from four public sources, with additional data compiled from private landowners. These sources include the following:

- DWR
- USGS
- ~~DWR~~
- Santa Barbara County Water Agency (SBCWA)
- San Luis Obispo County
- Private landowners

Data provided by these sources included well information such as location, well construction, well owner, ground surface elevation and other related components, as well as groundwater elevation data including information such as date measured, depth to water, groundwater surface elevation, questionable measurement code, and comments. At the time that this analysis was performed, groundwater elevation data was available for the time period from 1949 to June 2018.³ There are many wells with monitoring data from some time in the past, but no recent data, while a small number of wells have monitoring data recorded for periods of greater than 50 years. Figure 2-30 through Figure 2-33 show well locations with available monitoring data, and the entity that maintains monitoring records at each well. These figures also show in a larger, darker symbol if the monitoring well has been measured in 2017 or 2018.

Figure 2-30 shows the locations of well data received from the DWR database. As an assessment of which wells have been monitored recently, the wells with monitoring data collected between January 2017 and June 2018 were identified. Roughly half of the wells from DWR's database contain monitoring data in 2017-18, with roughly half the wells having no monitoring data during this period. Wells in DWR's database are concentrated in the central portion of the Basin, east of Bitter Creek and north of the Santa Barbara Canyon Fault (SBCF). Many wells in DWR's database have been typically measured bi-annually, with one measurement in the spring, and one measurement in the fall.

Figure 2-31 shows the locations of well data received from the USGS database. Many of these wells are duplicative of wells contained in the DWR database. The majority of wells from the USGS database were not monitored in 2017-18. Wells that were monitored in 2017-18 are concentrated in the western portion of the Basin, west of New Cuyama, with a small number of monitoring wells in the central portion of the

³ The analysis shown in this section was performed in the summer of 2018 and does not reflect data that may have been collected after June 2018. In addition, the analysis reflects the available data as provided by each entity - an assessment has not been performed on the standards and protocols followed by each entity that compiles and maintains the available datasets.



Basin and near Ventucopa. Many wells in the USGS database have~~s~~ been typically measured bi-annually, with one measurement in the spring, and one measurement in the fall-

Figure 2-24.



Figure 2-32 ~~Figure 2-32~~ shows the locations of well data received from Santa Barbara and San Luis Obispo counties. Wells from both counties were monitored in 2017-18. Wells monitored by Santa Barbara County are concentrated in the western portion of the Basin west of Bitter Creek. The two wells monitored by San Luis Obispo County are in the central portion of the Basin; these wells also appear in the USGS database. Data are collected in many of these wells on a bi-annual basis, with one measurement in the spring, and one measurement in the fall, with some measurements at some wells occurring on a quarterly basis.

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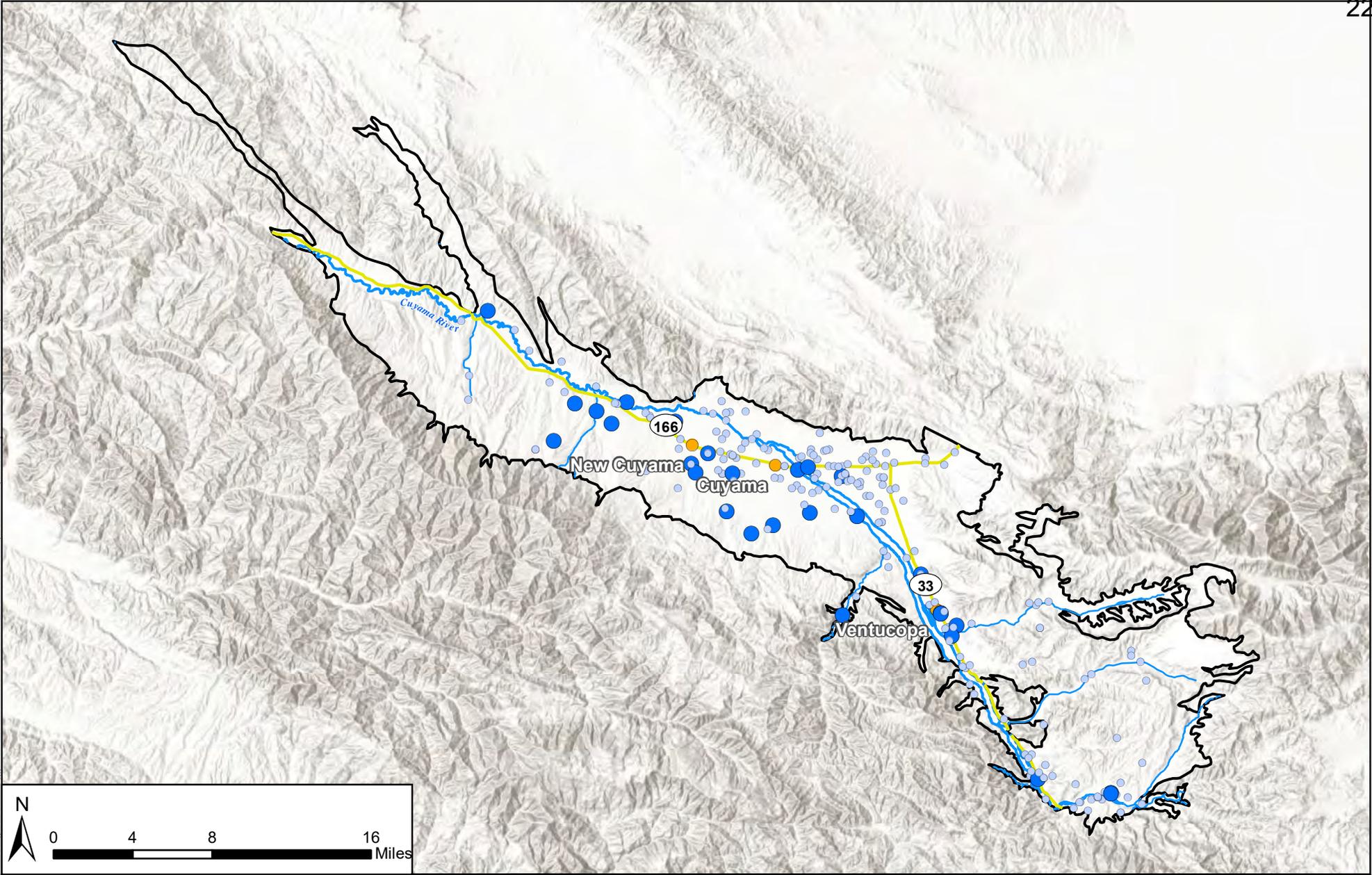


Figure 2-30: Cuyama GW Basin Wells with Monitoring Data Provided by DWR

Cuyama Basin Groundwater Sustainability Agency

Cuyama Valley Groundwater Basin Groundwater Sustainability Plan

December 2019

	Legend	 Cuyama Basin	 DWR Database Wells Last Measured in 2017-2018
		 Towns	 DWR Database Wells Last Measured 2016 and Earlier
		 Highways	
		 Cuyama River	
		 Streams	

Figure Exported: 11/13/2018 8:49:33 AM By: cec@lele.com Using: C:\Users\cec@lele.com\OneDrive - Woodard & Curran\PC\Folders\Desktop\Current Projects\011078-003 - Cuyama01 Local Cuyama GIS 2018\0803\WXDs\Text\Groundwater Conditions\Fig2_23_OPT1_Wells by_Agency

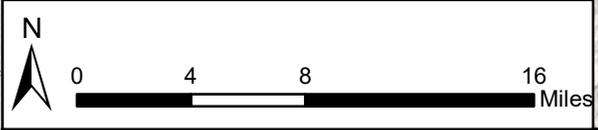
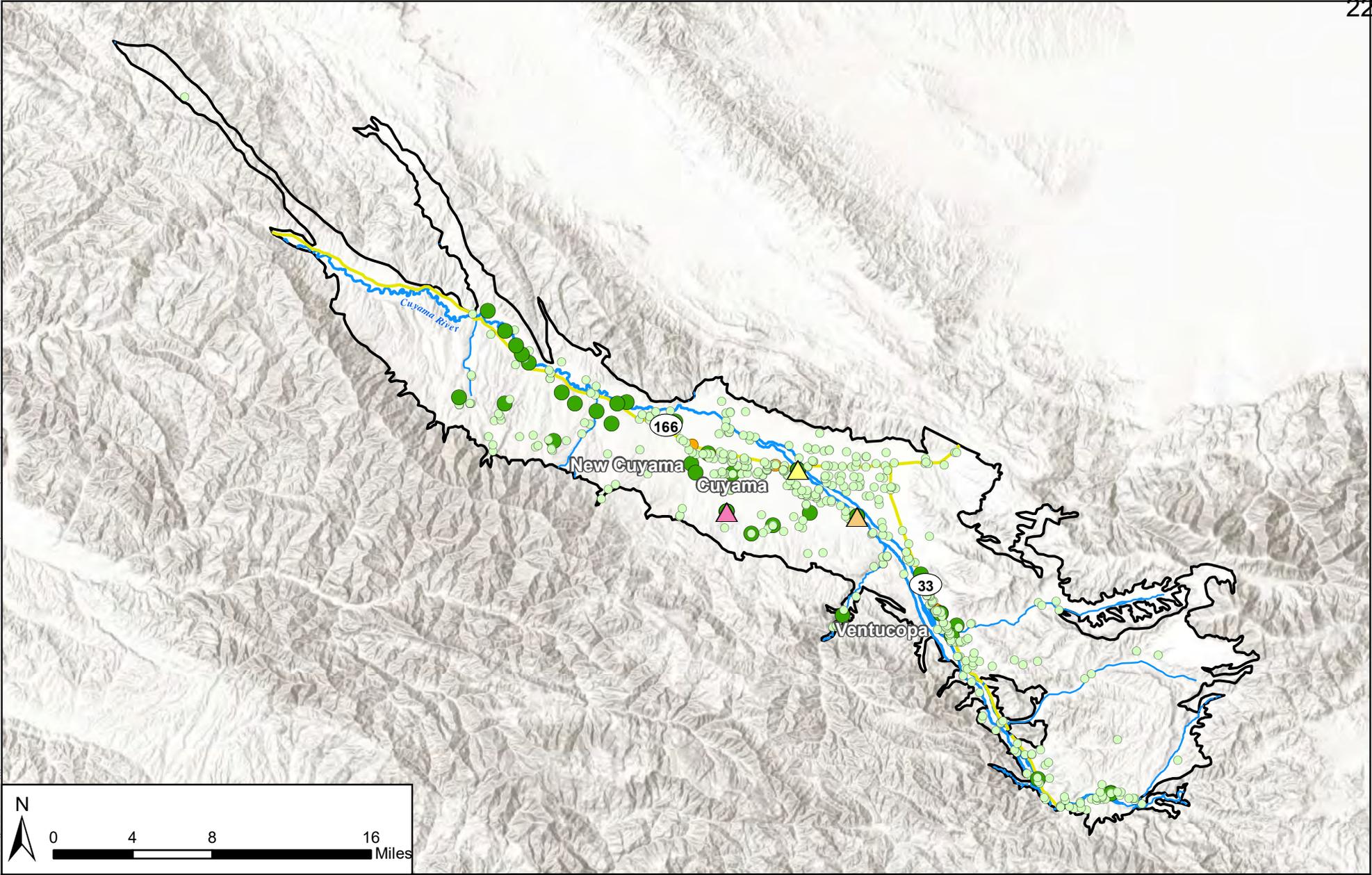


Figure 2-31: Cuyama GW Basin Wells with Monitoring Data Provided by USGS

Cuyama Basin Groundwater Sustainability Agency

Cuyama Valley Groundwater Basin Groundwater Sustainability Plan

December 2019



Legend

- Cuyama Basin
- Towns
- Highways
- Cuyama River
- Streams
- USGS Database Wells Last Measured in 2017-2018
- USGS Database Wells Last Measured 2016 or Earlier
- CVBR Multi-Completion Well
- CVFR Multi-Completion Well
- CVKR Multi-Completion Well



Figure Exported: 11/13/2018 11:13:20 AM By: cec@lelelon Using: C:\Users\cec@lelelon\OneDrive - Woodard & Curran\PC\Folders\Desktop\Current Projects\011078-003 - Cuyama01 Local Cuyama GIS 2018\0803\WX\Ds1\Text\Groundwater Conditions\Fig2_24_OPT1_Wells by_Agency

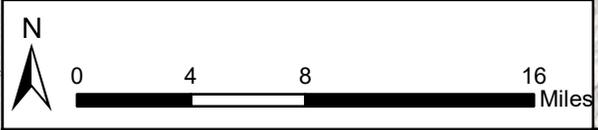
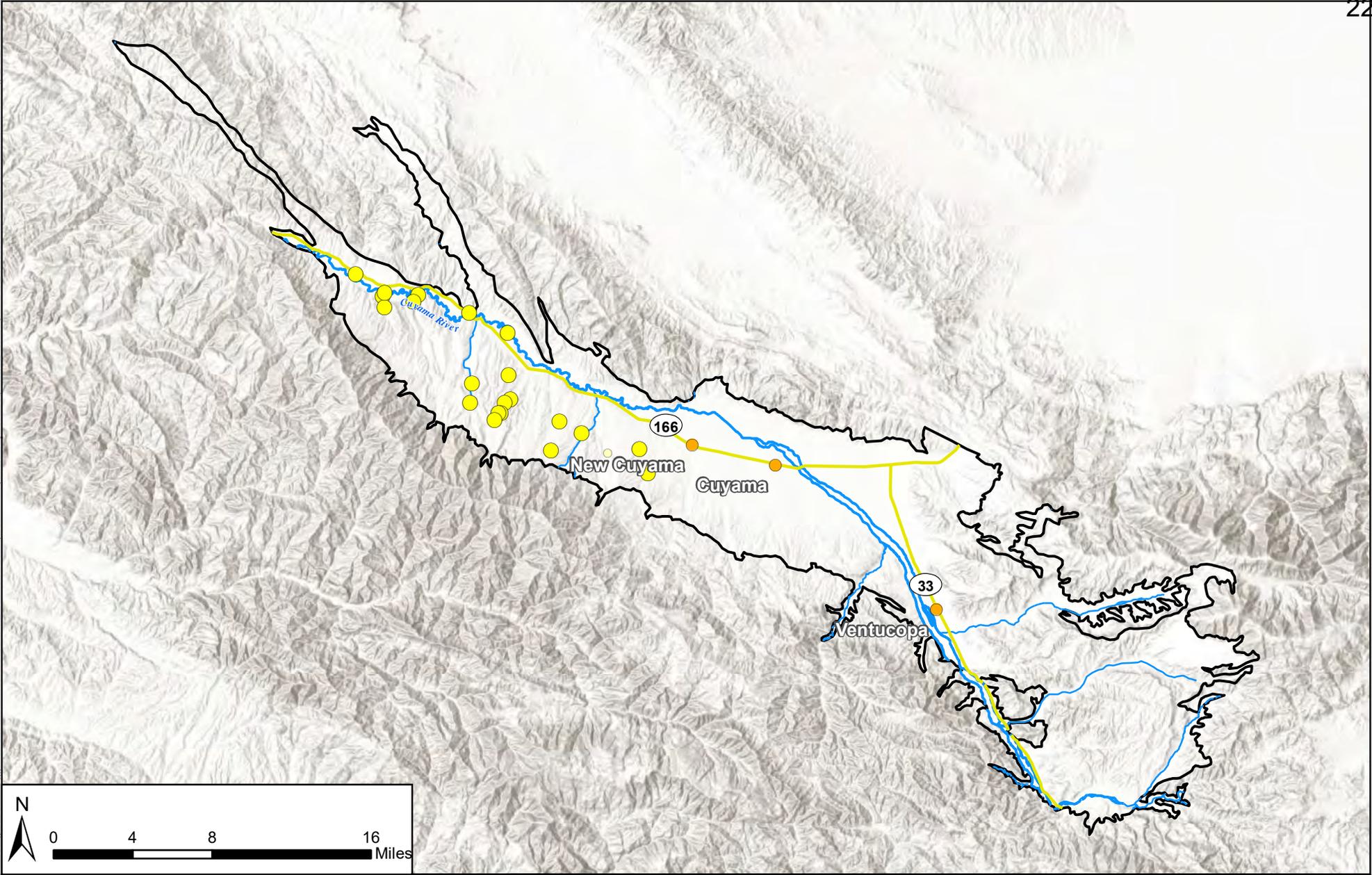


Figure 2-32: Cuyama GW Basin Wells with Monitoring Data Provided by Local Agencies

Cuyama Basin Groundwater Sustainability Agency

Cuyama Valley Groundwater Basin Groundwater Sustainability Plan

December 2019

 <p>WOODARD & CURRAN</p>	<p>Legend</p>	 Cuyama Basin	 County Database Wells Last Measured in 2017-2018
		 Towns	 County Database Wells Last Measured 2016 or Earlier
		 Highways	
		 Cuyama River	
		 Streams	



Figure 2-33 shows the locations of well data received from private landowners. The majority of wells provided by private landowners are located in the central portion of the Basin, between the Cuyama River and Highway 33, generally running along SR 166. Additional wells provided by private landowners are located along the Cuyama River and SR 166, nearwest of the Russell Ranch Oilfields Fault. Associated data provided with private landowners varies by source. Some data and measurements were taken annually, while other well owners ~~were taken~~ recorded data biannually or quarterly.

Figure 2-34 shows the locations of collected data from all entities by their last measured date- prior to the GSP 2020 submittal. Wells with monitoring data in 2017-2018 are shown in bright green triangles. There are recent measurements in many different parts of the Basin as follows:

- Near the Cuyama River in the eastern uplands and near Ventucopa
- In the central portion of the Basin, especially north of SR 166 but with some wells located in the southern portion of the central basin
- In the western portion of the Basin east of Aliso Canyon. An additional concentration of recent monitoring points is present along the Cuyama River near east of the Russell Ranch Oilfields Fault.

Figure 2-35 shows a comparison of data provided by private landowners and data compiled from the DWR, USGS, and the USGS county databases in the central portion of the Basin. This figure was developed to provide information on the consistency between data from these differing sources. The figure shows the location of compared wells, and the measurements on those wells by source. The measurements of groundwater elevation among the ~~measured~~ wells shown indicate that the monitoring by the private landowners and agencies approximately match in tracking historical trends from the public databases.

Figure 2-36 shows a comparison of data collected from other private landowners, and data collected from SBCWA. This figure was developed to provide information on the consistency between data from these differing sources. The figure shows the location of compared wells, and the measurements ~~on~~ from those wells by source. A long-term comparison is not possible due to the shorter measurement period of the Santa Barbara County wells, but the measurements of groundwater elevation among the measured wells indicate that the monitoring by private landowners in the western portion of the Basin and the county are similar in elevation, with the county's data showing slightly higher elevations.

2.2.4 Processing of Groundwater Elevation Data Since GSP Submittal

Since 2020, the CBGSA has performed monitoring of groundwater levels on a quarterly basis through the development of its own monitoring network. This network is described in detail in Chapter 4 of this GSP. Data collection was begun in August 2020. Additional efforts have improved understanding of the wells in the monitoring network, including a well survey that was completed in 2021 which surveyed the latitude, longitude, and elevation of each well. In addition, in October 2022, a well information survey was sent to all landowners in the Basin. This survey provided information on well ownership, location,



and completion information, well type (irrigation, residential, etc.), and well status (pumping vs not pumping).

Data processing of these data has been refined as additional data on wells from landowners has been received. This information has been included in the public Opti data management system (DMS) for review by Cuyama Basin Stakeholders. In addition to collecting data on wells already identified during GSP development, the CBGSA has constructed three new piezometers near mapped GDE locations and new multi-completion nested monitoring wells at six locations using grant funding from DWR. In addition, DWR constructed three new multi-completion nested wells under its Technical Support Services program. These new wells are located in areas that were identified by the CBGSA as spatial data gaps in the 2020 GSP. They are described in more detail in sections 2.2.4 and 2.2.10.

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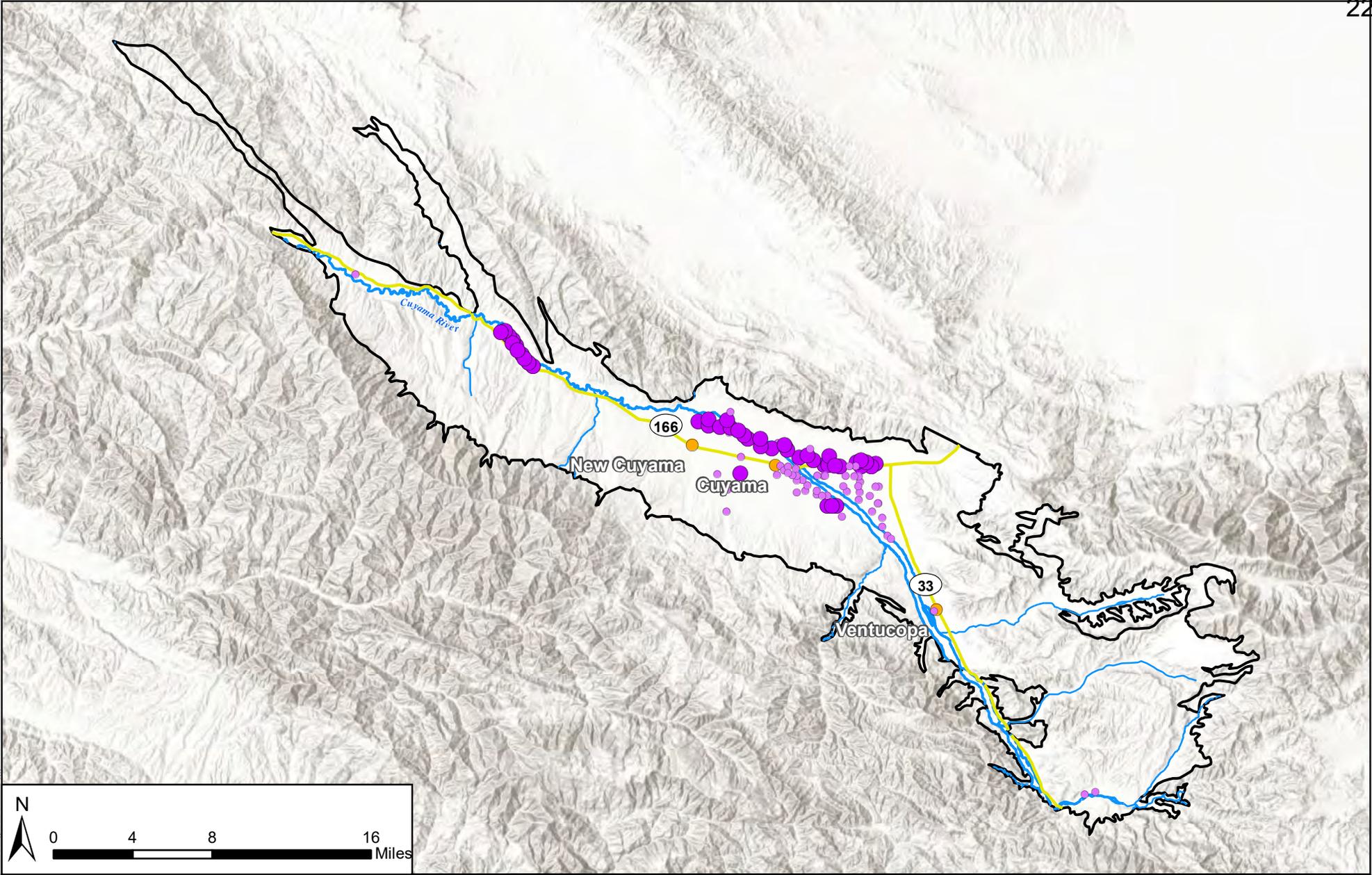


Figure 2-33: Cuyama GW Basin Wells with Monitoring Data Provided by Private Landowners

Cuyama Basin Groundwater Sustainability Agency
 Cuyama Valley Groundwater Basin Groundwater Sustainability Plan
 December 2019

	Legend	 Cuyama Basin	 Private Landowners Reported Wells Last Measured in 2017-2018
		 Towns	 Private Landowners Reported Wells Last Measured 2016 and Earlier
		 Highways	
		 Cuyama River	
		 Streams	

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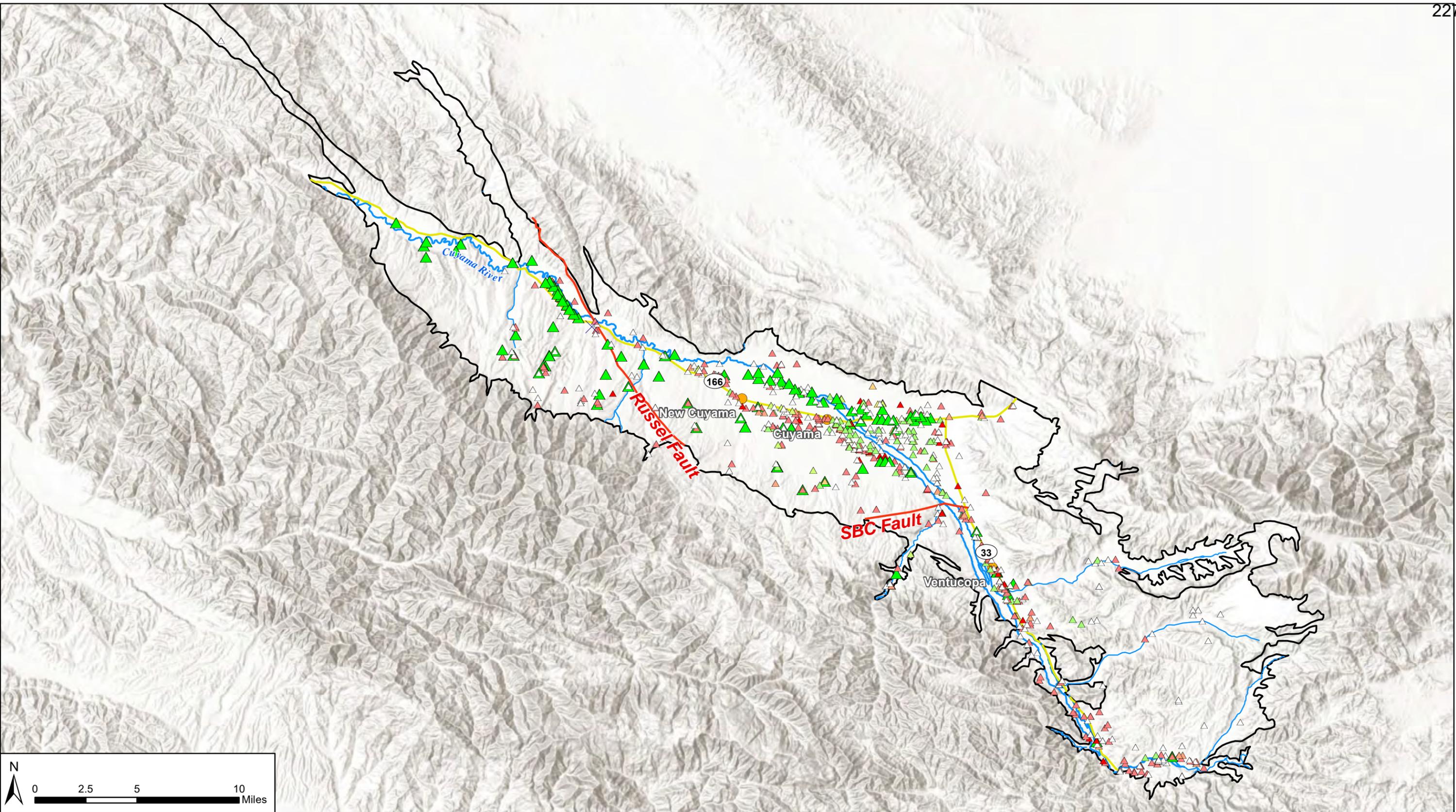


Figure 2-34: Cuyama GW Basin Wells by Last Measurement Date
 Cuyama Basin Groundwater Sustainability Agency
 Cuyama Valley Groundwater Basin Groundwater Sustainability Plan
 September 2019

 WOODARD & CURRAN	Legend	 Cuyama Basin	 Cuyama River	Most Recent Year with Measurements		
		 Highways	 Streams	 2017 - 2018	 1980 - 1989	 Pre-1950
 Towns	 Fault	 2010 - 2016	 1970 - 1979	 No Measurement Data		
		 2000 - 2009	 1960 - 1969			
		 1990 - 1999	 1950 - 1959			

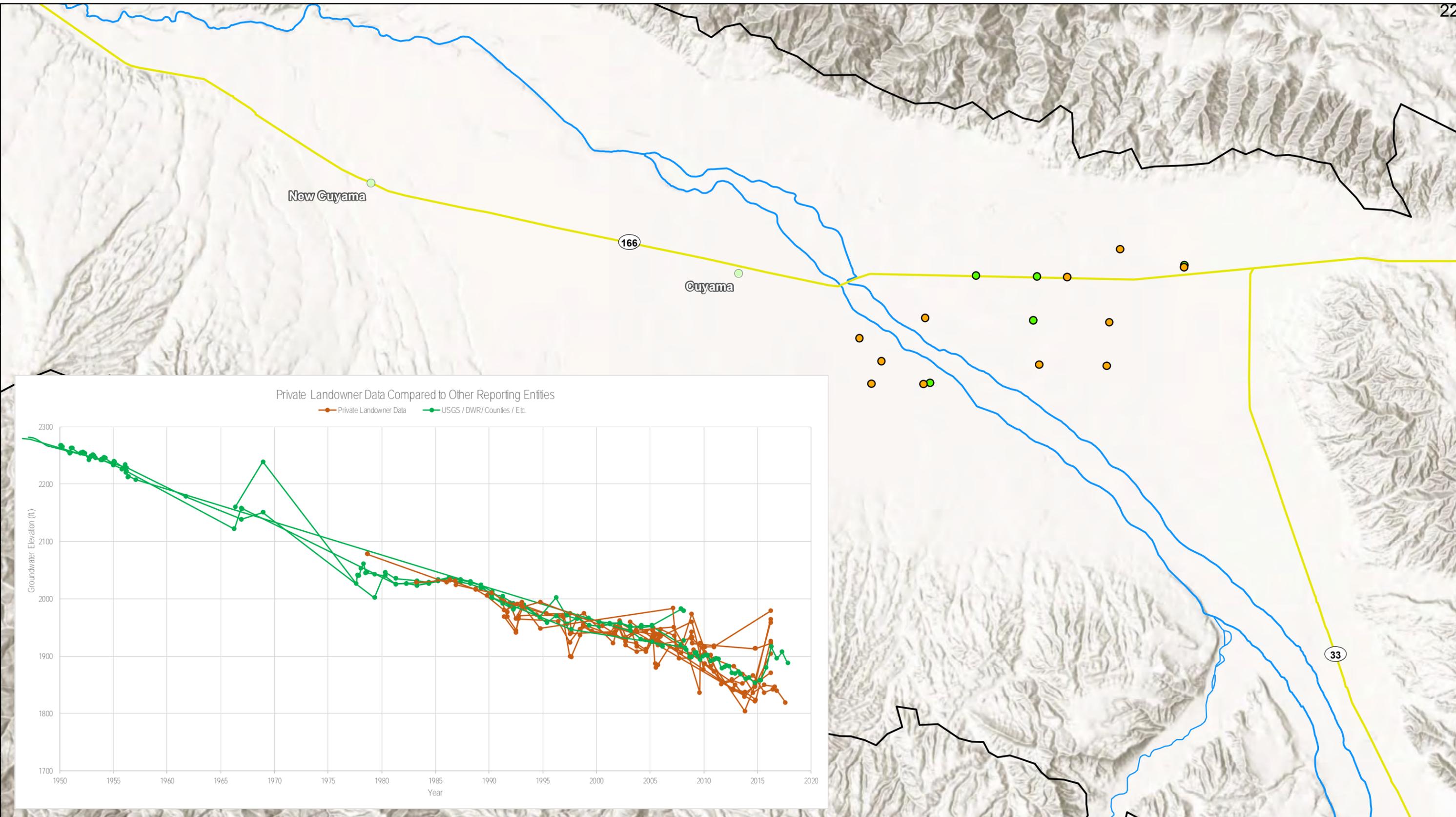


Figure 2-35: Central Cuyama GW Basin Wells and Hydrographs by Data Source
 Cuyama Basin Groundwater Sustainability Agency
 Cuyama Valley Groundwater Basin Groundwater Sustainability Plan
 December 2019



- Legend**
- Cuyama Basin
 - USGS, DWR, County, Etc., Wells
 - Towns
 - Private Landowners
 - Highways
 - Cuyama River
 - Streams

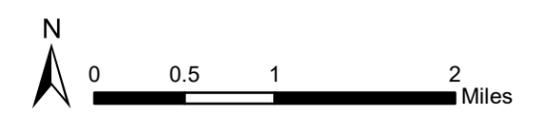


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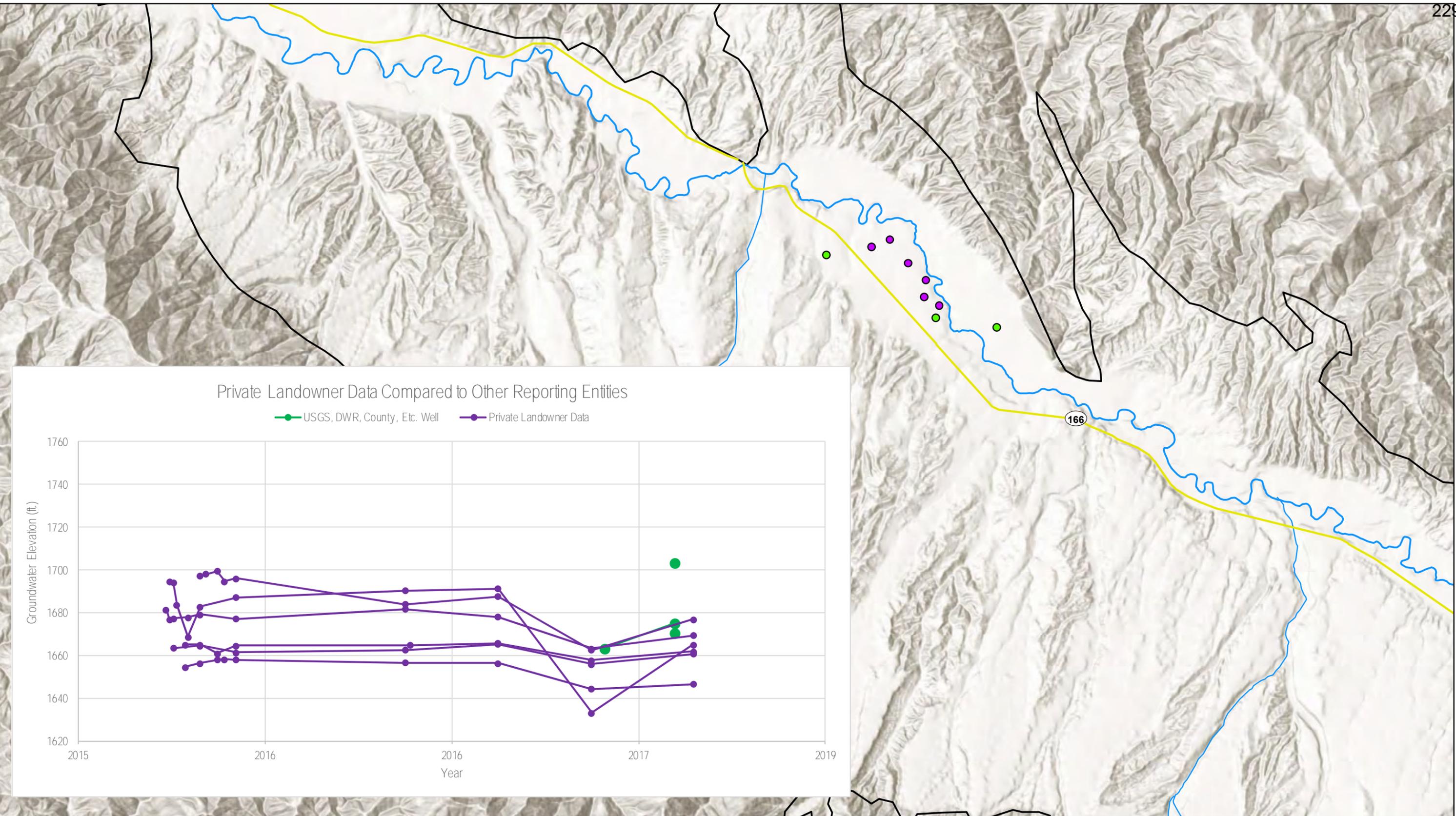
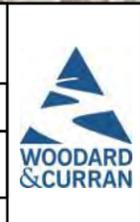
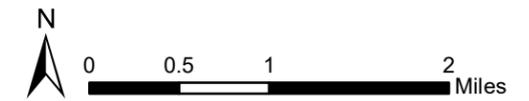


Figure 2-36: Western Cuyama GW Basin Wells and Hydrographs by Data Source
 Cuyama Basin Groundwater Sustainability Agency
 Cuyama Valley Groundwater Basin Groundwater Sustainability Plan
 December 2019



Legend

- Cuyama Basin
- Highways
- Cuyama River
- Streams
- USGS, DWR, County, Etc. Wells
- Private Landowner Wells





2.1.142.2.5 Groundwater Trends

This section describes groundwater trends in the Basin generally from the oldest available studies and data to the most recent. Groundwater conditions vary widely across the Basin. In the following sections, historical context is provided by summarizing information from relevant studies about conditions from 1947 to 1966, followed by discussion of how groundwater conditions have changed based on available historical groundwater level monitoring data.

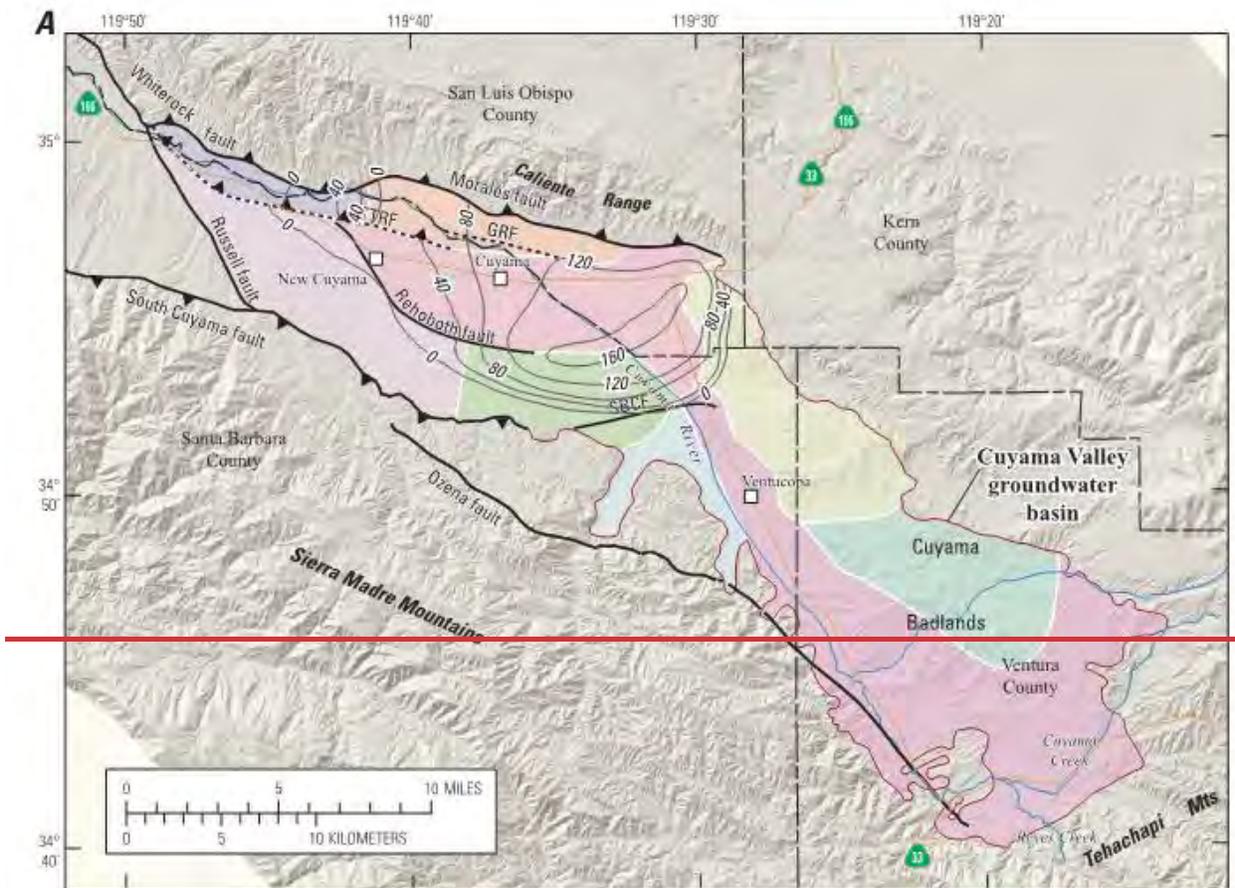
Historical Context – 1947 to 1966 Groundwater Trends

This section discusses public reports about conditions from 1947 to 1966. Information about groundwater conditions in the Basin during this period are limited to reports that discuss the central portion of the Basin and scattered groundwater elevation measurements in monitoring wells.

A USGS report titled *Water Levels in Observation Wells in Santa Barbara County, California* (USGS, 1956) discussed groundwater elevation monitoring in the Basin. The report states that ~~–,~~ prior to 1946, there was no electric power in the Cuyama Valley, which restricted intensive irrigation, and that groundwater levels in the central portion of the Basin remained fairly static until 1946. The report states that: “Declines in groundwater began after 1946,” and that groundwater declined “as much as 8.8 feet from the spring of 1955 to 1956; the average decline was 5.2 feet. The decline of water levels at the lower and upper ends of the valley during this period was not so great as in the middle portion and averaged 1.7 and 2.2 feet respectively. Since 1946, water levels in observation wells have declined d on the average of about 27 feet” (USGS, 1956).

A USGS report titled *Hydrologic Models and Analysis of Water Availability in the Cuyama Valley, California* (USGS, 2015) presents two maps generated by using CUVHM simulated data. ~~Figure 2-29~~ Figure 2-37 shows the estimated drawdown in the central portion of the Basin from 1947 to 1966. ~~Figure 2-29~~ Figure 2-37 shows that estimated drawdown ranged from zero at the edges of the central basin to over 160 feet in the southeastern portion of the central Basin.

~~Figure 2-30~~ Figure 2-38 shows the estimated contours of groundwater elevation for ~~Septembersummer~~ 1966. These contours show a low area in the central portion of the central Basin, and a steep groundwater gradient in the southeast portion near Ventucopa and in the highlands. A gentle groundwater gradient occurs in the southwestern portion of the central Basin, generally matching topography. Few wells are located in this area and groundwater elevation contours were estimated over large distances by the USGS.

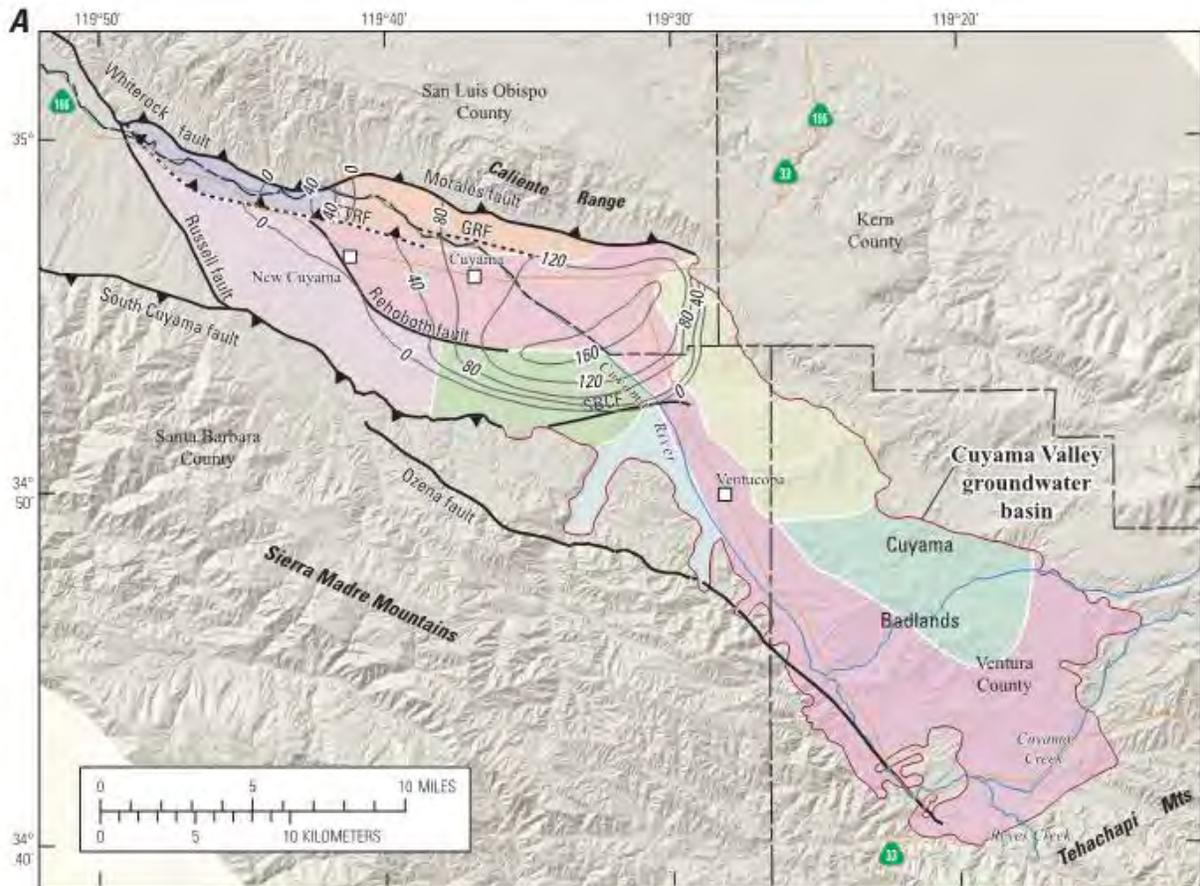


Shaded relief base created from 30 m digital elevation model from USGS National Elevation Dataset (NED); North America Vertical Datum 1983 (NAVD83). Hydrology sourced from 1:24,000-scale National Hydrography Dataset, 1974-2008. Place names sourced from USGS Geographic Names Information System, 1974-2009. Albers Projection, NAD83.

Modified from Singer and Swarzenski, 1970

EXPLANATION

<p>Cuyama groundwater basin subregion</p> <ul style="list-style-type: none"> Caliente Northern-Main Central Sierra Madre Foothills Northeast Ventucopa Uplands Northwestern Sierra Madre Foothills Northern Ventucopa Uplands Southern Sierra Madre Foothills Southern Ventucopa Uplands Southern-Main Western Basin 	<ul style="list-style-type: none"> Normal fault Thrust fault Thrust fault, concealed GRF, Graveyard fault; SBCF, Santa Barbara Canyon fault; TTRF, Turkey Trap Ridge fault 	<p> Estimated drawdown contour (1966-1947). Interval is 40 feet</p>
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Shaded relief base created from 30 m digital elevation model from USGS National Elevation Dataset (NED); North America Vertical Datum 1983 (NAVD83). Hydrology sourced from 1:24,000-scale National Hydrography Dataset, 1974-2008. Place names sourced from USGS Geographic Names Information System, 1974-2009. Albers Projection, NAD83.

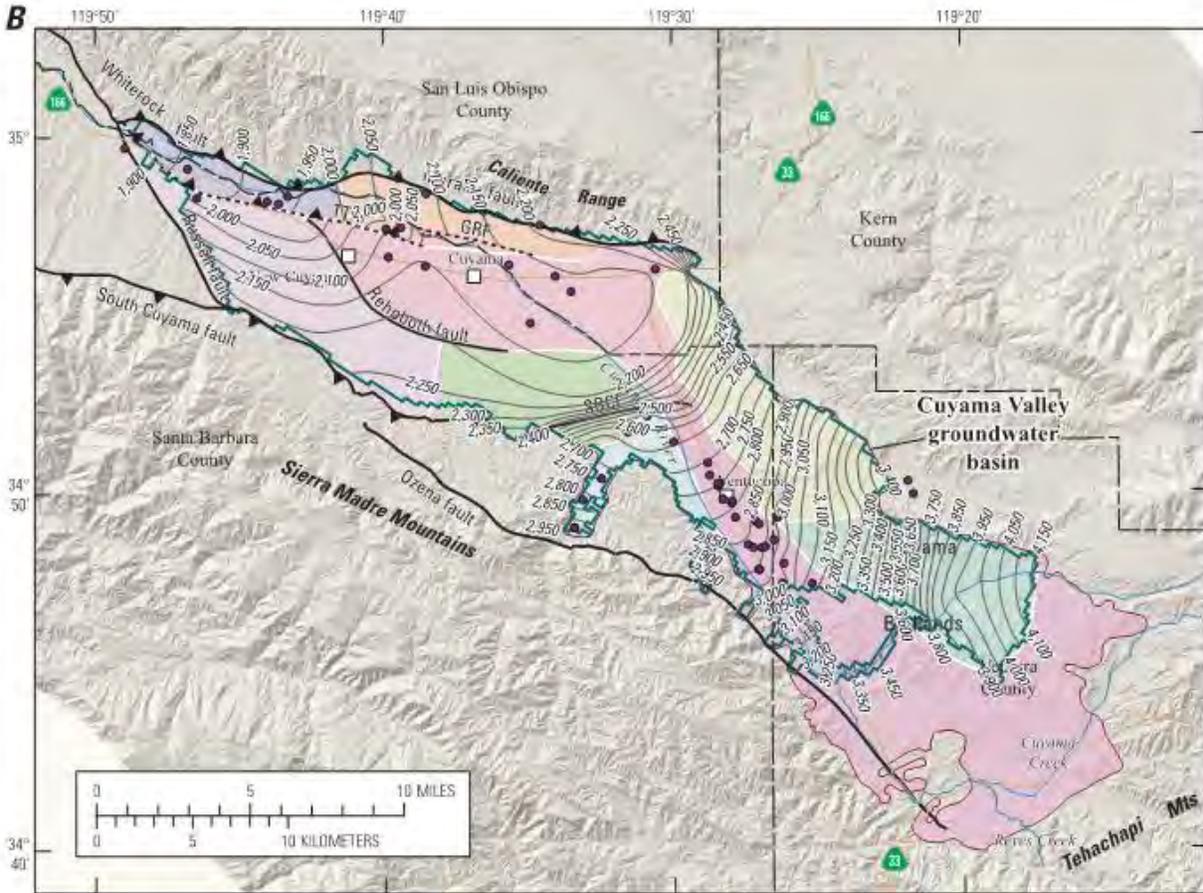
Modified from Singh and Swarzenski, 1970

EXPLANATION

<p>Cuyama groundwater basin subregion</p> <ul style="list-style-type: none"> Caliente Northern-Main Central Sierra Madre Foothills Northeast Ventucopa Uplands Northwestern Sierra Madre Foothills Northern Ventucopa Uplands Southern Sierra Madre Foothills Southern Ventucopa Uplands Southern-Main Western Basin 	<ul style="list-style-type: none"> Normal fault Thrust fault Thrust fault, concealed GRF, Graveyard fault; SBCF, Santa Barbara Canyon fault; TTRF, Turkey Trap Ridge fault 	<p>Estimated drawdown contour (1966-1947). Interval is 40 feet</p>
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Source: USGS, 2015

Figure 2-37: Water Level Drawdown Contours, 1947 to 1966 to 1947



Shaded relief base created from 30-m digital elevation model from USGS National Elevation Dataset (NED); North America Vertical Datum 1983 (NAVD83). Hydrology sourced from 1:24,000-scale National Hydrography Dataset, 1974-2009. Place names sourced from USGS Geographic Names Information System, 1974-2009. Albers Projection, NAD83.

Modified from Singer and Swarzenski, 1970

EXPLANATION

<p>Cuyama groundwater basin subregion</p> <ul style="list-style-type: none"> Caliente Northern-Main Central Sierra Madre Foothills Northeast Ventucopa Uplands Northwestern Sierra Madre Foothills Northern Ventucopa Uplands Southern Sierra Madre Foothills Southern Ventucopa Uplands Southern-Main Western Basin 	<ul style="list-style-type: none"> Normal fault Thrust fault Thrust fault, concealed GRF, Graveyard fault; SBCF, Santa Barbara Canyon fault; TTRF, Turkey Trap Ridge fault 	<ul style="list-style-type: none"> Active model-grid boundary Water-level altitude, summer 1966 ; interval is 50 feet Control point
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Source: USGS, 2015

Figure 2-38: 1966 Water Level Contours



Groundwater Trends According to Available Monitoring Data

To understand how groundwater conditions have changed in the Basin in recent decades, analysts developed and analyzed groundwater ~~hydrographs, vertical gradients and contours, which are discussed below~~ elevation hydrographs and contour maps, and horizontal and vertical hydraulic gradients, which are discussed below. Since the GSP was approved, the CBGSA has implemented its own monitoring program to monitor groundwater trends. The CBGSA publishes quarterly groundwater conditions reports that provide groundwater trends from the Basin's groundwater monitoring network (described in detail in Chapter 4). All data are published to the CBGSA's online public Opti DMS.

Groundwater Hydrographs

Groundwater hydrographs were developed to provide indicators of groundwater trends throughout the Basin. Measurements from each well ~~with historical monitoring data~~ were compiled into one hydrograph for ~~each well~~ data collected from 2015 through early 2024. These hydrographs are presented in Appendix A.

In many cases, changes in historical groundwater conditions at particular wells have been influenced by climactic patterns in the Basin (Section 2.3). Historical precipitation is highly variable, with several relatively wet years and some multi-year droughts.

~~Groundwater conditions generally vary in~~ Figure 2-39 ~~239 shows the current monitoring network that has been updated with this GSP submittal. Subsequent maps show~~ different parts of the Basin. ~~Figure 2-31 starting in the west and moving to the eastern portion of the Basin to show specific groundwater conditions in selected areas.~~

Figure 2-40 shows hydrographs ~~in select wells in different portions~~ for each region of the Basin. These wells were selected because they broadly represent Basin conditions in their areas. More information about conditions is below.

- ~~In the area southeast of southwest region near Round Springs Canyon, near the Ozena Fire Station (Well 89), groundwater levels have shown a decline from 2019-2022 and then have been fluctuating from 2022-2024. This well is not pumped and the measurements represent static water levels. In the eastern region in the City of Ventucopa (Well 62), groundwater levels have stayed relatively stable with a small decline during over the 2012 to 2015 drought, historical record and showed quick recovery.~~
- ~~In the vicinity of Ventucopa (at Well 62), groundwater levels have followed climactic patterns and have generally been declining since 1995.~~
- ~~Just south of the SBCF (at Well 101), a recent increase in groundwater levels have been fairly stable and are closer to the surface than levels in Ventucopa.~~



- North of the SBCF starting at the end of 2023. This well is not pumped and east of Bitter Creek measurements represent static water levels.
- In the central portion of the Basin (at Wells 55 and 615 Well 91), groundwater levels have been declining consistently since 1950 from 2015 to 2024. There was an increase in the decline in 2021 but water levels rebounded. This well is not pumped and measurements represent static water levels.
- In the area west of Bitter Creek (at Wells 119 and 830) Also, in the central region (Well 77), groundwater levels are near ground surface near the Cuyama River, and are below ground in the area to the south, uphill from the river. Levels have shown steady declines since 2015 with seasonal fluctuations during most years.
- In the western portion of the Basin (Well 118), groundwater levels have been generally stable since 1966 2016 with groundwater levels within about 60 feet of ground surface. This well is not pumped and measurements represent static water levels.

Figure 2-32 shows selected hydrographs for wells in the area near Ventucopa. Near Ventucopa, hydrographs for Wells 85 and 62 show the same patterns and conditions from 1995 to the present and show that groundwater levels in this area respond to climatic patterns, but also have been in decline since 1995 and are currently at historic low elevations. The hydrograph for Well 85 shows that prior to 1985 groundwater levels responded to drought conditions but recovered during wetter years. Well 40 is located just south of the SBCF and its hydrograph indicates that groundwater levels in this location have remained stable from 1951 to 2013, when monitoring ceased. Wells 91 and 620 are north of the SBCF and their hydrographs show more recent conditions, where depth to water has declined consistently and is below 580 feet below ground surface (bgs).

Figures 2-33 and 2-34 show hydrographs of discontinued and currently monitored wells in the central portion of the Basin, north of the SBCF and east of Bitter Creek. The hydrographs of discontinued wells in this area are shown in Figure 2-33. These hydrographs show consistent declines of groundwater levels and little to no response to either droughts or wetter periods. The hydrograph for Well 35 shows a consistent decline from 1955 to 2008, from 30 feet bgs to approximately 150 feet bgs. Well 472 shows a decline from approximately 5 feet bgs in 1949 to approximately 85 feet bgs in 1978.

Figure 2-34 shows hydrographs of currently monitored wells in the central portion of the Basin. In general, these hydrographs show that groundwater levels are decreasing, with the lowest levels in the southeast portion of the area just northwest of the SBCF, as shown in the Well 610 hydrograph, where groundwater levels were below 600 feet bgs. Levels remain lowered along the Cuyama River, as shown in the hydrographs for Wells 604 and 618, which are currently approximately 500 feet bgs. Groundwater levels are higher to the west (Well 72) and towards the southern end of the area (Well 96). However, almost all monitoring wells in this area show consistent declines in elevation.

Figure 2-35 shows hydrographs of monitoring wells in the western portion of the Basin, west of Bitter Creek. Hydrographs in this area show that generally, groundwater levels are near the surface near the



Cuyama River, and further from the surface to the south, which is uphill from the river. The hydrograph for Well 119 shows a few measurements from 1953 to 1969, and three more recent measurements. All measurements for Well 119 show a depth to water of 60 feet bgs. The hydrograph for Well 846 shows that in 2015 depth to water was slightly above 40 feet and is slightly below 40 feet in 2018. The hydrograph for Well 840 shows a groundwater level near ground surface in 2015, and a decline to 40 feet bgs in 2018. Hydrographs for wells uphill from the river (Wells 573 and 121) show that groundwater is roughly 70 feet bgs in this area. Hydrographs for Wells 571 and 108, at the edge of the Basin have recent measurements, and show groundwater levels that range from 120 to 140 feet bgs.



Figure 2-41 shows hydrographs for six wells in the western part of the Basin. Wells 836 and 830 show a similar trend of stable water levels. A slight decline in water levels occurs in late followed by a rebound through 2023 due to the wet hydrologic conditions. The hydrograph for Well 833 shows a sharp water level decline in late 2020 with variable recovery through 2023 with water levels fluctuating 20 feet over this period. Wells 841 and 845 show seasonal fluctuations that reflect seasonal pumping for irrigated agriculture. The wells are located adjacent to the Cuyama River and have water levels within 100 feet of ground surface.

Figure 2-42 shows hydrographs for six other wells in the western portion of the Basin that not adjacent to the Cuyama River. However, only Wells 117 and 106 are dedicated monitoring wells with no pumping. Well 117 has been stable other than a sharp increase in 2017. Wells 573, 118, and 106 have had stable water levels throughout the period of record at approximately 70 feet bgs, 55 feet bgs, and 140 feet bgs, respectively. At Well 107, groundwater levels have fluctuated from 70 to 110 feet bgs from 2017 through 2023.

Figure 2-43 shows hydrographs for four wells in the western central part of the Basin. Wells 114 and 112, both active pumping wells, show steady water levels at depths of 50 feet and 90 feet bgs, respectively. Well 568, also an active pumping well, shows steady water levels except in late 2022 but the water level recovered in mid-2023. Well 474 is a monitoring well that had steady water levels from 2015 to 2019 with depth to water of 190 feet bgs. Since that time, water levels have risen about 30 feet..

Figure 2-44 shows hydrographs for three wells in the north central portion of the Basin. Well 72, 74 and 604 are all active pumping wells. Well 72 has seen fluctuations in groundwater levels with current measurements just below 150 feet bgs. Water levels in Well 74 have been slowly declining with current water level at 250 feet bgs. Water levels in Well 604 have risen since 2018 to about 450 feet bgs.

Figure 2-45 shows selected hydrographs also in the central portion of the Basin. Well 103 is a dedicated monitoring well, and Wells 608 and 609 are active pumping wells. Well 103 has the shallowest depth to water, with water levels still fluctuating from 2015-2024, with current depths just above 250 ft bgs. Wells 608 and 609, both close to the Cuyama River, had similar water level increases in 2017 and subsequent fluctuations since late 2020. Current depth to water measurements are slightly above 450 feet bgs.

Figure 2-46 shows selected hydrographs in the central portion of the Basin further east of those noted above. Well 96 is a monitoring well while Wells 612 and 615 are active pumping wells. Well 96 has seen steady water level measurements from 2015-2024. Well 612, close to the Cuyama River, had increasing water levels from 2018 to mid-2020 and decreasing levels to 2024 to below 450 ft bgs. Well 615 has seen steady declines in water level measurements since 2017 with current depth to water below 500 feet bgs.

Figure 2-47 shows selected hydrographs also in the central portion of the Basin further to the east. Wells 95, 610, 629, and 633 are active pumping wells, while Wells 91 and 316 are monitoring wells. All wells have decreasing water level measurements from 2015 to 2024 except Well 629 that had an increase



in 2023. Depth to water in Well 629 is about 530 feet bgs whereas it ranges from below 550 to 650 ft bgs in the other wells.

Figure 2-48 is the final hydrograph map in this series, showing selected hydrographs for the southeastern portion of the Basin. Wells 85, 100, and 101 are active pumping wells, while Wells 62 and 89 are monitoring wells. These five wells span a large area of the Basin and have varying water level changes from 2015 to 2024. Water levels have increased in Wells 62, 85, and 100 in 2023, corresponding to the wet hydrologic conditions in the Basin. Water levels in Well 101 from 2015 to 2022 but have been steady since that time. Water levels in Well 89 have fluctuated but show an overall increase. This well has the shallowest depth to water of this group of wells at around 30 feet bgs.

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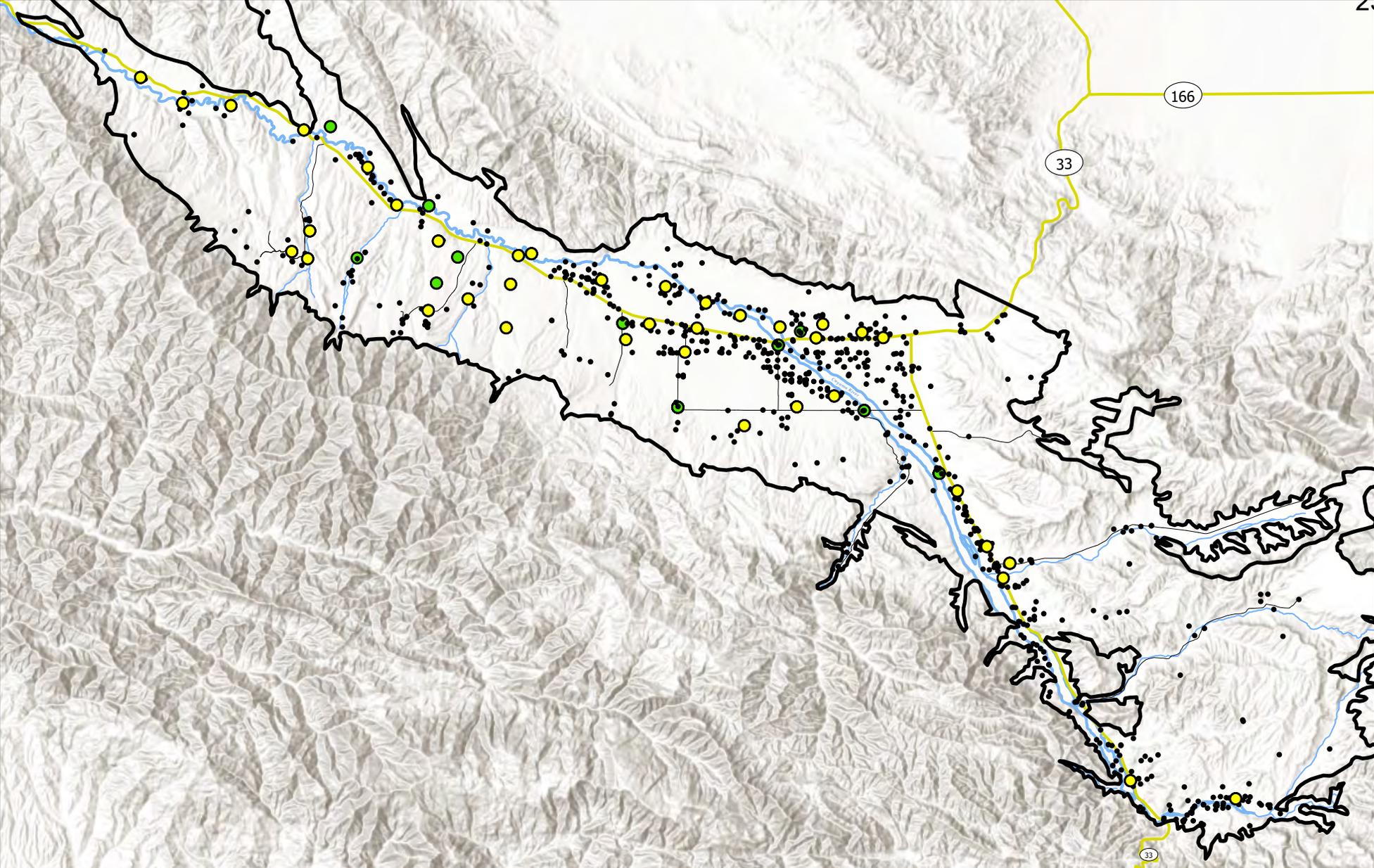


Figure 2-39: Monitoring Well Locations

Cuyama Valley Groundwater Basin

Legend	● Well with Hydrograph	— Highway	— Cuyama River
	● Well without Hydrograph	— Local Road	 Cuyama Basin
	● Well not Monitored	— Creek	

N

0 1.25 2.5 5 Miles

Map Created: July 2024

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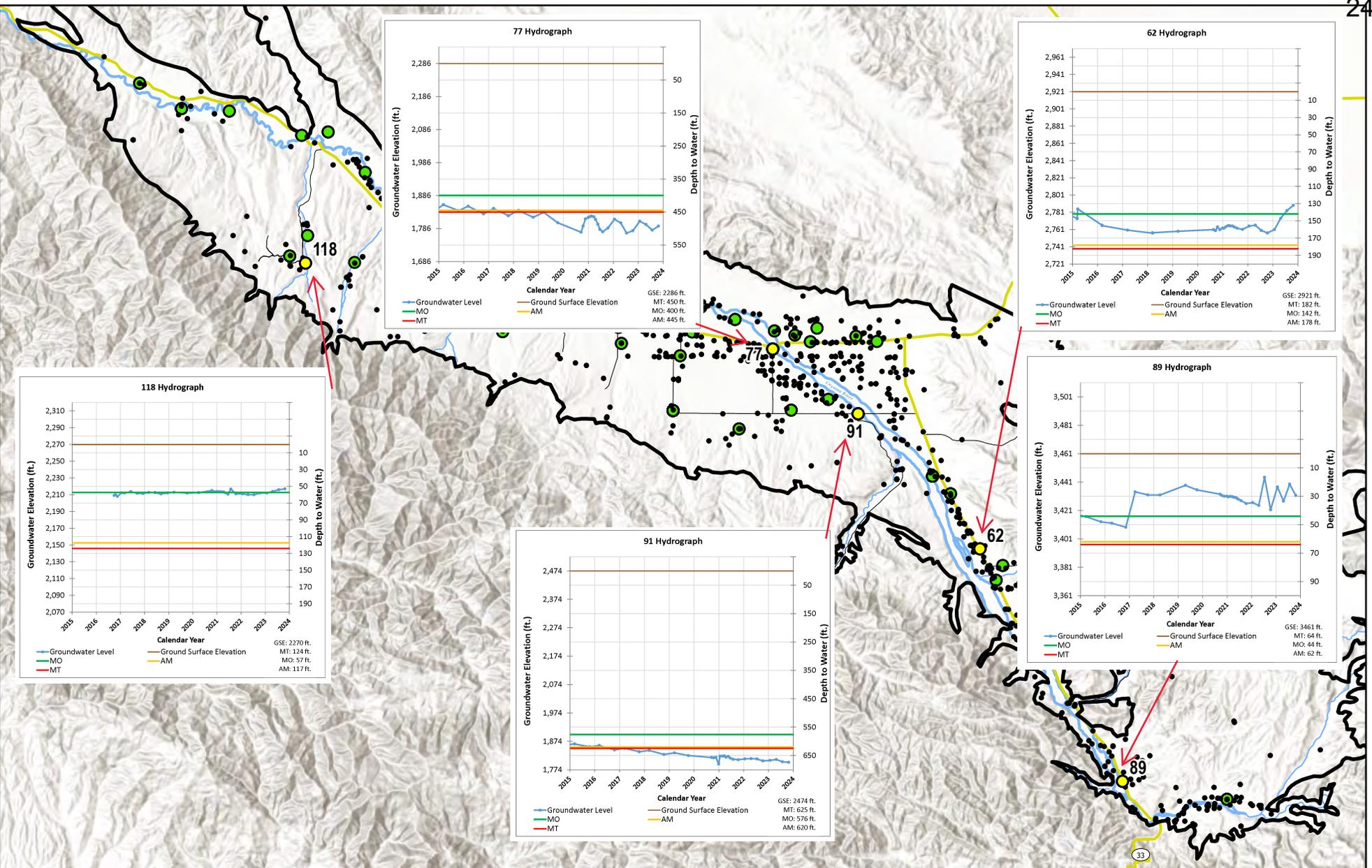


Figure 2-40: Monitoring Well Network Hydrographs

Cuyama Valley Groundwater Basin

Legend

- Well with Hydrograph
- Highway
- Cuyama River
- Well without Hydrograph
- Local Road
- Cuyama Basin
- Well not Monitored
- Creek

N

0 1.25 2.5 5 Miles

Map Created: July 2024

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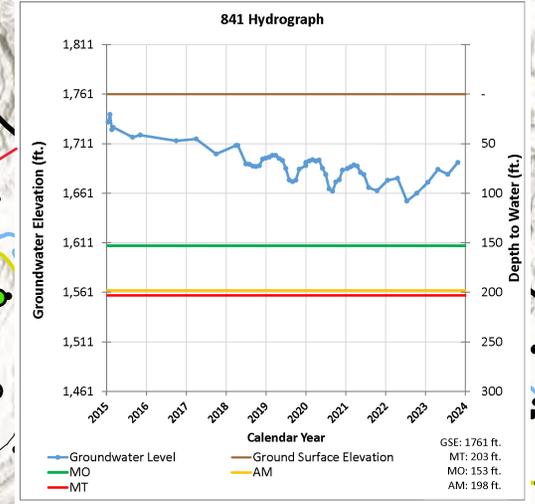
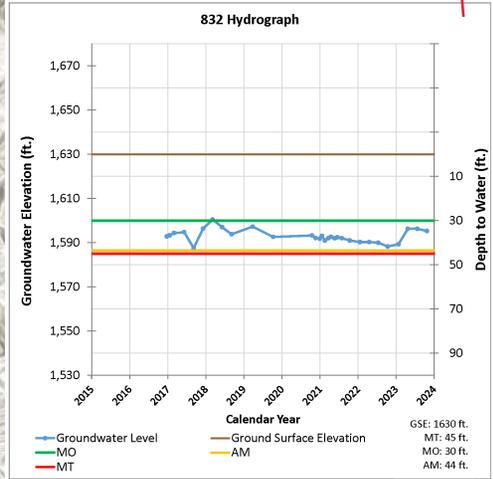
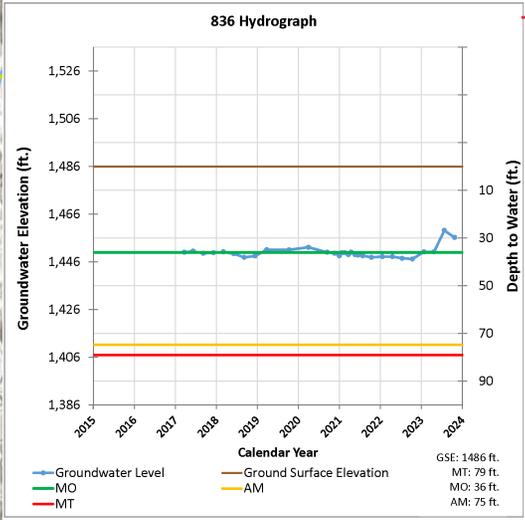
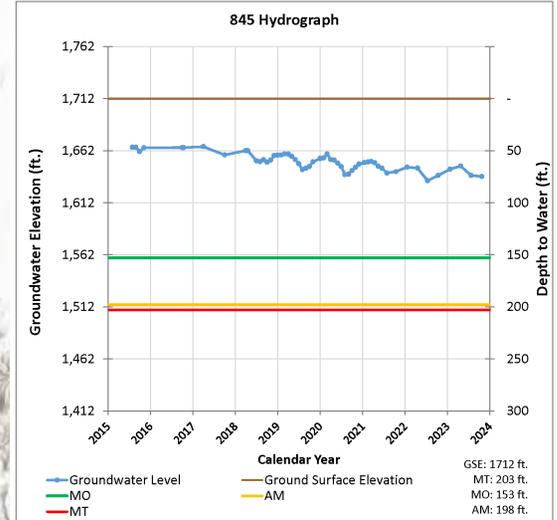
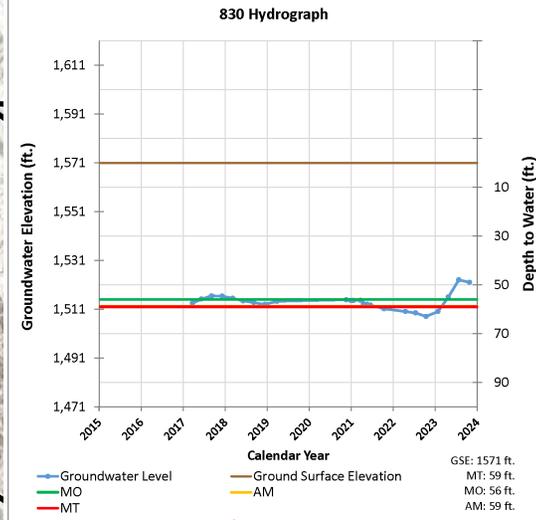
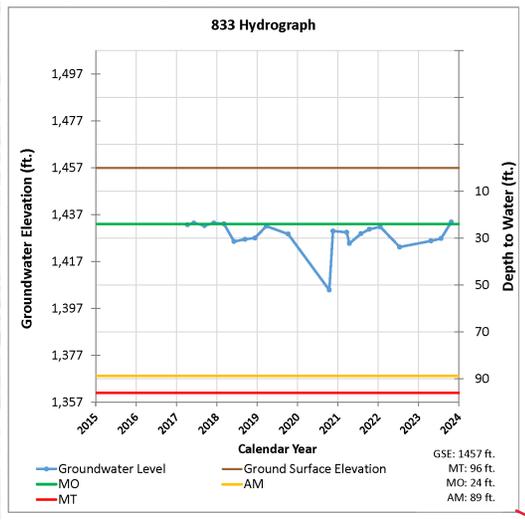
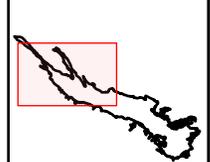


Figure 2-41: Monitoring Well Network Hydrographs
Cuyama Valley Groundwater Basin

Legend

- Well with Hydrograph
- Well without Hydrograph
- Well not Monitored
- Highway
- Local Road
- Creek
- Cuyama River
- Cuyama Basin



0 0.75 1.5 3 Miles
Map Created: July 2024

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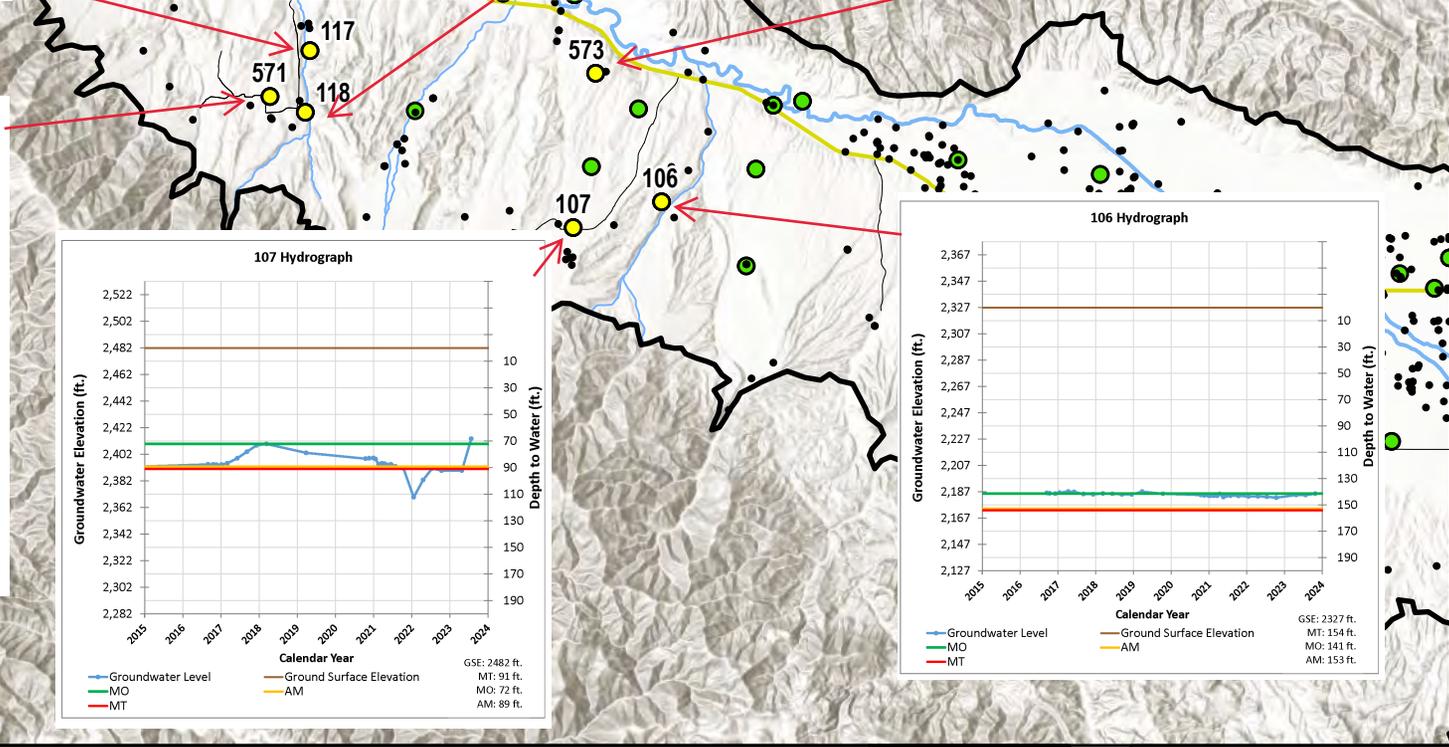
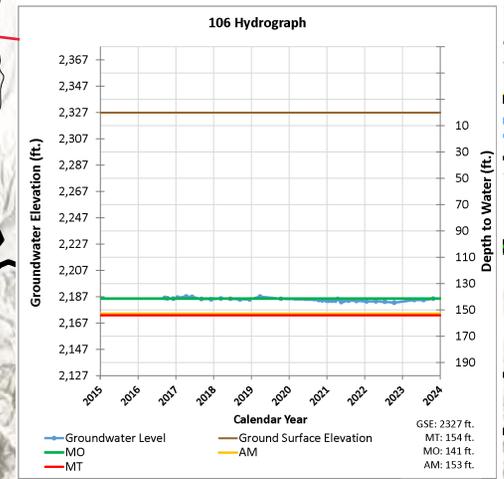
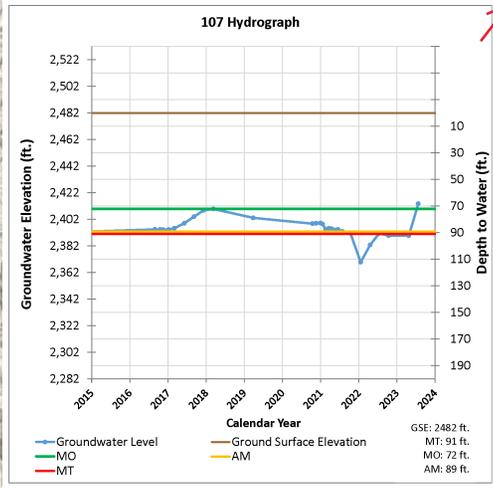
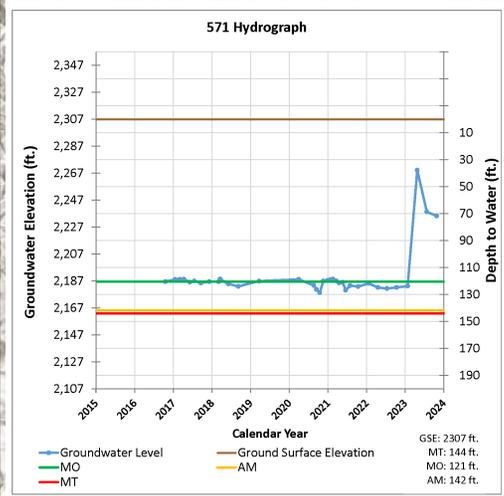
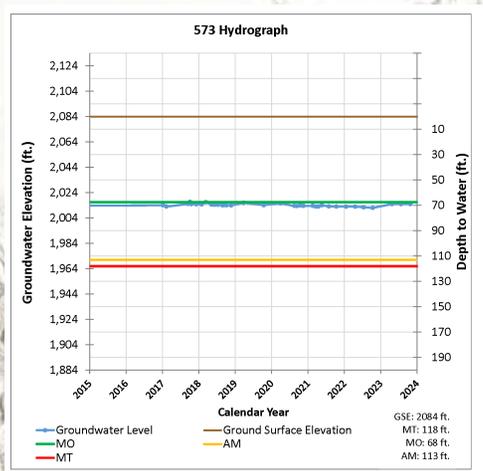
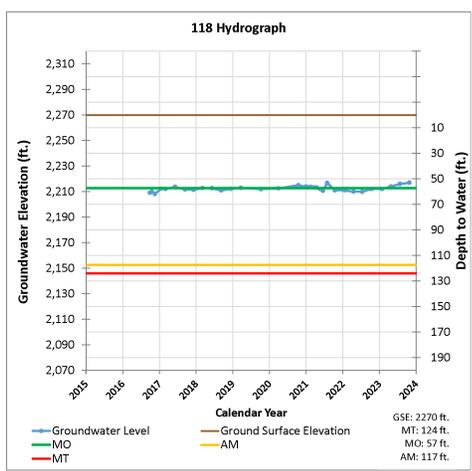
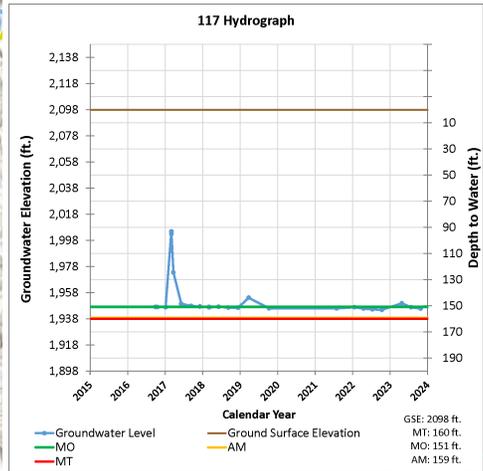
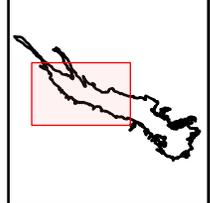


Figure 2-42: Monitoring Well Network Hydrographs

Cuyama Valley Groundwater Basin

Legend

- Well with Hydrograph
- Well without Hydrograph
- Well not Monitored
- Highway
- Local Road
- Creek
- Cuyama Basin
- Cuyama River



0 0.75 1.5 3 Miles

Map Created: July 2024

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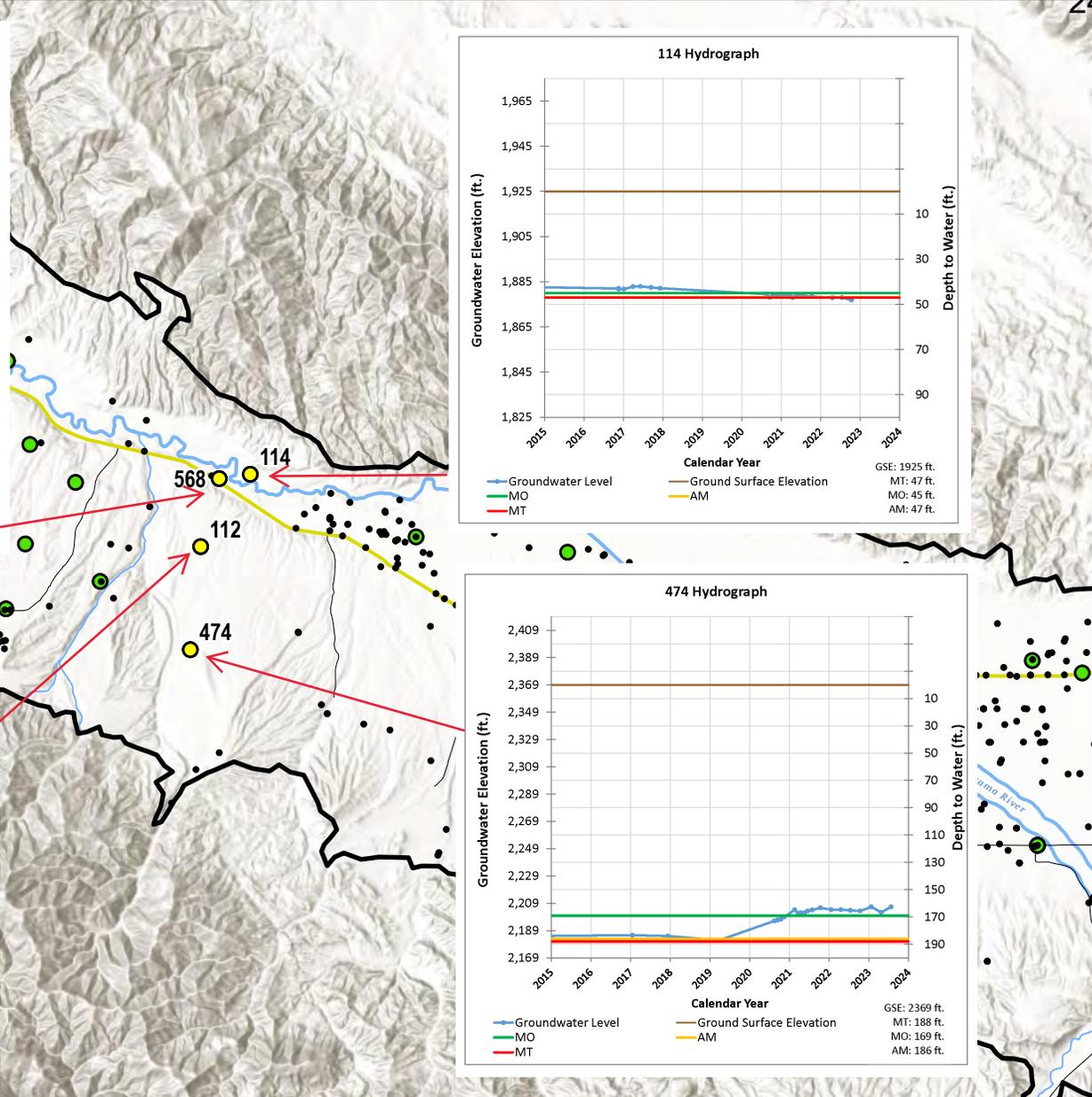
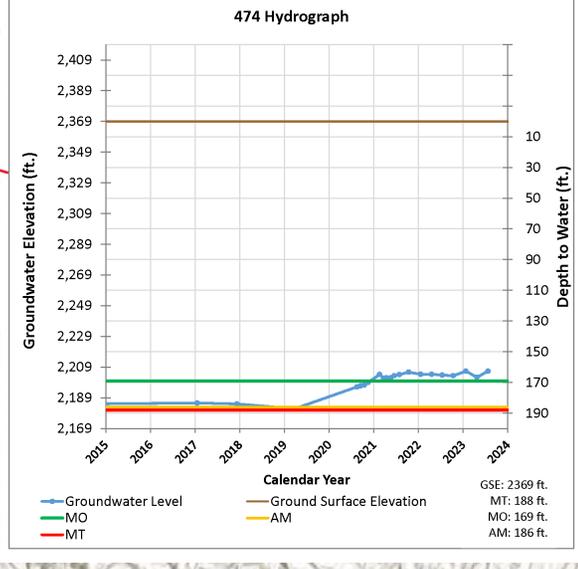
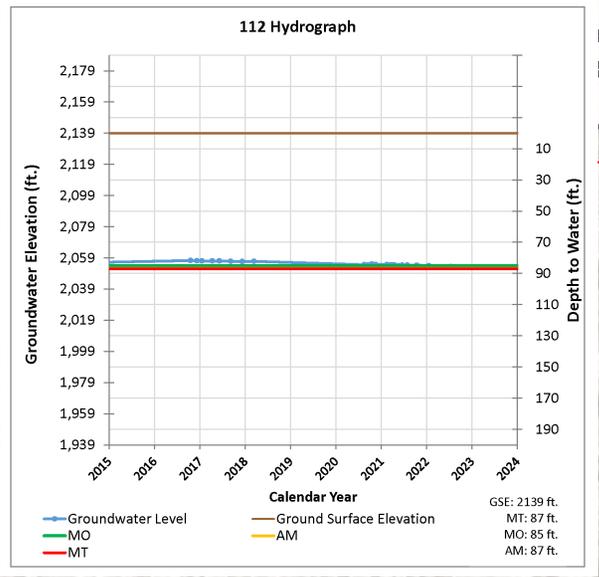
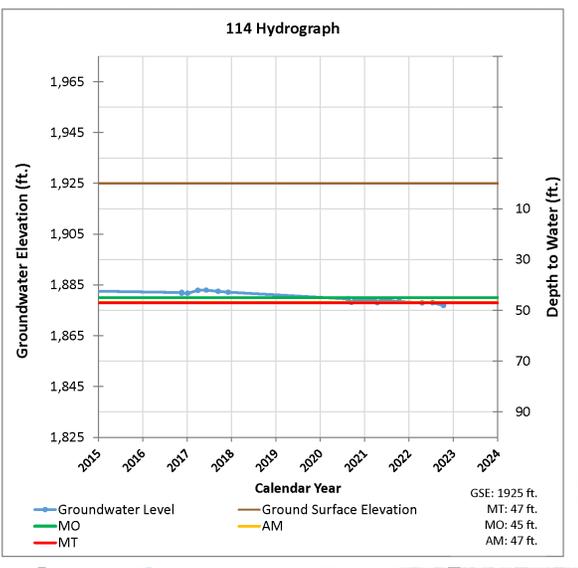
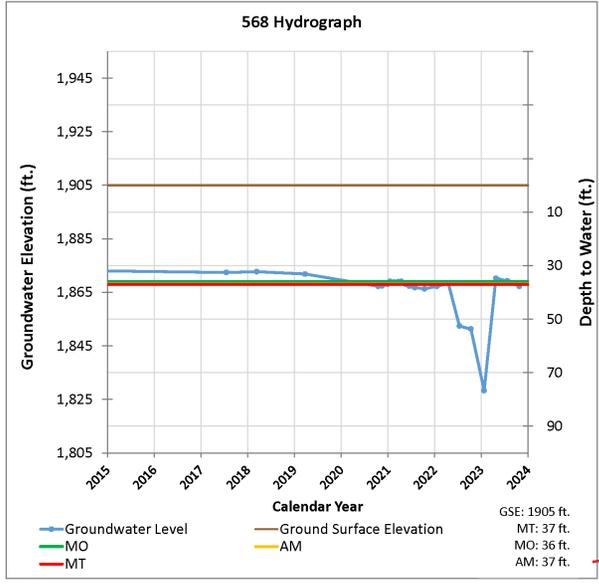


Figure 2-43: Monitoring Well Network Hydrographs

Cuyama Valley Groundwater Basin

Legend

- Well with Hydrograph
- Well without Hydrograph
- Well not Monitored
- Highway
- Local Road
- Creek
- Cuyama River
- Cuyama Basin

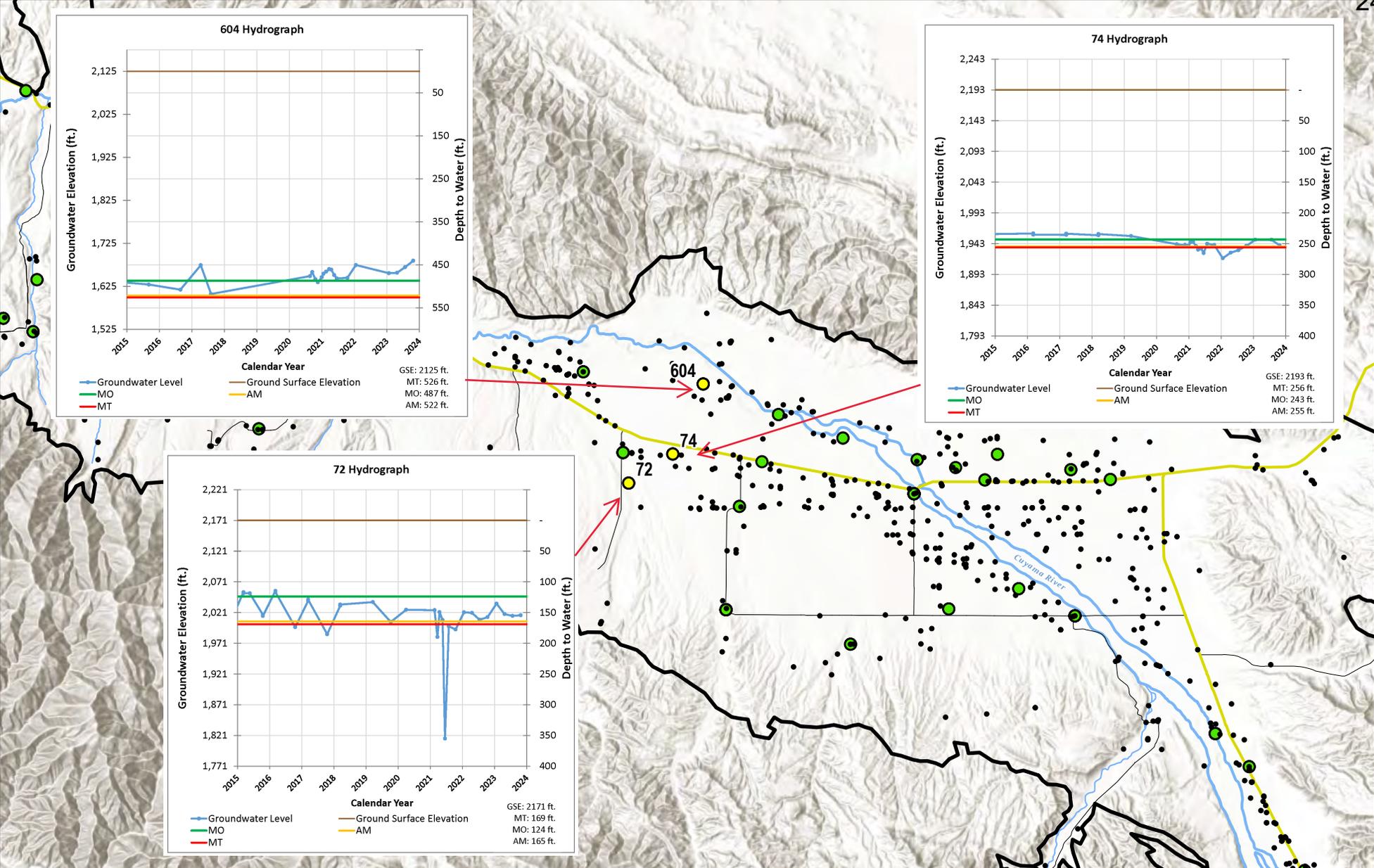


0 0.5 1 2 Miles

Map Created: July 2024

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<p>Figure 2-44: Monitoring Well Network Hydrographs</p> <p>Cuyama Valley Groundwater Basin</p>	<p>Legend</p> <ul style="list-style-type: none"> ● Well with Hydrograph ● Well without Hydrograph ● Well not Monitored — Highway — Local Road — Creek Cuyama Basin 				
		<p>0 0.5 1 2 Miles</p> <p>Map Created: July 2024</p>			

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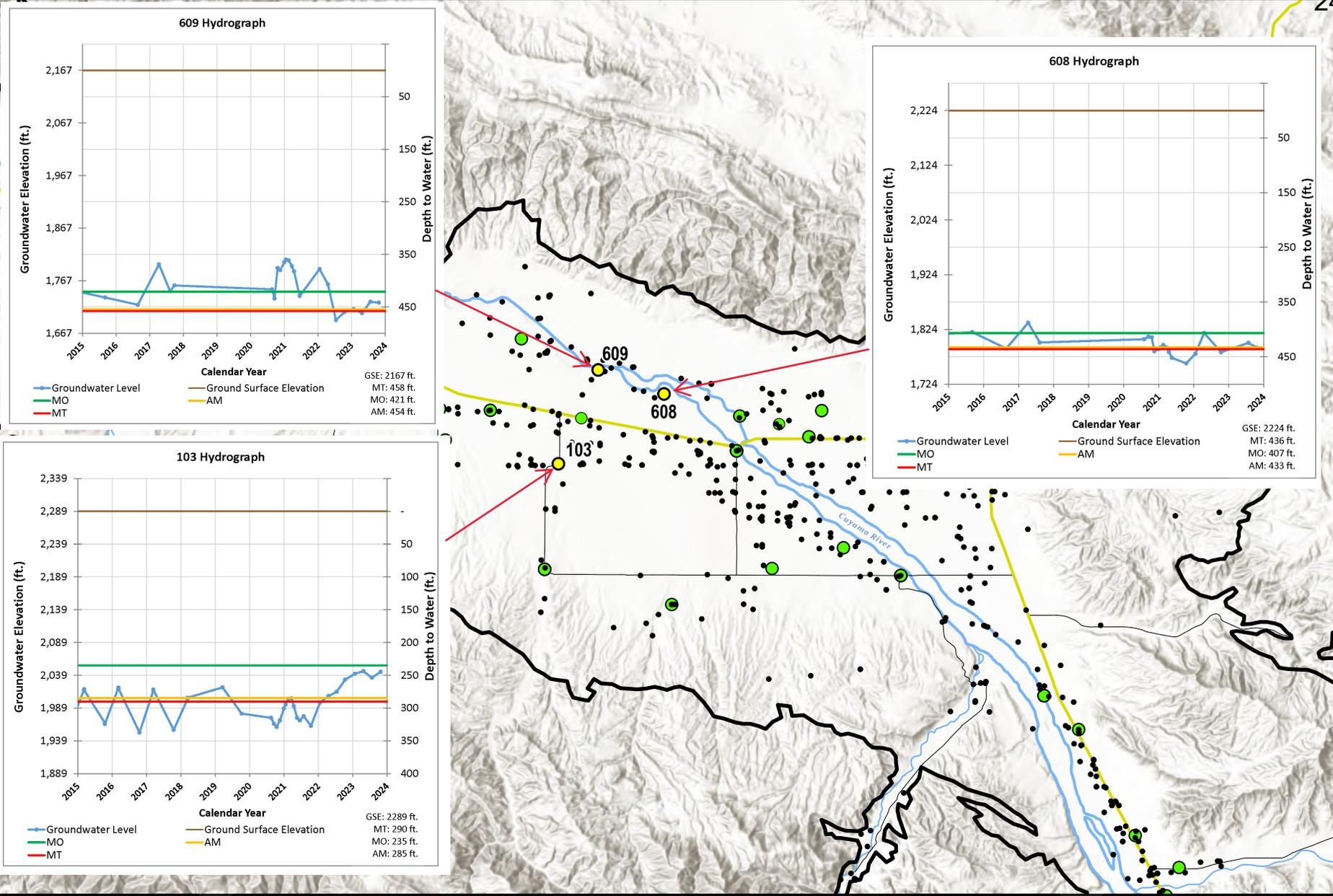
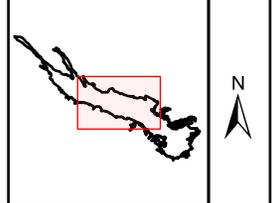


Figure 2-45: Monitoring Well Network Hydrographs

Cuyama Valley Groundwater Basin

Legend

- Well with Hydrograph
- Well without Hydrograph
- Well not Monitored
- Highway
- Local Road
- Creek
- Cuyama River
- Cuyama Basin



0 0.5 1 2 Miles

Map Created: July 2024

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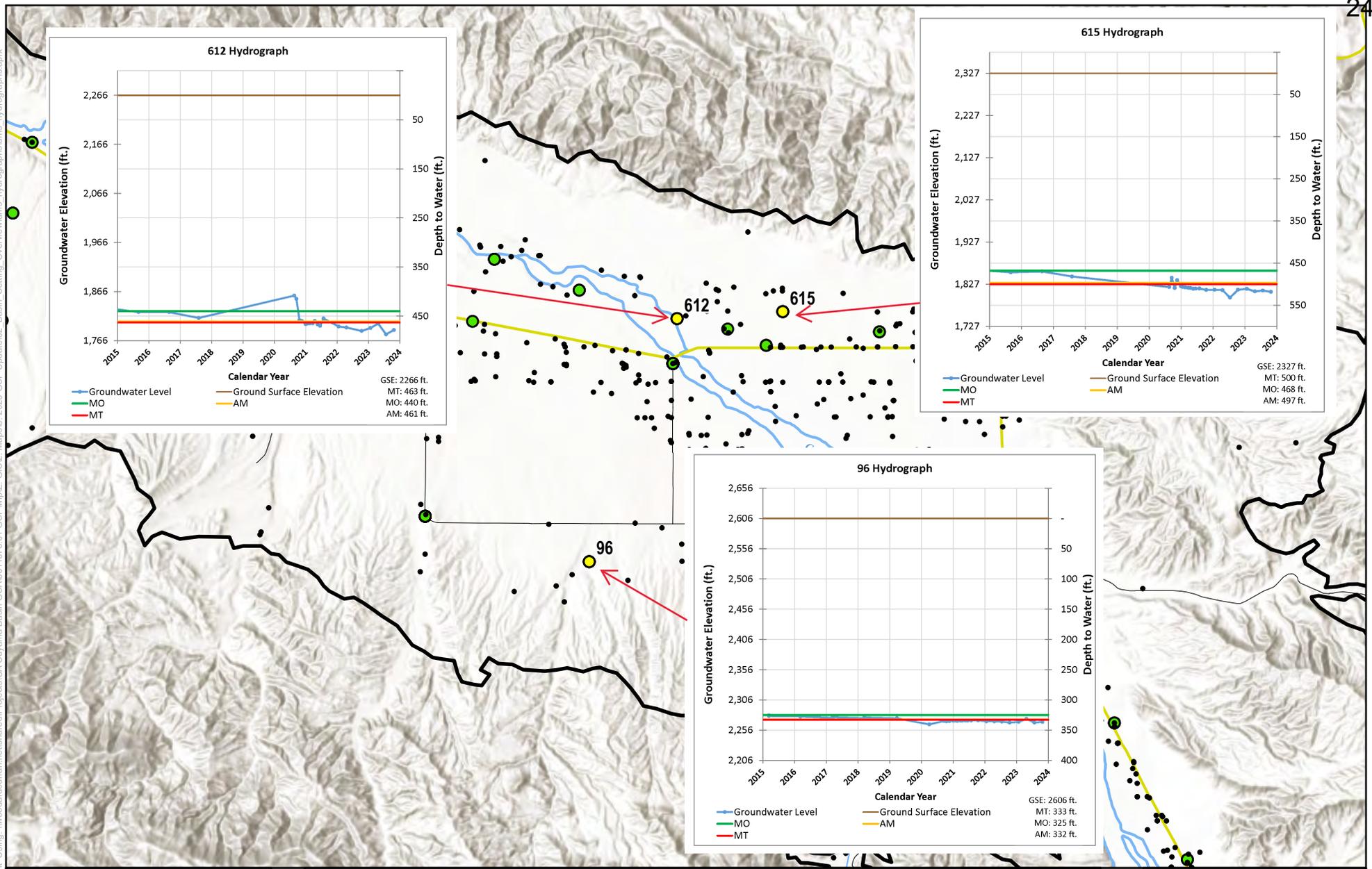
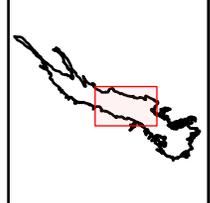


Figure 2-46: Monitoring Well Network Hydrographs

Cuyama Valley Groundwater Basin

Legend

- Well with Hydrograph
- Well without Hydrograph
- Well not Monitored
- Highway
- Local Road
- Creek
- Cuyama River
- Cuyama Basin



0 0.5 1 2 Miles

Map Created: July 2024

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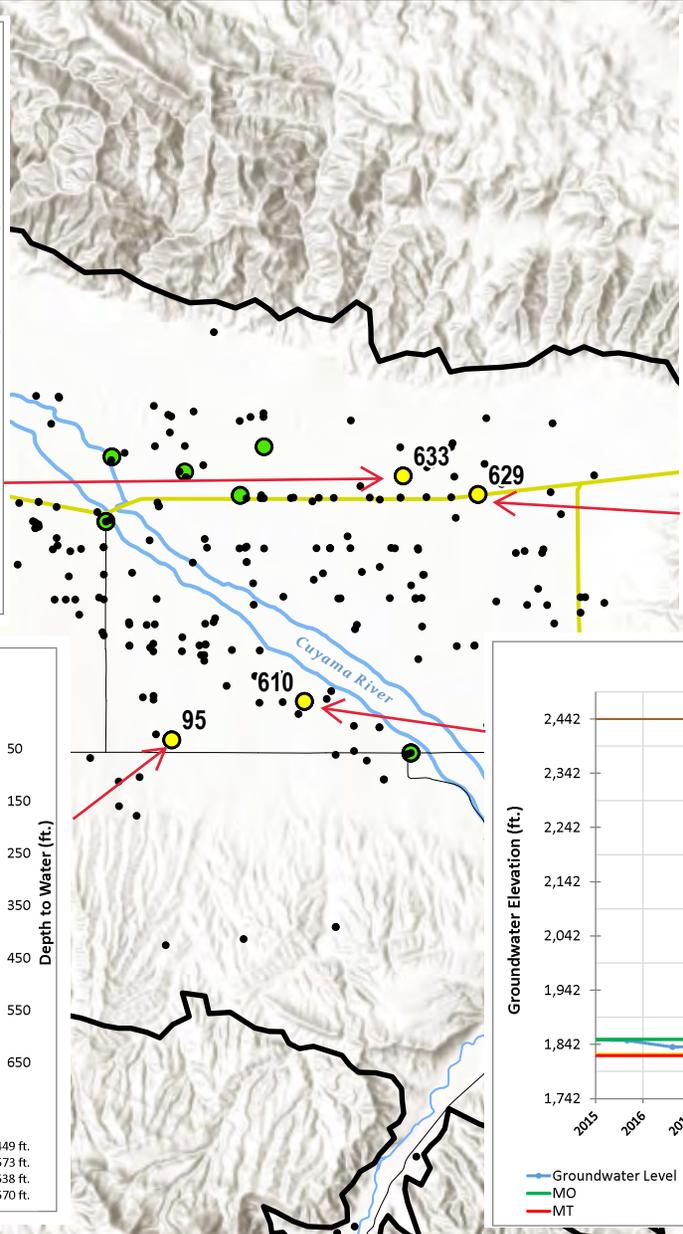
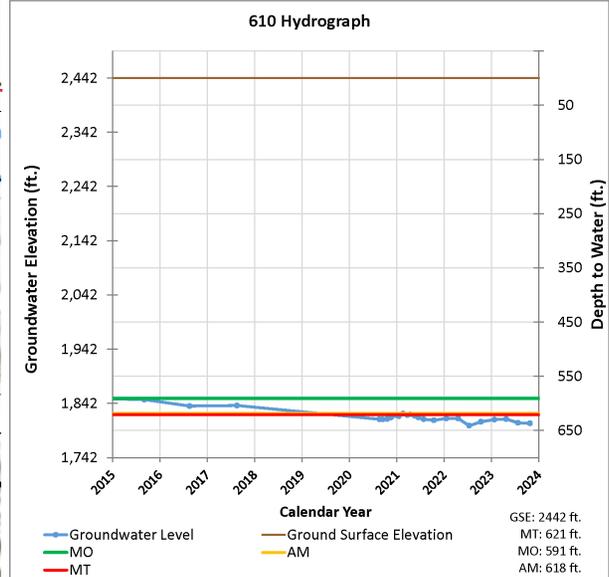
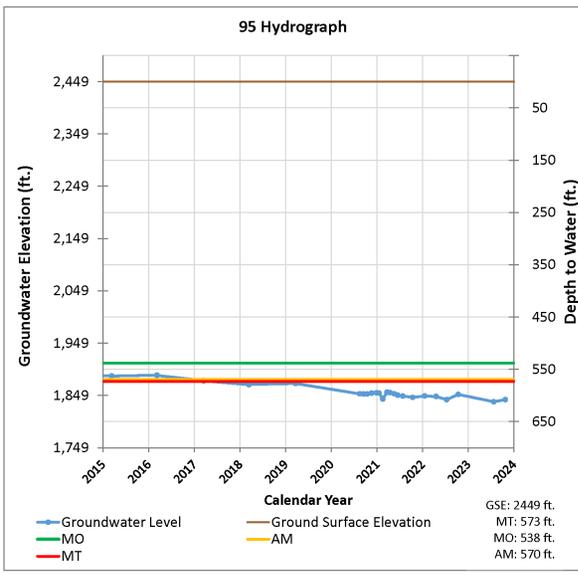
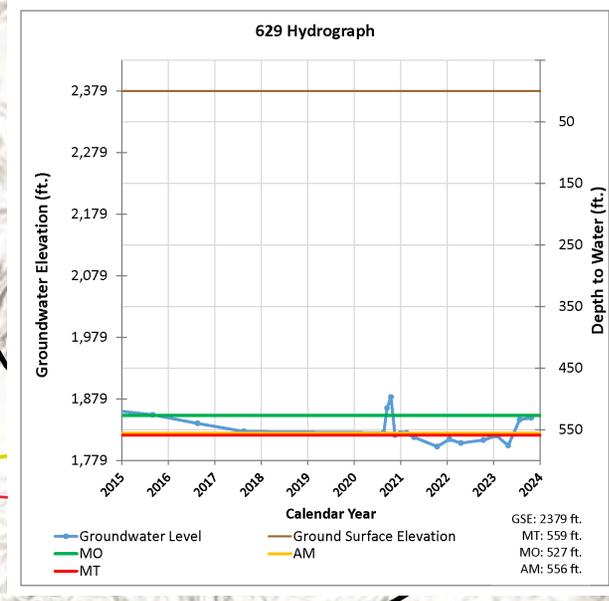
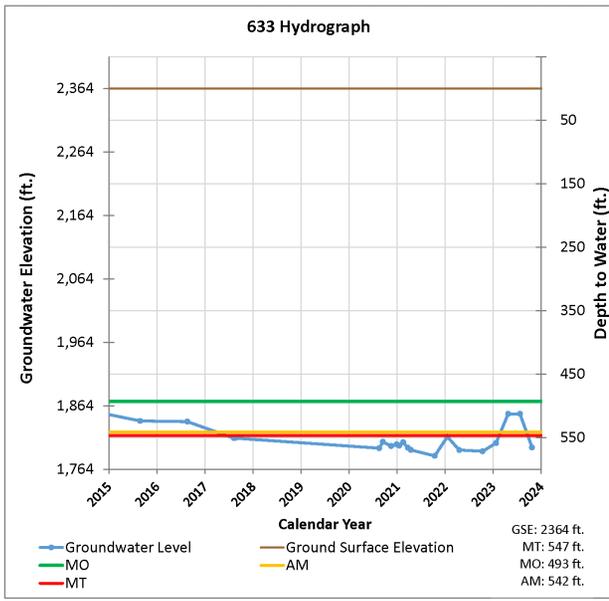


Figure 2-47: Monitoring Well Network Hydrographs

Cuyama Valley Groundwater Basin

Legend

- Well with Hydrograph
- Well without Hydrograph
- Well not Monitored
- Highway
- Local Road
- Creek
- Cuyama River
- Cuyama Basin



0 0.5 1 2 Miles

Map Created: July 2024

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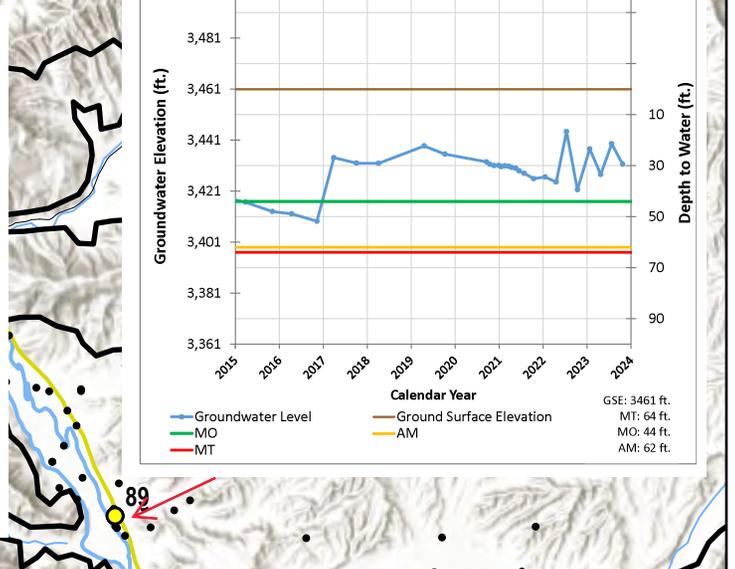
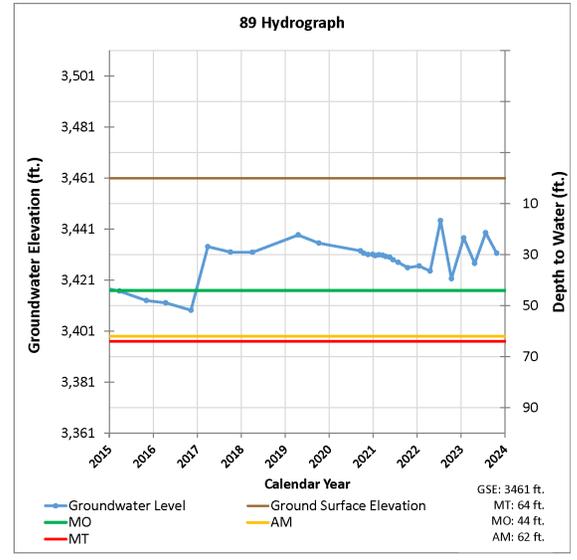
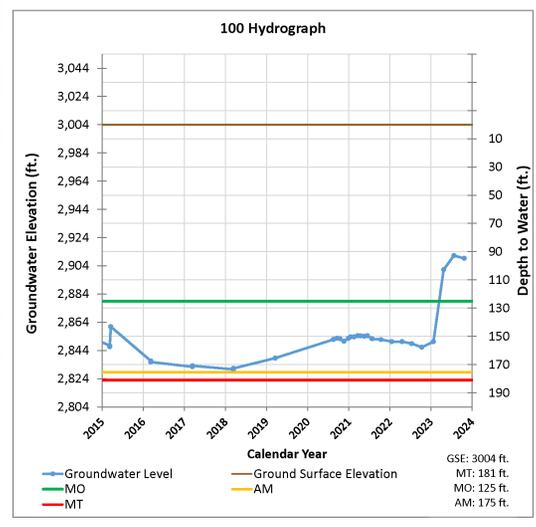
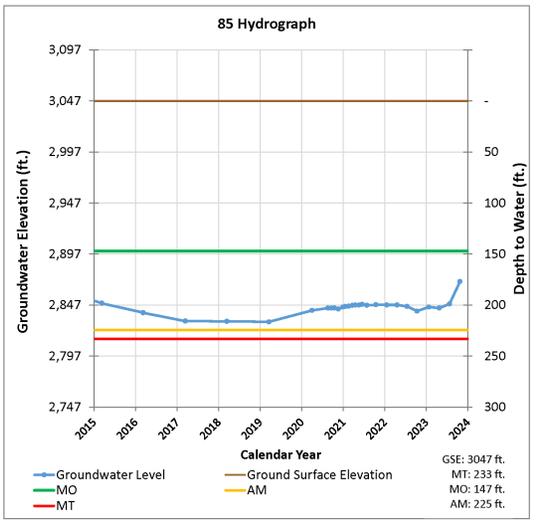
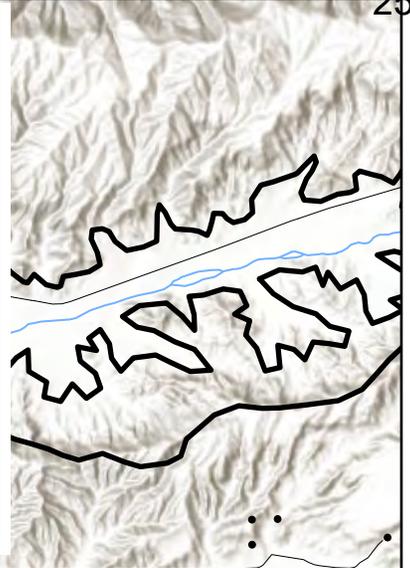
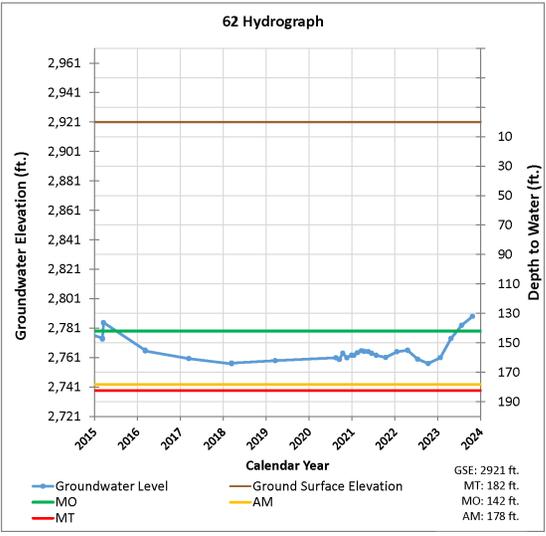
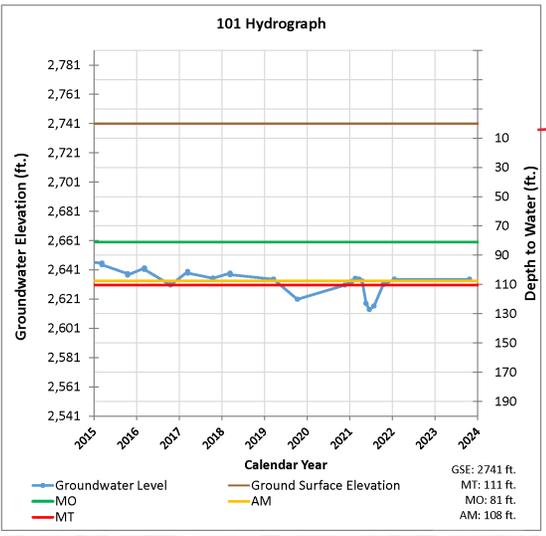
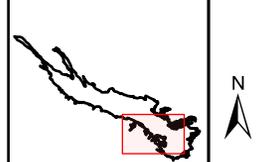


Figure 2-48: Monitoring Well Network Hydrographs

Cuyama Valley Groundwater Basin

Legend

- Well with Hydrograph
- Well without Hydrograph
- Well not Monitored
- Highway
- Local Road
- Creek
- Cuyama River
- Cuyama Basin



0 0.5 1 2 Miles

Map Created: July 2024

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Vertical Gradients

A vertical hydraulic gradient ~~describes~~represents the movement of groundwater perpendicular to the ground surface, and may be up or down. A vertical gradient is ~~typically measured~~calculated by comparing the elevations of groundwater in ~~a well~~wells with ~~multiple completions that are~~ of different screen depths. If groundwater elevations in the shallower ~~completions~~well are higher than in the deeper ~~completions~~well, the gradient is ~~identified as a~~ downward ~~gradient~~. ~~A,~~ corresponding to downward ~~gradient is one where~~ groundwater ~~is moving down into the ground~~flow. If groundwater elevations in the shallower ~~completions~~well are lower than in the deeper ~~completions~~well, the gradient is ~~identified as an~~ upward ~~gradient~~. ~~An,~~ corresponding to upward ~~gradient is one where~~ groundwater ~~is upwelling towards the surface~~flow. If groundwater elevations are similar ~~throughout the completions, there is no,~~ the vertical gradient ~~to identify is~~ insignificant. An understanding of the Basin's vertical gradients is required by Section 354.16(a) of the SGMA regulations, and this understanding further describes how groundwater moves in the Basin.

There are ~~three~~12 multiple completion nested wells in the Basin. ~~A multiple~~ At these locations, individual wells are constructed in the same borehole with different screen intervals. The depth between the screen intervals is sealed to prevent groundwater flow from one screen to another in the borehole. The USGS constructed nested monitoring wells at three locations in Cuyama Valley known as CVKR, CVBR, and CVFR. These nests are named after their location on Kirschenmann Road, Bell Road, and Foothill Road, respectively. Each location consists of four individual nested wells.

~~Three additional multi-completion nested well includes perforations at multiple intervals, and therefore provides information~~ locations were constructed by DWR under its Technical Support Services (TSS) program. Each location consists of three individual nested wells with Opti numbers 900-902 at multiple depths in the well. Figure TSS #1, 903-905 at TSS #3, and 906-908 at TSS #2-23. The CBGSA received additional grant funding through the SGMA implementation grant and has installed five multi-completion wells; however, since these wells are newly constructed and do not yet have a record of groundwater level measurements, discussions of vertical gradients for these wells are not included.. Figure 2-49249 is an overview map that shows the locations of the multiple completion wells in the Basin, and are located in the central portion of the Basin, north of 11 multi-competition wells and Opti well 914 and MW-D. Opti well 914 was drilled in a location that was identified as a potential multi completion well, but due to the SBCF and east of Bitter Creek geology encountered during drilling, it ended up with only one well completion. MW-D has not been constructed yet but will be completed prior to the GSP submittal.



~~Figure 2-36~~ Figure 2-50 shows the combined hydrograph for the multiple completion well CVFR, which was ~~installed by USGS.~~⁴ ~~constructed by the USGS.~~⁵ ~~The first measurements were recorded on October 27, 2009.~~ CVFR is comprised of four ~~completions, each at wells with~~ different ~~screen~~ depths as follows:

- ~~Opti well 91 (CVFR-1)~~ is the deepest completion with a screened interval from 960 to 980 feet bgs.
- ~~Opti well 316 (CVFR-2)~~ is the second deepest completion with a screened interval from 810 to 830 feet bgs.
- ~~Opti well 17 (CVFR-3)~~ is the third deepest completion with a screened interval from 680 to 700 feet bgs.
- ~~Opti well 318 (CVFR-4)~~ is the shallowest completion with a screened interval from 590 to 610 feet bgs. ~~Measurements for the shallowest completion stopped in 2014 when the depth to water dropped below 610 ft bgs (i.e., the well is dry).~~

The hydrograph of the four completions shows that they are close to the same elevation at each completion, ~~and therefore it is unlikely that there is any vertical gradient with a change of only three feet on the last recorded measurement date of April 26, 2024.~~ Therefore, the vertical gradient is insignificant at this location.

~~Figure 2-37~~ ~~Figure 2-51~~⁵¹ shows the combined hydrograph for the multiple completion well CVBR, ~~which was installed by USGS.~~ The first measurements occurred on September 29, 2009. CVBR is comprised of four ~~completions, each at wells with~~ different ~~screen~~ depths as follows:

- ~~Opti well 99 (CVBR-1)~~ is the deepest completion with a screened interval from 830 to 850 feet bgs.
- ~~Opti well 322 (CVBR-2)~~ is the second deepest completion with a screened interval from 730 to 750 feet bgs.
- ~~Opti well 324 (CVBR-3)~~ is the third deepest completion with a screened interval from 540 to 560 feet bgs.
- ~~Opti well 325 (CVBR-4)~~ is the shallowest completion with a screened interval from 360 to 380 feet bgs.

~~The hydrograph of the four completions shows that at the deeper completions, groundwater elevations are slightly lower than the shallower completions in the winter and spring, and deeper completions are generally lower than the shallower completion in the summer and fall. This indicates that during the irrigation season, the deeper portions of the aquifer are likely to be where pumping occurs. This pumping removes water from the deeper portion of the aquifer, creating a vertical gradient during the summer and~~

⁴ ~~All three multiple completion wells were installed by the USGS as part of the Cuyama Valley Water Availability Study in cooperation with SBCWA~~

⁵ ~~All three multiple completion wells were constructed by the USGS as part of the Cuyama Valley Water Availability Study in cooperation with SBCWA~~



fall. By the spring, enough water has moved down or horizontally to replace removed water, and the vertical gradient is significantly smaller at this location in the spring measurements.

Figure 2-38 Historical measurements in the four wells illustrate that water levels are typically lowest in the deepest well and highest in the shallowest well, indicating a downward vertical gradient. However, beginning in 2023, water levels in the deepest and shallowest wells are about the same, with a difference of only about two feet. These recent measurements indicate an insignificant vertical gradient.

Figure 2-52 shows the combined hydrograph for the multiple completion well CVKR, which was installed by the USGS. The first measurements were recorded on March 3, 2009. CVKR is comprised of four completions, each at wells with different screen depths as follows:

- Opti well 77 (CVKR-1) is the deepest completion with a screened interval from 960 to 980 feet bgs.
- Opti well 420 (CVKR-2) is the second deepest completion with a screened interval from 760 to 780 feet bgs.
- Opti 421 (CVKR-3) is the third deepest completion with a screened interval from 600 to 620 feet bgs.
- Opti 422 (CVKR-4) is the shallowest completion with a screened interval from 440 to 460 feet bgs.

The hydrograph of the four completions shows that at the deeper completions are slightly lower than the shallower completions in the spring at each completion, and deeper completions are generally lower in the summer and fall. This indicates that during the irrigation season, the deeper portions of the aquifer are likely to be where pumping occurs. This pumping removes water from the deeper portion of the aquifer, creating a vertical gradient during the summer and fall. By the winter and spring, enough water has moved down to replace removed water, and the vertical gradient is very small at this location in the spring measurements.

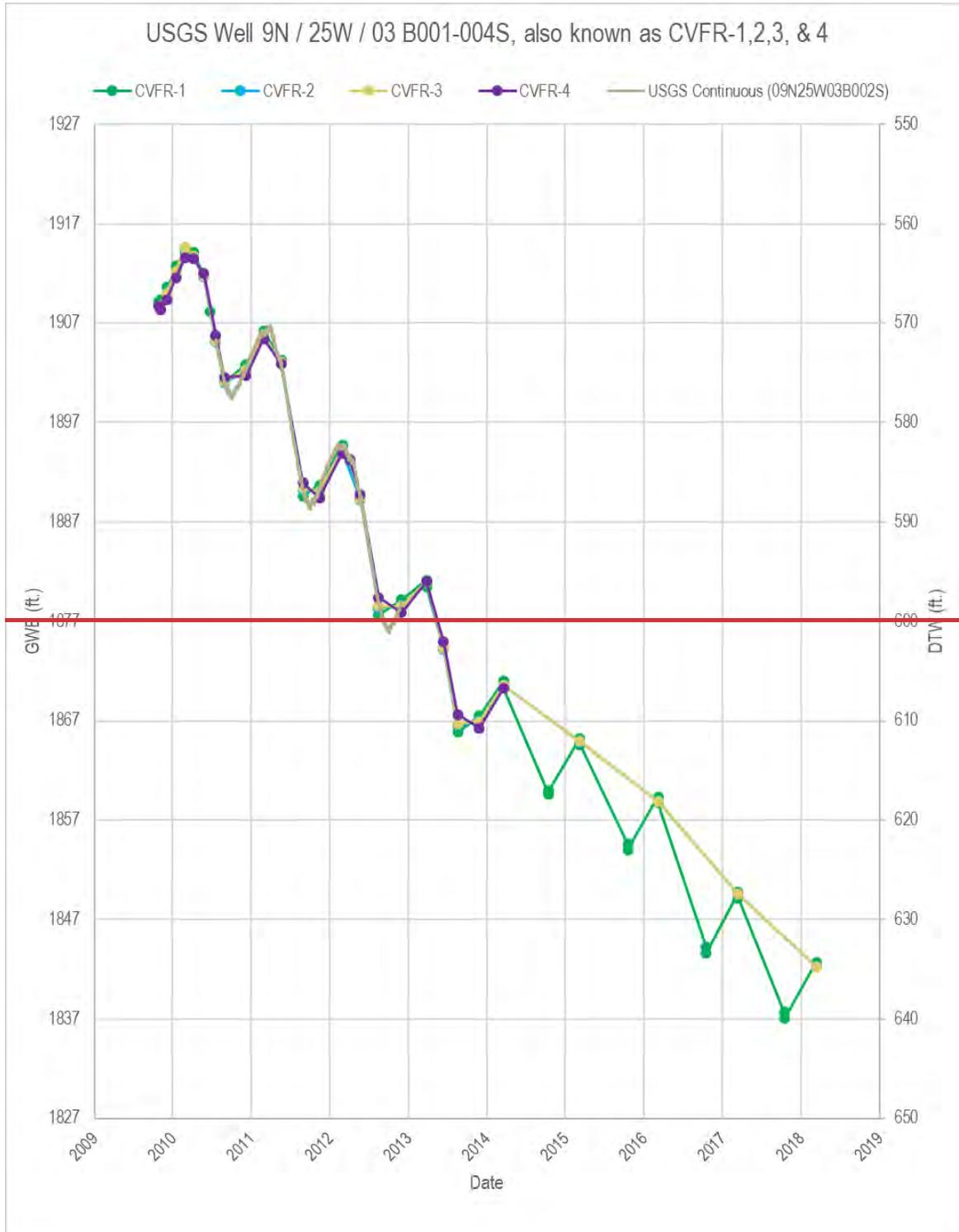


Figure 2-36: Hydrographs of CVFR1-4

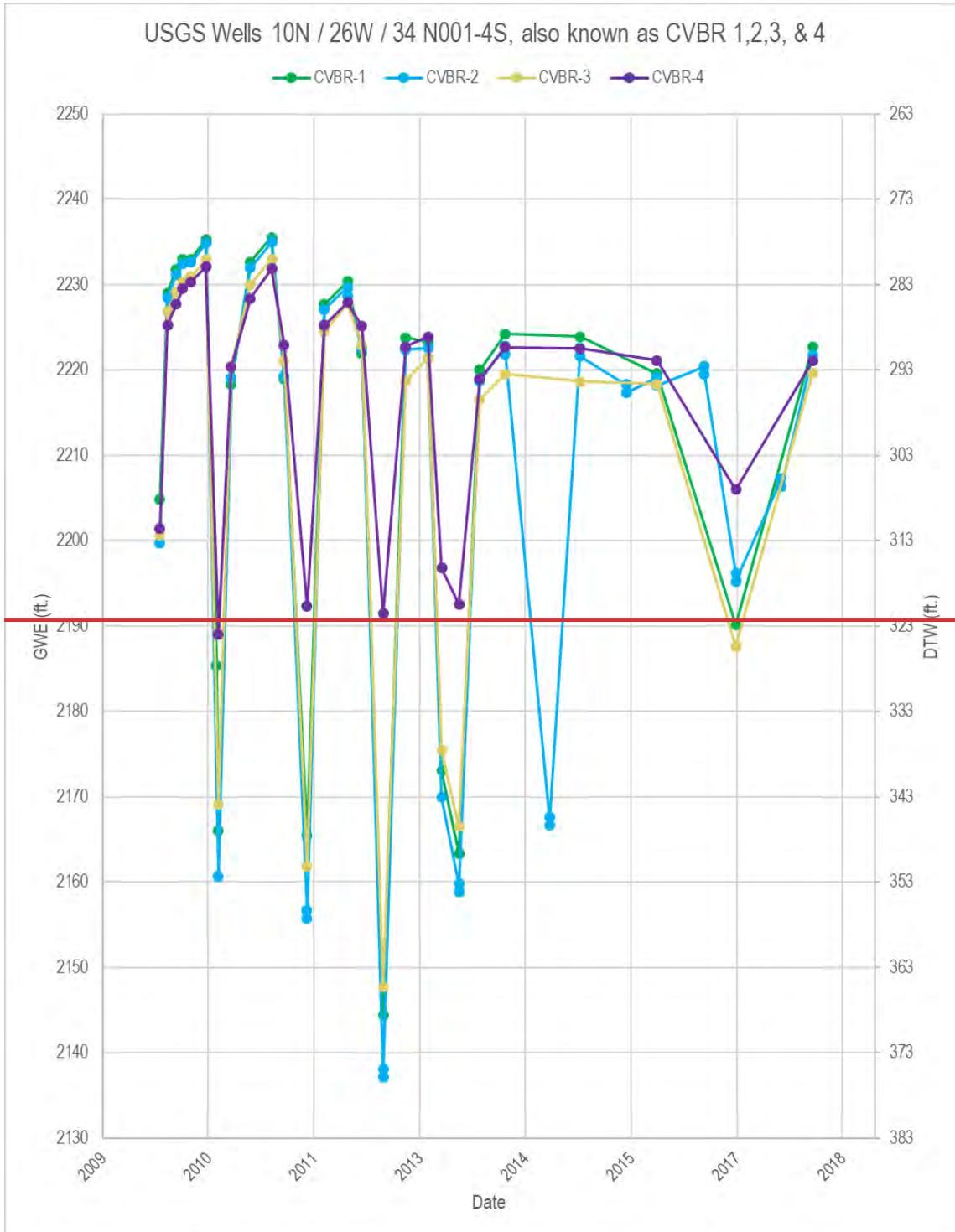




Figure 2-53253 Similar to the hydrograph for CVBR, the hydrograph of these four wells illustrates that water levels are typically lowest in the deepest well and highest in the shallowest well, indicating a downward vertical gradient. The hydrograph also shows an apparently erroneous measurement in the shallowest well, in mid-2023. Figure 2-53253 shows the combined hydrograph for the multi completion wells at TSS #1, Opti numbers 900-902. These three wells have different screen depths as follows:

- Opti well 902 is the deepest completion with a screen interval from 325 to 365 feet bgs.
- Opti well 901 is the second deepest completion with a screened internal from 165 to 205 feet bgs,
- Opti well 900 is the shallowest completed with a screened interval from 50 to 60 feet bgs.

The combined hydrograph shows that the deepest well typically has the highest water level, indicating a small upward vertical gradient. However, the latest measurement, taken on April 24, 2024, shows only a two-foot variation between these wells.

Figure 2-54254 shows the combined hydrograph for the multi completion wells at TSS #3, Opti numbers 903-905. These three wells have different screen depths as follows:

- Opti well 905 is the deepest completion with a screen interval from 540 to 570 feet bgs.
- Opti well 904 has the second deepest completion with a screen interval from 360 to 400 feet bgs.
- Opti well 903 has the shallowest completion with a screen interval from 265-305 feet bgs.

Similar to the wells at TSS #1, the hydrograph shows the deepest well typically has the highest water level, indicating a small upward vertical gradient. This small has remained consistent throughout the sampling period from July 2022 to the last current measurement in April 2024. Figure 2-55255 shows the combined hydrograph for the multi completion wells at TSS #2, Opti numbers 906-908. These three wells have different screen depths as follows:

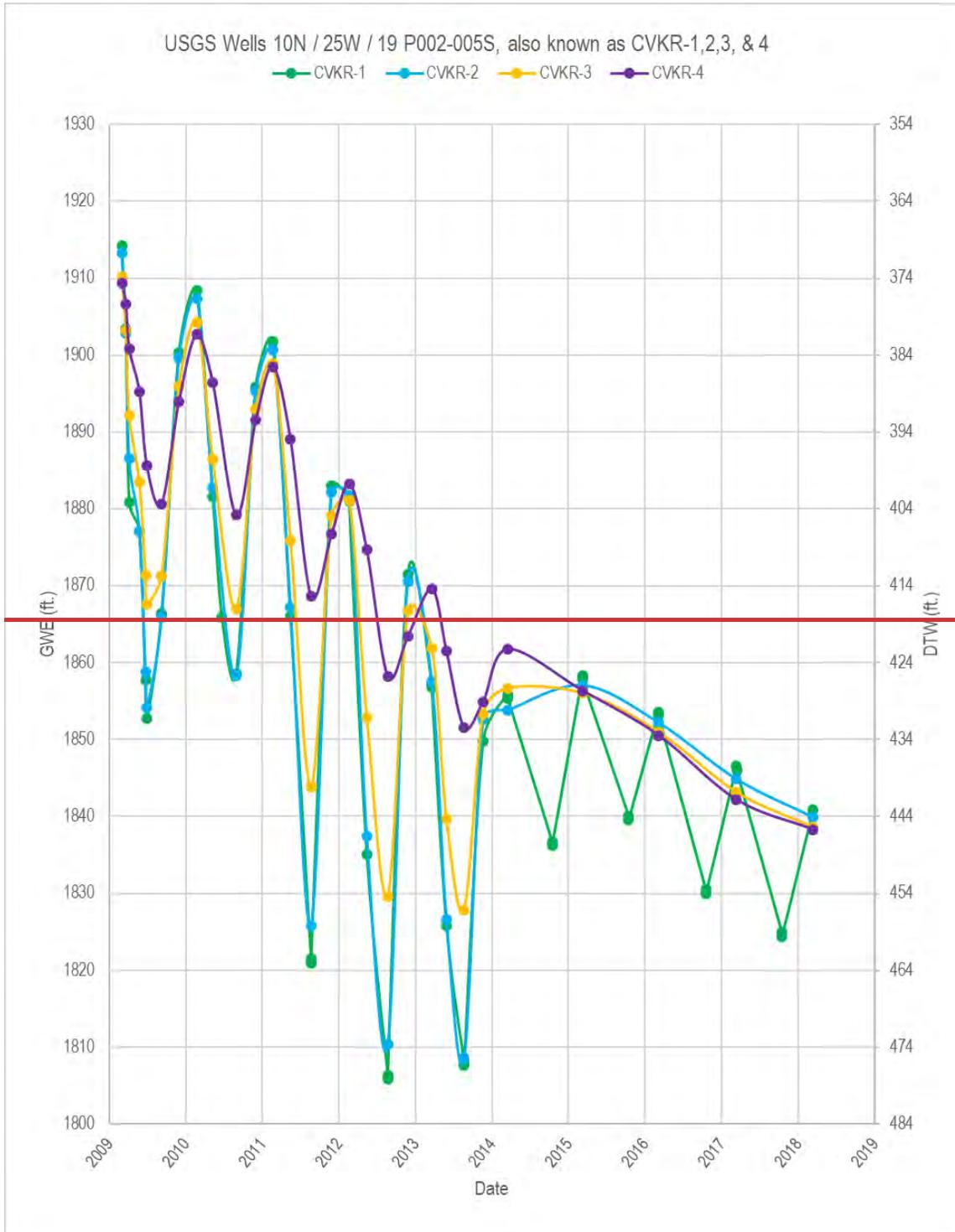
- Opti well 908 is the deepest completion with a screen interval from 650-660 feet bgs.
- Opti well 907 is the second deepest completion with a screen interval 515-525 feet bgs.
- Opti well 906 is the shallowest completion with a screen interval from 130-150 feet bgs.

The combined hydrographs for these wells show an upward vertical gradient with the highest water levels in the deepest well followed by the intermediate-depth well, and the shallowest well, respectively. The differences in groundwater elevation indicate the upward vertical gradient between the intermediate and deep well is higher than the vertical gradient between the shallow and intermediate well. These water level differences are generally consistent throughout the sampling period.



Table 2-2-2-2 shows the screen depths for new multi completion wells recently constructed by the CBGSA under the SGMA grant.

Table 2-37: Hydrographs of CVBR1-42: CBGSA Nested Wells





Nested Well	Deep Completion (feet bgs)	Shallow Completion (feet bgs)	Water Level Measurements (feet bgs)
Opti well 912-913 (MW-F)			
Opti 913	350-370 ft.	-	6/5/2024 (39.29 ft.)
Opti 912	-	180-200 ft.	6/5/2024 (8.05 ft.)
Opti 915-916 (MW-H)			
Opti 916	880- 900 ft.	-	5/13/2024 (507.82 ft.)
Opti 915	-	660-680 ft.	5/13/2024 (574.67 ft.)
Opti 917-918 (MW-E)			
Opti 918	720-740 ft.	-	No current Water Level data
Opti 917	-	610- 630 ft	No current Water Level data
Opti Well 919-920 (MW-G)			
Opti 920	420-440 ft.	-	No current Water Level data
Opti 919	-	280-300 ft.	No current Water Level data
Opti 914 (MW-C)			
Opti 914	500-520 ft. (Only one completion due to the geology encountered during drilling)		No current Water Level data
MW-D	This well has not been constructed but will be completed prior to the GSP 2025 Submittal.		

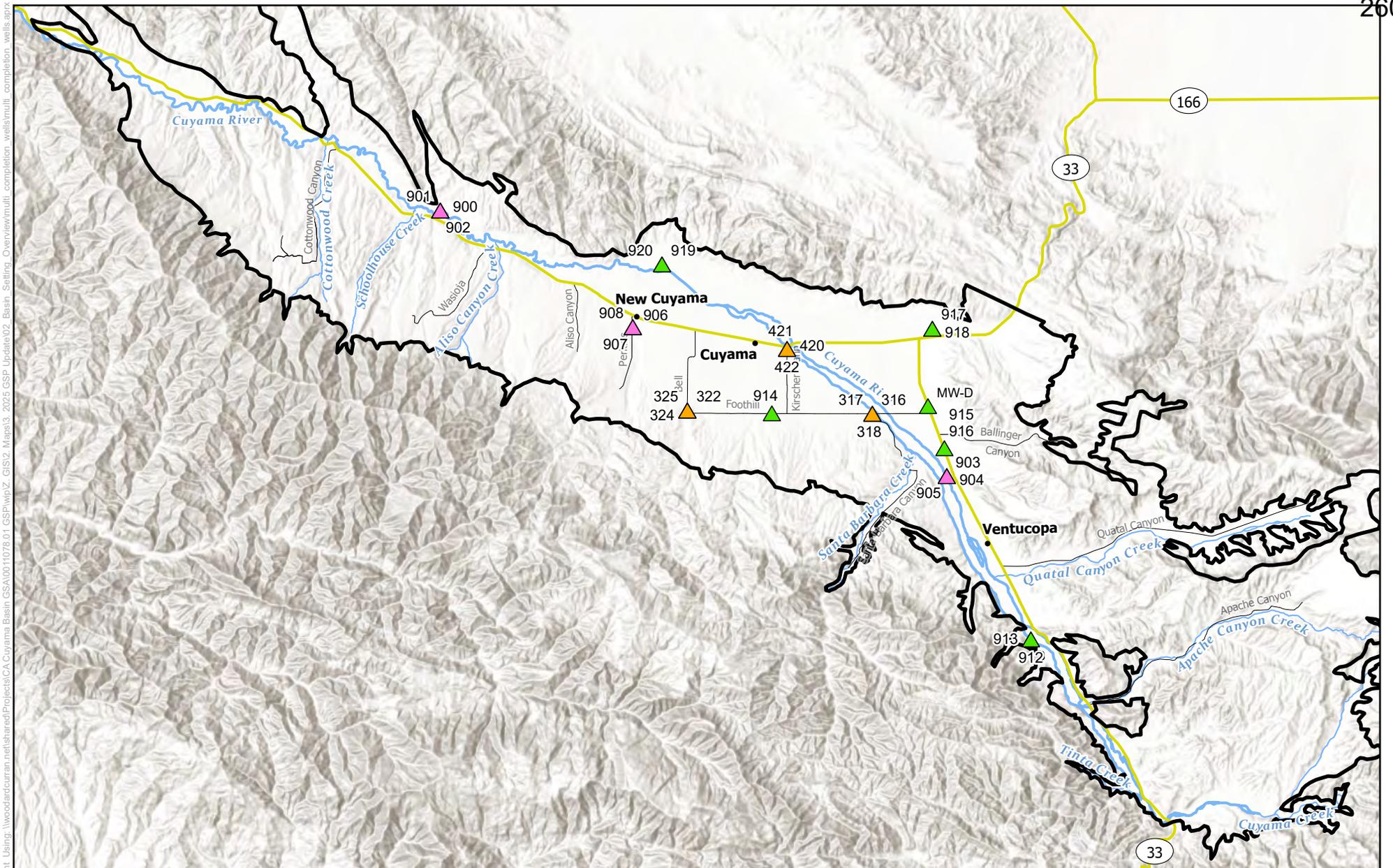


Figure 2-49: Multi Completion And Nested Wells

Cuyama Valley Groundwater Basin

Legend

- ▲ CBGSA
- ▲ TSS
- ▲ USGS
- Highway
- Local Road
- Town
- Creek
- Cuyama River
- Cuyama Basin



0 1.25 2.5 5 Miles

Map Created: July 2024

Figure Exported: 7/15/2024, By: Dhlunt, Using: WoodardCurran.net\shared\Projects\CA Cuyama Basin_GSA0011078.01_GSP\wp\Z_GIS2_Maps\3_2025_GSP_Update\02_Basin_Sealing_Overview\multi_completion_wells\multi_completion_wells.aprx

Third Party GIS Disclaimer: This map is for reference and graphical purposes only and should not be relied upon by third parties for any legal decisions. Any reliance upon the map or data contained herein shall be at the users' sole risk. Data sources: CA DWR, Esri, USGS

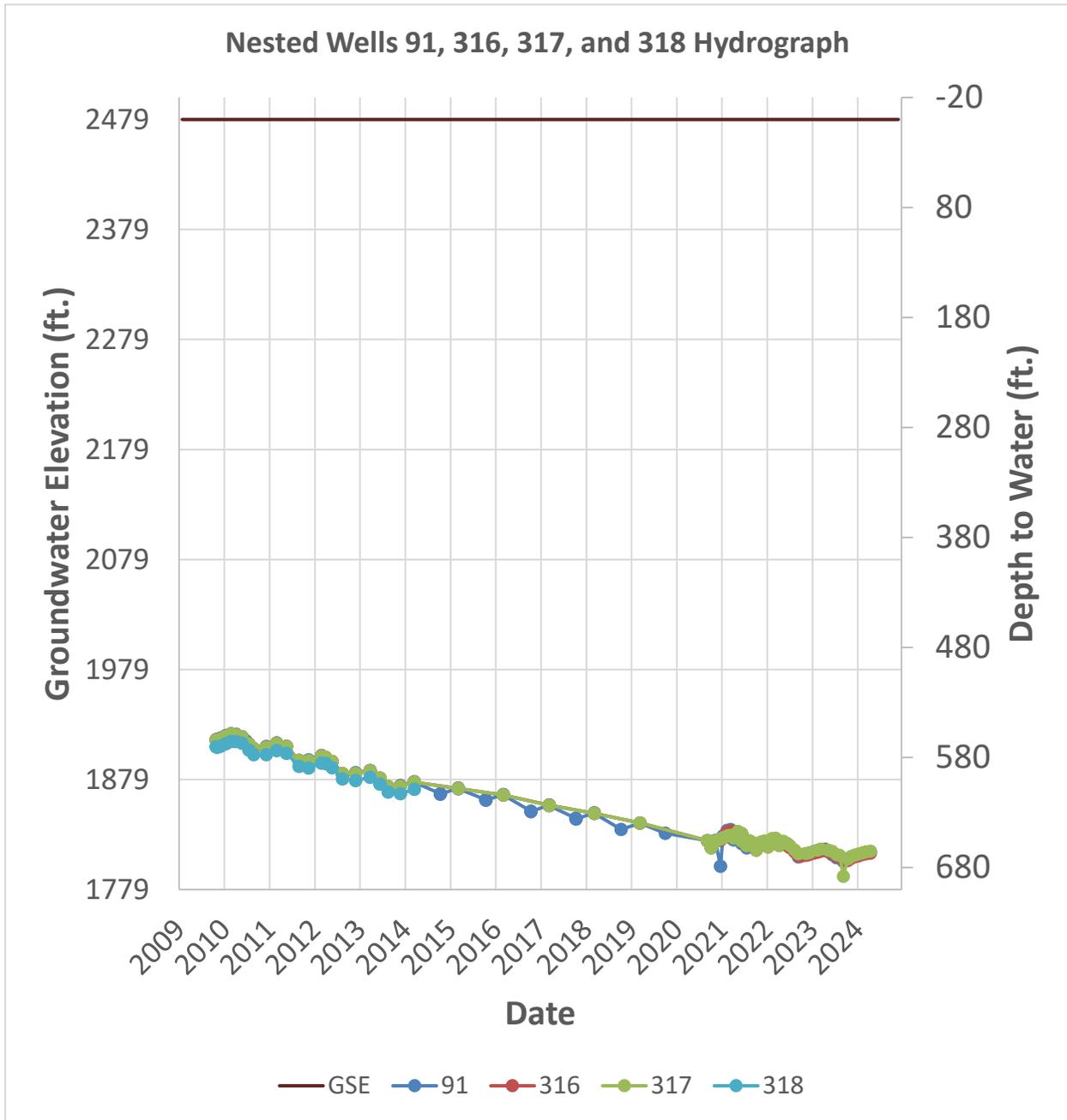


Figure 2-50: Hydrographs of Opti well 91, 316, 317, 318 (USGS Well CVFR1-4)

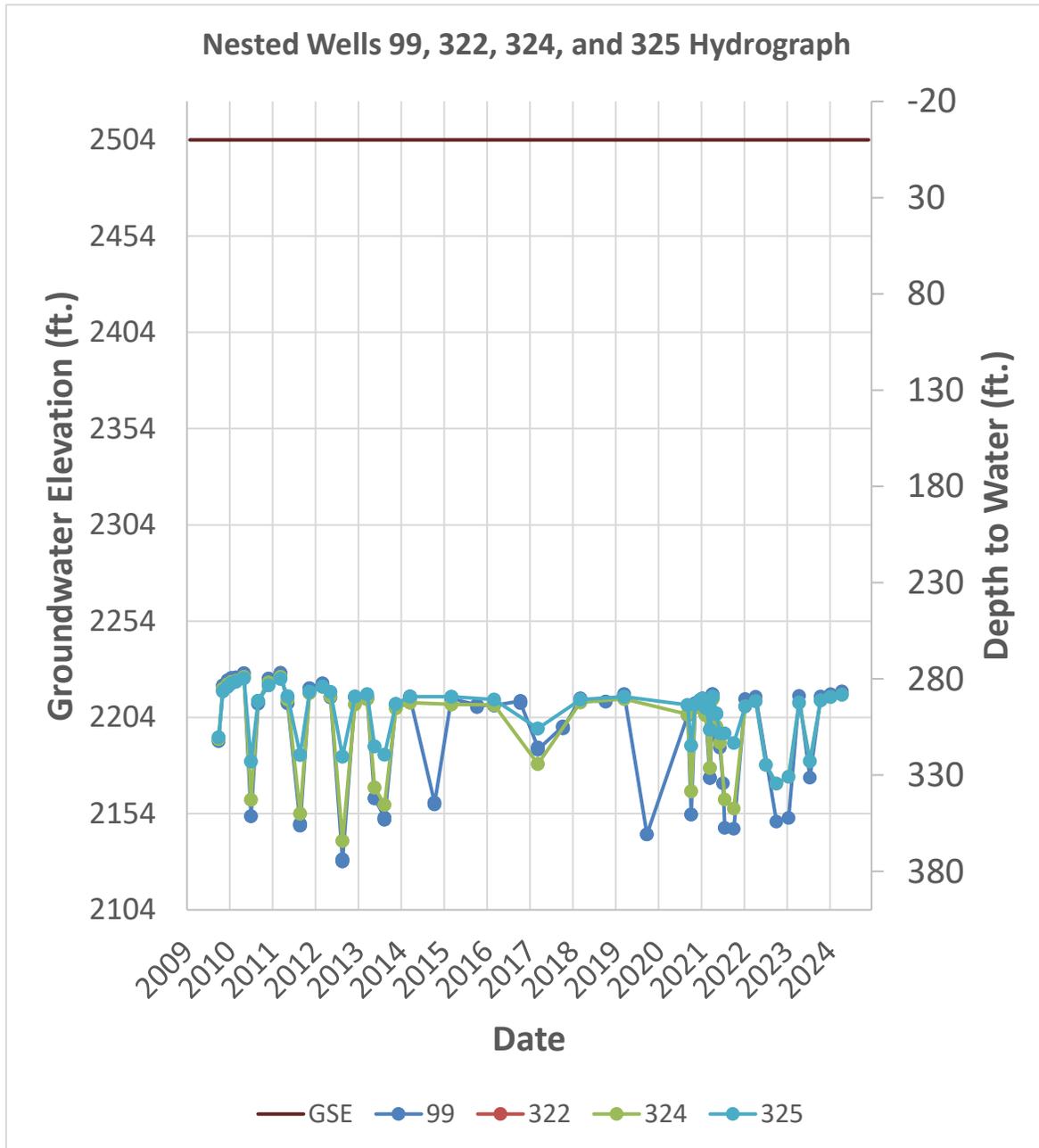


Figure 2-51: Hydrographs of Opti well 99, 322, 325, and 325 (USGS Well CVBR1-4)

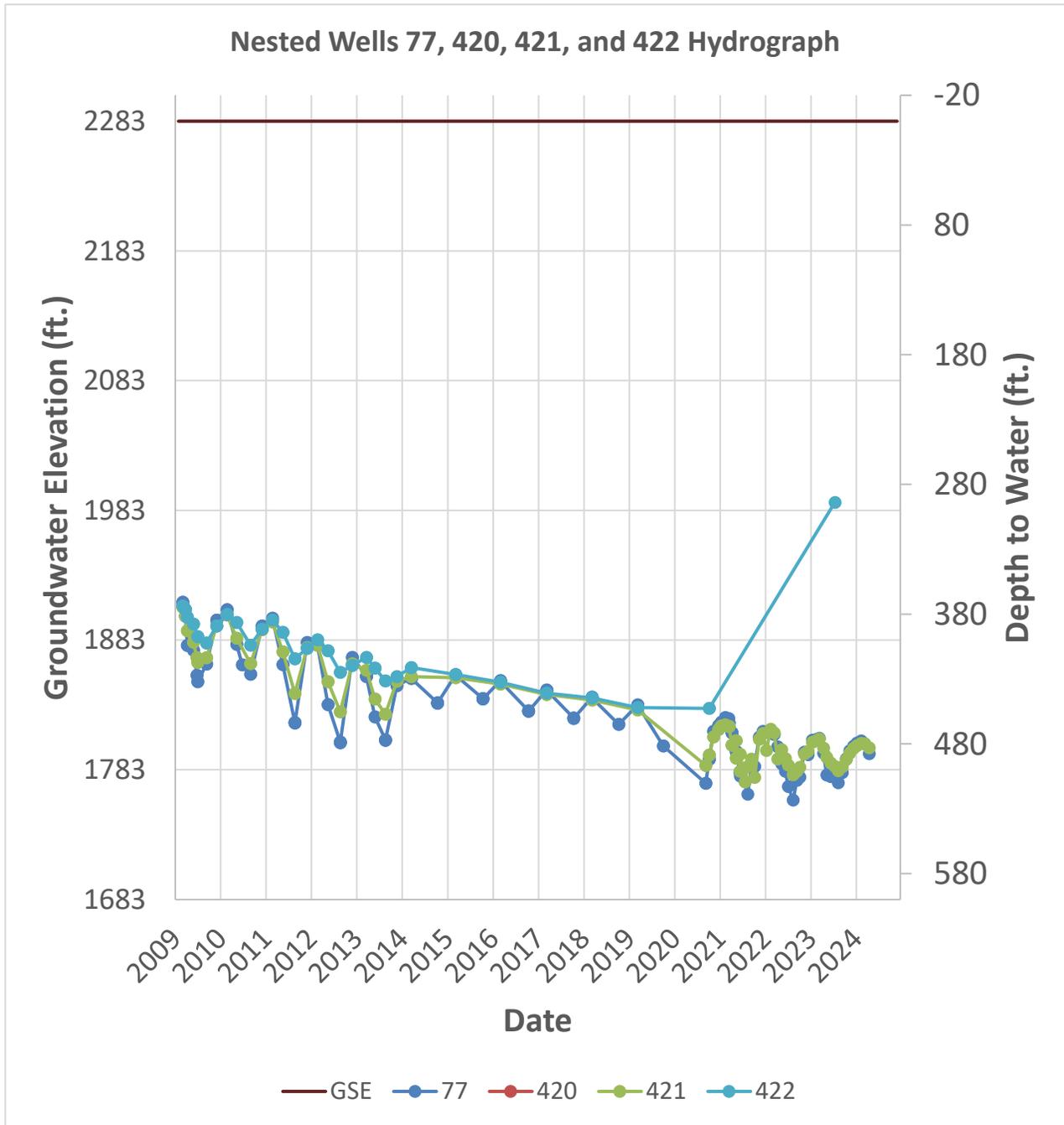


Figure 2-52: Hydrographs of Opti well 77, 420, 421, and 422 (USGS well CVKR1-4)

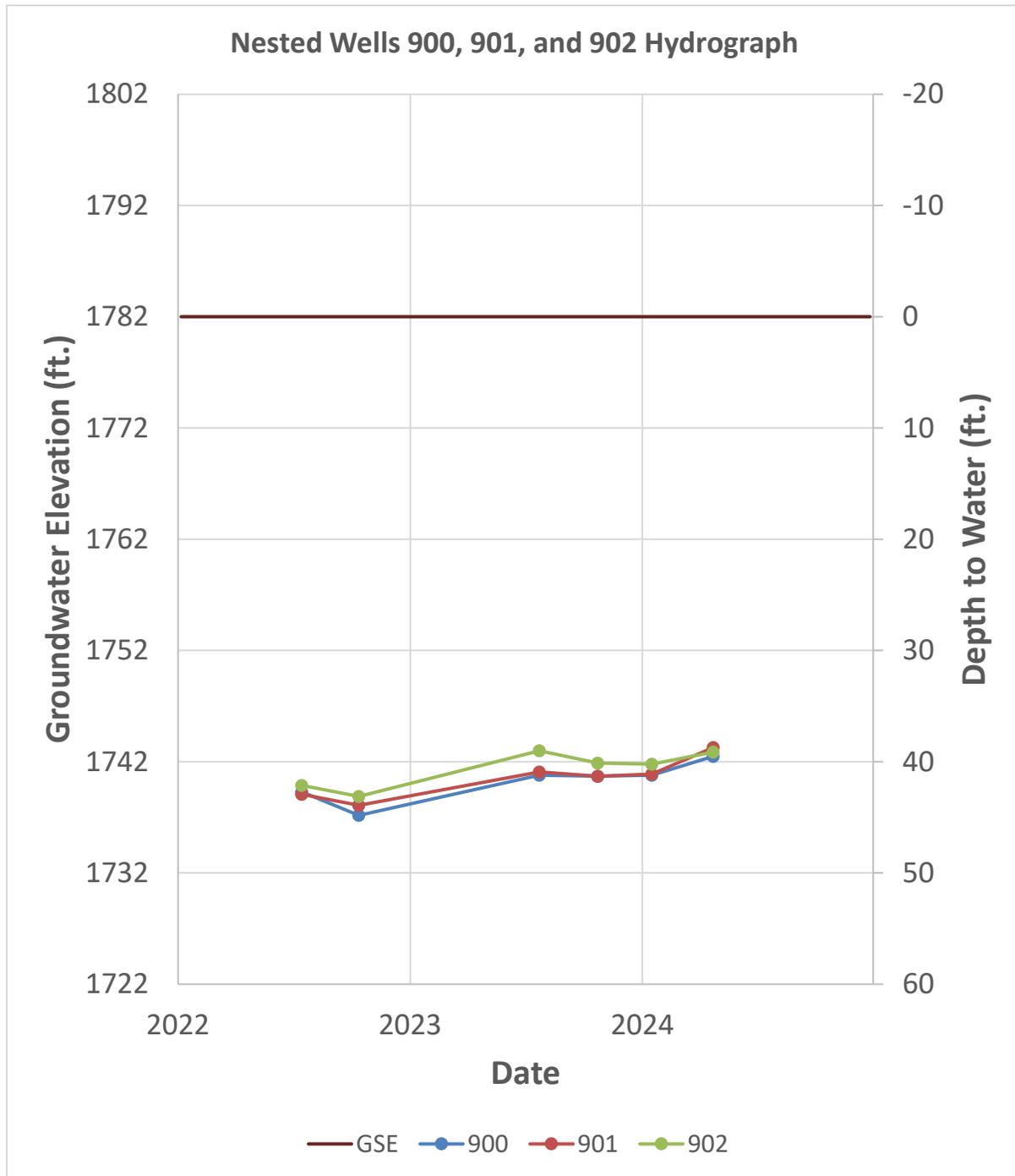


Figure 2-53: TSS Hydrographs Opti well 900, 901 and 902

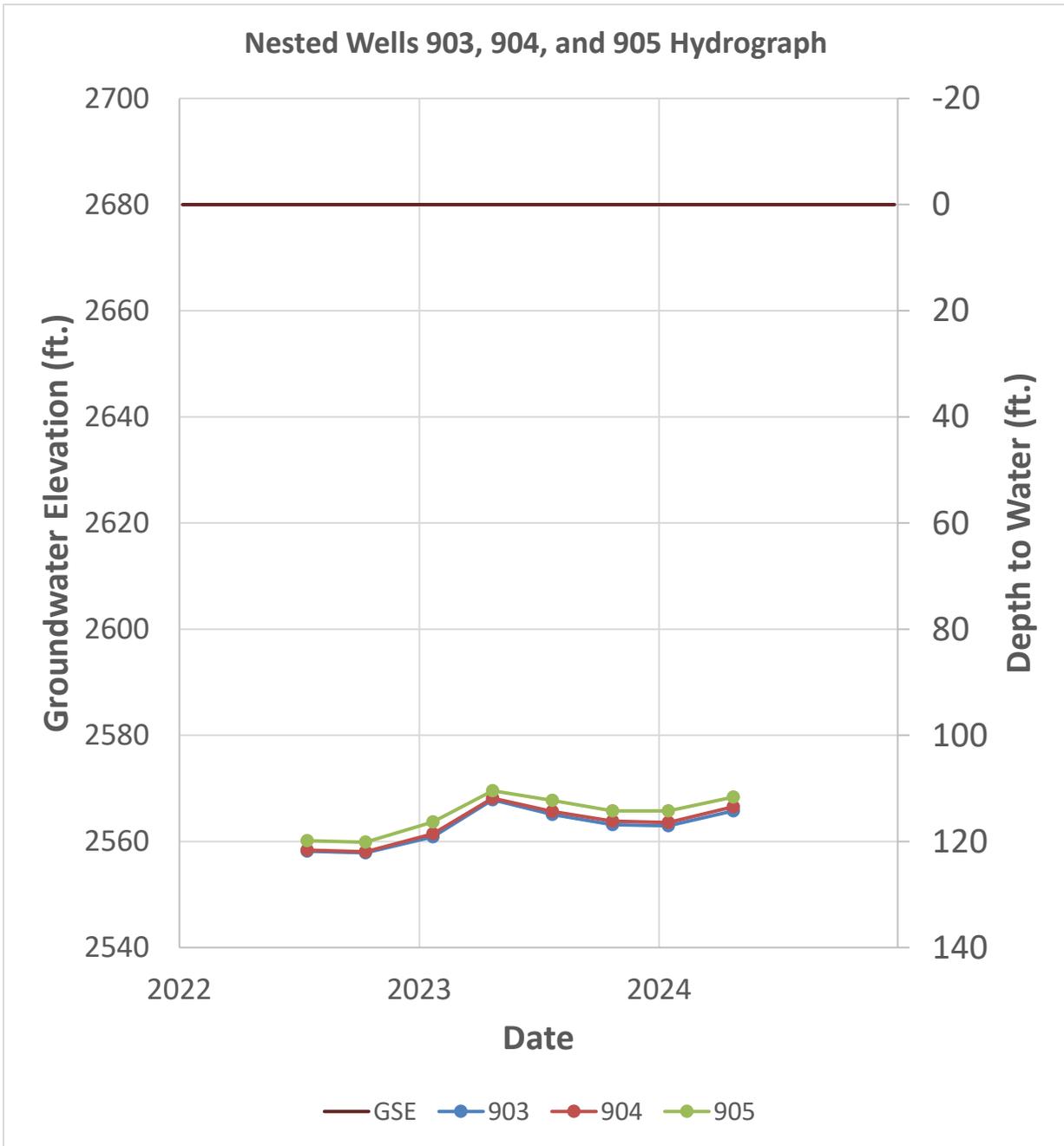


Figure 2-54: TSS Hydrograph 2 Opti wells 903, 904, and 905.

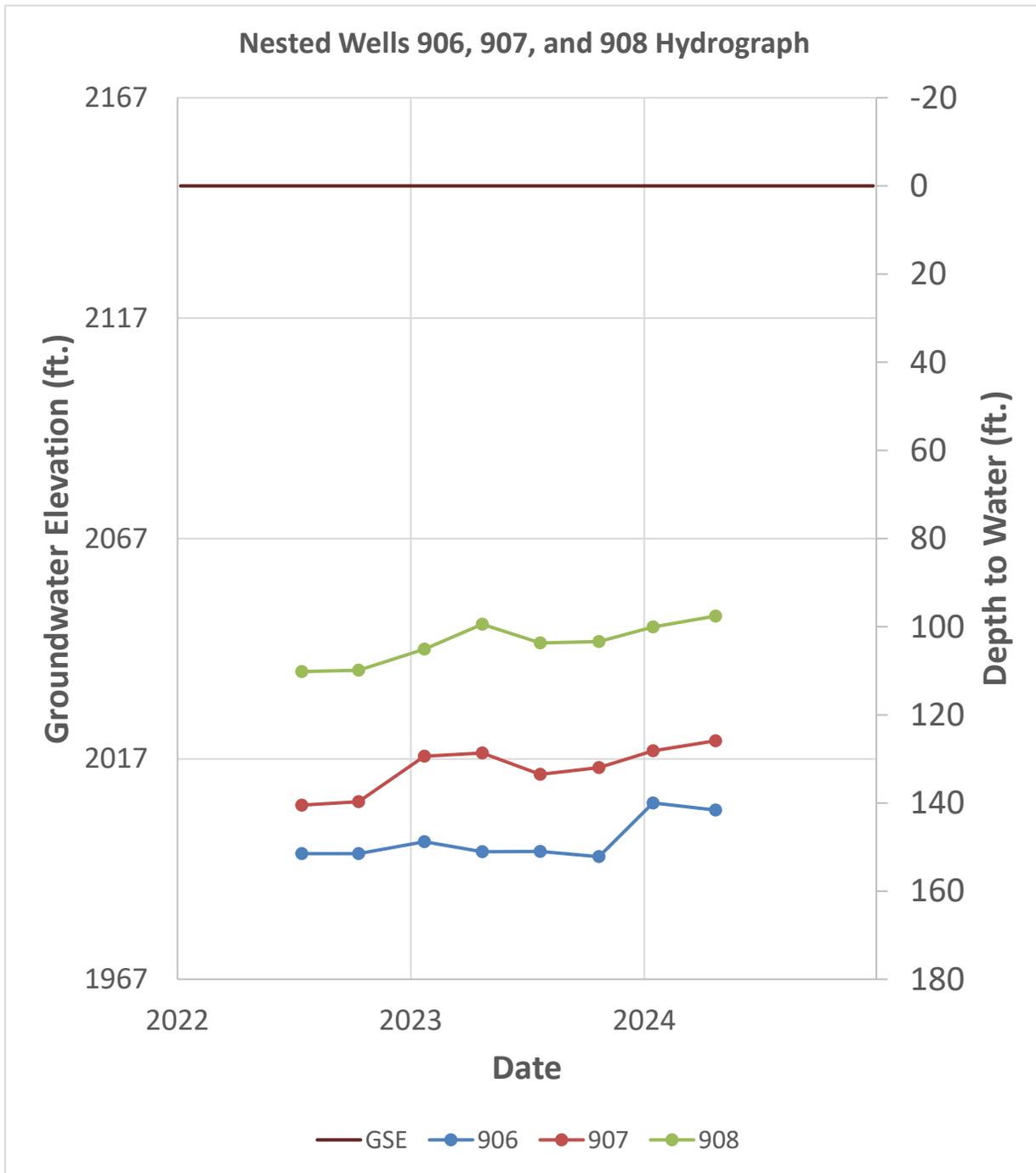


Figure 2-55: TSS hydrograph 3 for Opti wells 906, 907, and 908.



Groundwater Contours

Analysts prepared groundwater contour maps to improve understanding of recent groundwater trends in the Basin. Analysts used the data collected and described in ~~Section 0~~[Sections 2.2.3 and 2.2.4](#) to develop these maps. A contour map shows changes in groundwater elevations by interpolating groundwater elevations between monitoring sites. The elevations are shown on the map with the use of a contour line, which indicates that at all locations that line is drawn, the line represents groundwater at the elevation indicated. There are two versions of contour maps used in this section: one that shows the elevation of groundwater above mean sea level, which is useful because it can be used to identify the horizontal gradients ~~of~~[and](#) groundwater [flow directions](#), and one that shows contours of depth to water, the distance from the ground surface to groundwater, which is useful because it can identify areas of shallow or deep groundwater.

Methodology

To complete the groundwater elevation maps in the 2020 GSP an inverse distance weighting (IDW) interpolation was conducted and then manually adjusted to meet expected conditions. The new methodology interpolates groundwater elevation using a specialized algorithm to create a ‘hydrologically connected’ potentiometric surface (ArcGIS Topo to Raster tool). This best represents the groundwater elevations as it helps to reduce depressions and variance in areas with limited data. The resulting interpolation and contours were then cropped within the bounding area of available data using a concave hull. Some minor manual adjustments were applied to the Basin boundary to reduce or remove areas with sparse data. Contours greater than one mile away from any well were labeled as ‘approximate.’ Conceptual flowlines were added based on the interpolated groundwater elevation contours to represent generalized groundwater flow directions.

To visualize the depth to groundwater in the Basin and areas with localized drawdown, an IDW was used for interpolation of depth to water measurements. Resulting rasters and contours were then cropped using the same procedure described above.

The new methodology is an improvement over the original methodology because it does not rely on manual contouring. Data can be processed following a set protocol, producing consistent results.

Analysts prepared groundwater contour maps for both groundwater elevation and depth to water for the following periods:

- [Spring 2024](#)
- [Fall 2022](#)
- [Fall 2020](#)
- Spring 2018
- Fall 2017



- Spring 2017
- Spring 2015

• ~~Fall 2014~~

These years were selected for ~~contours display~~ because they are representative of current conditions, and ~~because these years identify conditions near January 1, 2015, when SGMA came into effect. seasonal patterns.~~ The contour maps are described below.

Each contour map follows the same general format. ~~Each contour map is contoured at using a 50100-foot contour interval, with contour elevations indicated in white numeric labels, and measurements at individual monitoring points indicated in black numeric labels. Areas where the contours are dashed and not colored inbetween are inferred contours that extend elevations beyond because the available data availability are spaced far apart~~ and are included for reference only. The groundwater contours were also based on certain assumptions in order to accumulate enough data points to generate useful contour maps. Assumptions are as follows:

- Measurements from wells of different depths are representative of conditions at that location and there are no vertical gradients. Due to the limited spatial amount of monitoring points, data from wells of a wide variety of depths were used to generate the contours.
- Measurements from dates that may ~~be as far apart temporally as span up to~~ three months are representative of conditions during the spring or fall season, and conditions have not changed substantially from the time of the earliest measurement used to the latest. ~~Due to the limited temporal amount of measurements in the Basin, data from a wide variety of measurement dates were used to generate the contours.~~



within that season.

These assumptions generate allow for the generation of contours that are useful at the planning level for understanding groundwater levels across the Basin, and to identify general horizontal gradients and regional groundwater level trends. The contour maps are not indicative of exact values across the Basin because the interpolated groundwater contour maps contours reflect approximate conditions between measurement points, ~~and~~. The contours do not account for topography or bedrock outcrops within the Basin. Therefore, a well on a ridge may be farther from groundwater than one in a canyon, and the contour map will not reflect that level of detail. Figure 2-56 shows groundwater elevation contours for spring of 2024. In the southeastern portion of the Basin near the Ozena fire station, the groundwater gradient appears to indicate flow that follows the Cuyama River. The contour map shows a steep gradient across the SBCF and groundwater flow to an area of lower groundwater elevation northeast of the town of Cuyama. From the town of New Cuyama to the west, the groundwater elevation contours reflect a gradient and flow to the north-northeast, from areas with higher land surface elevations towards areas with lower elevations and towards the Cuyama River.

Expansion and improvement of the monitoring network to generate a more accurate understanding of groundwater trends in the Basin is discussed in Chapter 4.

~~Figure 2-39~~ Figure 2-57 shows depth to groundwater contours for spring of 2024. South of the SBCF, depth to groundwater is about 100-200 feet bgs. North of the SBCF, depth to groundwater declines rapidly to over 600 feet bgs. Depth to groundwater reduces (i.e., is closer to ground surface) to the west towards New Cuyama, where groundwater is around 200-300 feet bgs. West of Bitter Creek, groundwater is shallower than 200 feet bgs in many locations and shallower than 100 feet bgs at some well locations.

~~Figure 2-58~~ Figure 2-58 shows groundwater elevation contours for fall of 2022. The contour map shows a steep gradient across the SBCF and groundwater flow to an area of lower groundwater elevation northeast of the town of Cuyama. From the town of New Cuyama to the west, the groundwater gradient reflects generalized flow to the north-northeast, from topographically higher areas towards areas with lower topography and the Cuyama River.

~~Figure 2-59~~ Figure 2-59 shows depth to groundwater contours for fall of 2022. Just south of the SBCF, depth to groundwater is about 200-300 feet bgs. North of the SBCF, depth to groundwater declines rapidly to over 600 feet bgs. Depth to groundwater reduces (i.e., is closer to ground surface) to the west towards New Cuyama, where groundwater is around 300 feet bgs. West of Bitter Creek, groundwater is shallower than 200 feet bgs in many locations and shallower than 100 feet bgs in some well locations.

Figure 2-60 shows groundwater elevation contours for fall of 2020. Much like the maps for 2024 and 2022, the contour map shows a steep gradient across the SBCF and groundwater flow to an area of lower groundwater elevation northeast of the town of Cuyama. From the town of New Cuyama to the west, the groundwater elevation contours reflect a gradient and flow to the north-northeast, from areas with higher land surface elevations towards areas with lower elevations and towards the Cuyama River.



~~Figure 2-61261~~ shows depth to groundwater contours for fall of 2020. Just south of the SBCF, depth to groundwater is about 200 feet bgs. North of the SBCF, depth to groundwater declines rapidly to over 600 feet bgs. Depth to groundwater reduces (i.e., is closer to ground surface) to the west towards New Cuyama, where groundwater is around 300 feet bgs. West of Bitter Creek, groundwater is shallower than 100 feet bgs in most well locations.

~~Figure 2-62262~~ shows groundwater elevation contours for spring of 2018, along with arrows showing the direction of groundwater flow. In the southeastern portion of the Basin near Ventucopa, groundwater ~~has a horizontal gradient~~ flows to the northwest. The gradient increases in the vicinity of the SBCF and groundwater flows to an area of lowered groundwater elevation southeast of the town of Cuyama. Lowered groundwater elevations in this area are also associated with a flow gradient to the southeast from the town of Cuyama. From the town of New Cuyama to the west, ~~the groundwater has~~ elevation contours reflect a horizontal gradient that generally flows and flow to the northeast, from areas with higher elevation topography and surface elevations towards areas with lower elevation topography where elevations and towards the Cuyama River is located.

~~Figure 2-40~~~~Figure 2-63263~~ shows depth to groundwater contours for spring of 2018. Just south the SBCF, depth to groundwater is ~~near~~about 100 feet bgs. North of the SBCF, depth to groundwater declines rapidly ~~and is~~to over 600 feet bgs. Depth to groundwater reduces (i.e., is closer to ground surface) to the west towards New Cuyama, where groundwater is around 150 feet bgs. West of Bitter Creek, groundwater is shallower than 100 feet bgs in most locations; and is shallower than 50 feet bgs in the far west and along the Cuyama River.



Figure 2-39: Cuyama Basin Wells by Groundwater Surface Elevation in Spring 2018



Figure 2-40: Cuyama Basin Wells by Depth to Water in Spring 2018



The remaining contour maps for spring 2017, fall 2017, spring 2015, and fall 2014 are shown below. These dates were selected to show the changes over the most recent period of three years for which data were available in the spring (from 2015 to 2018) and from the fall (from 2014 to 2017).

Figure 2-41 shows groundwater elevation contours for fall of 2017. Because more data were available in this time frame, the contour map shows increased detail in some areas. In the southeastern portion of the Basin near the Ozena fire station, groundwater gradients appear to indicate flows that follow the Cuyama River. The contour map shows a steep gradient across the SBCF and flows groundwater flow to an area of lowered groundwater elevation northeast of the town of Cuyama. From the town of New Cuyama to the west, the groundwater has elevation contours reflect a horizontal gradient that generally flows and flow to the northeast, from areas with higher elevation topography and surface elevations towards areas with lower elevation topography where elevations and towards the Cuyama River is located.



Figure 2-41: Fall 2017 Groundwater Elevation Contours



~~Figure 2-42~~Figure 2-65~~265~~ shows depth to water contours for fall of 2017. ~~Because more data were available in this time frame, the contour map has increased detail in some areas. In the southeastern portion of the Basin near the Ozena fire station, depth to water is under 50 feet bgs.~~ There is a steep gradient near the SBCF, and depth to groundwater is below 600 feet bgs immediately northwest of the SBCF. The central portion of the Basin generally has a depth to water between 400 and 500 feet bgs, with depth to groundwater decreasing to the west of New Cuyama. West of Bitter Creek, groundwater is generally shallower than 100 feet below bgs, and is shallower than 50 feet bgs along the Cuyama River in most cases.

Figure 2-66~~266~~



Figure 2-42: ~~Fall 2017~~ Depth to Water Contours



Figure 2-43 shows groundwater elevation contours for spring of 2017. ~~Because more data were available in this time frame, the contour map has increased detail in some areas. In the southeastern portion of the Basin near the Ozena fire station, groundwater gradients appear to indicate flows that follow the Cuyama River.~~ The contour map shows a steep gradient across the SBCF and ~~flows groundwater flow~~ to an area of lowered groundwater elevation northeast of the town of Cuyama. From the town of New Cuyama to the west, ~~the groundwater~~ ~~has~~ ~~elevation contours reflect~~ a ~~horizontal~~ gradient ~~that generally flows and flow~~ to the northeast, from areas with higher ~~elevation topography~~ ~~land surface elevations~~ towards areas with lower ~~elevation topography where~~ ~~elevations and towards~~ the Cuyama River ~~is located~~.



Figure 2-43: Spring 2017 Groundwater Elevation Contours



~~Figure 2-44~~~~Figure 2-67~~~~267~~ shows depth to water contours for spring of 2017. ~~In the southeastern portion of the Basin near the Ozena fire station, depth to water is under 50 feet bgs.~~ Depth to groundwater near Ventucopa is between 150 and 200 feet bgs. There is a steep gradient near the SBCF, and depth to groundwater is below 600 feet bgs immediately northwest of the SBCF. The central portion of the Basin generally has a depth to water between 350 and 500 feet bgs, with depth to groundwater decreasing to the west of New Cuyama. West of Bitter Creek, groundwater is generally shallower than 100 feet below bgs, and is shallower than 50 feet bgs along the Cuyama River in most cases.



Figure 2-44: Spring 2017 Depth to Water Contours



Figure 2-45 ~~Figure 2-68~~268 shows groundwater elevation contours for spring of 2015. ~~In the southeastern portion of the Basin near the Ozena fire station, Data for this year is more limited but the groundwater gradients appear to indicate flows~~ gradient indicates flow that follows the Cuyama River. ~~The contour map shows a steep gradient across the SBCF and flows to an area of lowered groundwater elevation northeast of the town of Cuyama. From the town of New Cuyama to the west, the limited number of data points restrict strong interpretation of the gradient, which is to the northwest, from areas with higher land surface elevations towards areas with lower elevations towards the central portion of the Basin.~~

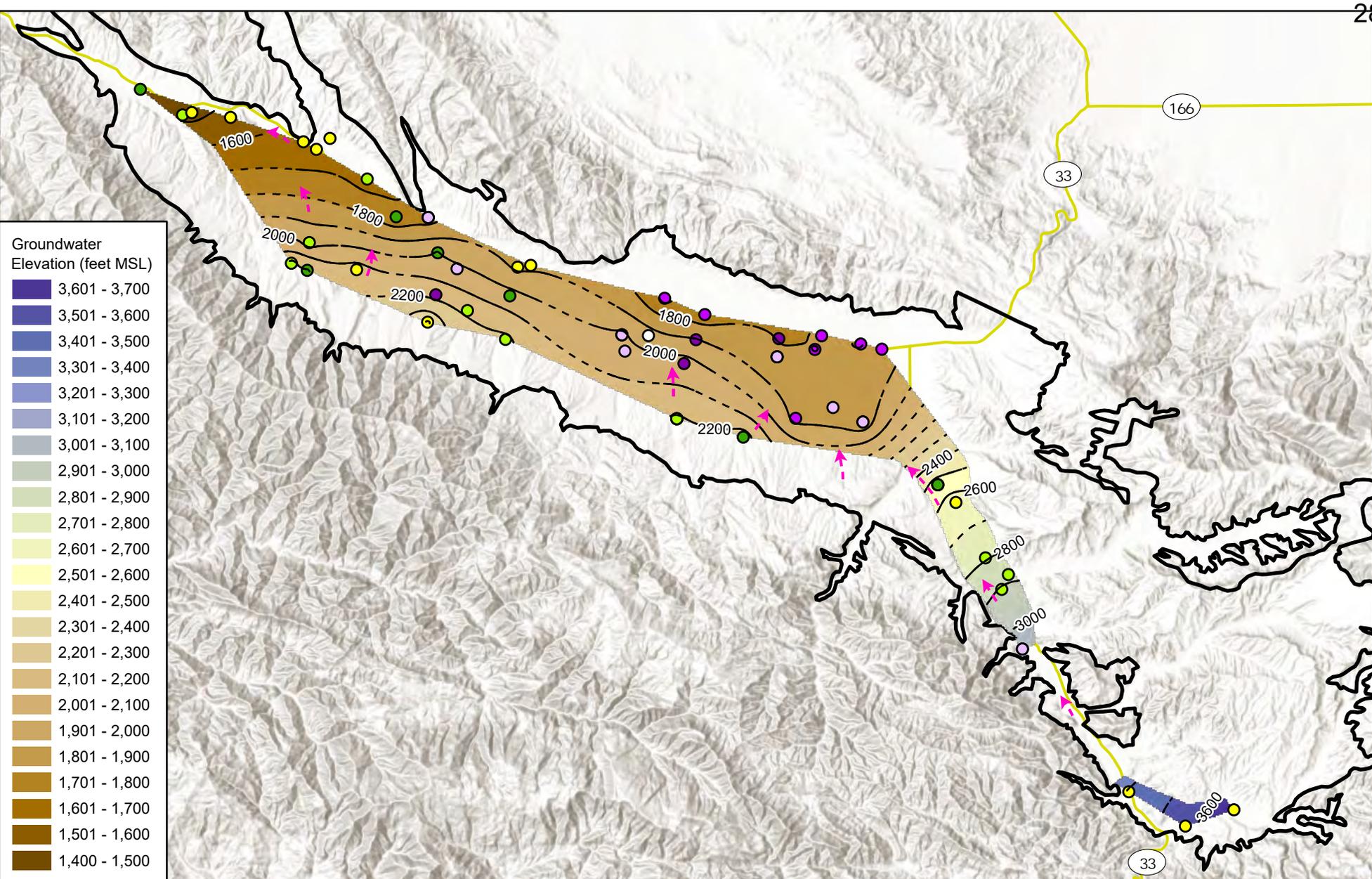


Figure 2-45: Spring 2015 Groundwater Elevation Contours



Figure 2-46 ~~Figure 2-69~~ ~~269~~ shows depth to water contours for spring of 2015. ~~In the southeastern portion of the Basin~~ ~~Data indicates a steep gradient near the Ozena fire station, SBCF, and~~ ~~depth to water is under 50 feet bgs.~~ ~~Depth to groundwater near Ventucopa is between 150 and 200 feet bgs.~~ ~~There is a steep gradient near the SBCF, and~~ groundwater is below 600 feet bgs immediately northwest of the SBCF. The central portion of the Basin generally has a depth to water between ~~3500~~ and ~~450~~ ~~600+~~ feet bgs, with groundwater levels rising to the west of New Cuyama. These depths are in general less severe than those shown for the spring of 2017, reflecting deepening depth to groundwater conditions in the central portion of the Basin. Interpretation from New Cuyama to monitoring points in the northwest is hampered by a limited set of data points.

Figure Exported: 7/18/2024, By: ceapleken, Using: \\woodardcurran.net\shared\Projects\CA\Cuyama Basin_GSAU0011078_01_GSP\wp\Z_GIS\2_Maps\3_2025_GSP_Update\02_Basin_Setting_Overview\GSP2025_dfw_gwa.aprx



Groundwater Elevation (feet MSL)

3,601 - 3,700
3,501 - 3,600
3,401 - 3,500
3,301 - 3,400
3,201 - 3,300
3,101 - 3,200
3,001 - 3,100
2,901 - 3,000
2,801 - 2,900
2,701 - 2,800
2,601 - 2,700
2,501 - 2,600
2,401 - 2,500
2,301 - 2,400
2,201 - 2,300
2,101 - 2,200
2,001 - 2,100
1,901 - 2,000
1,801 - 1,900
1,701 - 1,800
1,601 - 1,700
1,501 - 1,600
1,400 - 1,500

Figure 2-56: Spring 2024 Groundwater Elevation
Cuyama Valley Groundwater Basin

Legend

- Groundwater Elevation Contour
- - - Approximate Contour
- > Conceptual Flowline
- Highway
- Cuyama Basin
- Well Depth (feet)
- Unknown
- 0 - 200
- 201 - 400
- 401 - 600
- 601 - 800
- 801 - 1000
- 1001 - 1200

N

0 1.25 2.5 5 Miles

Map Created: July 2024

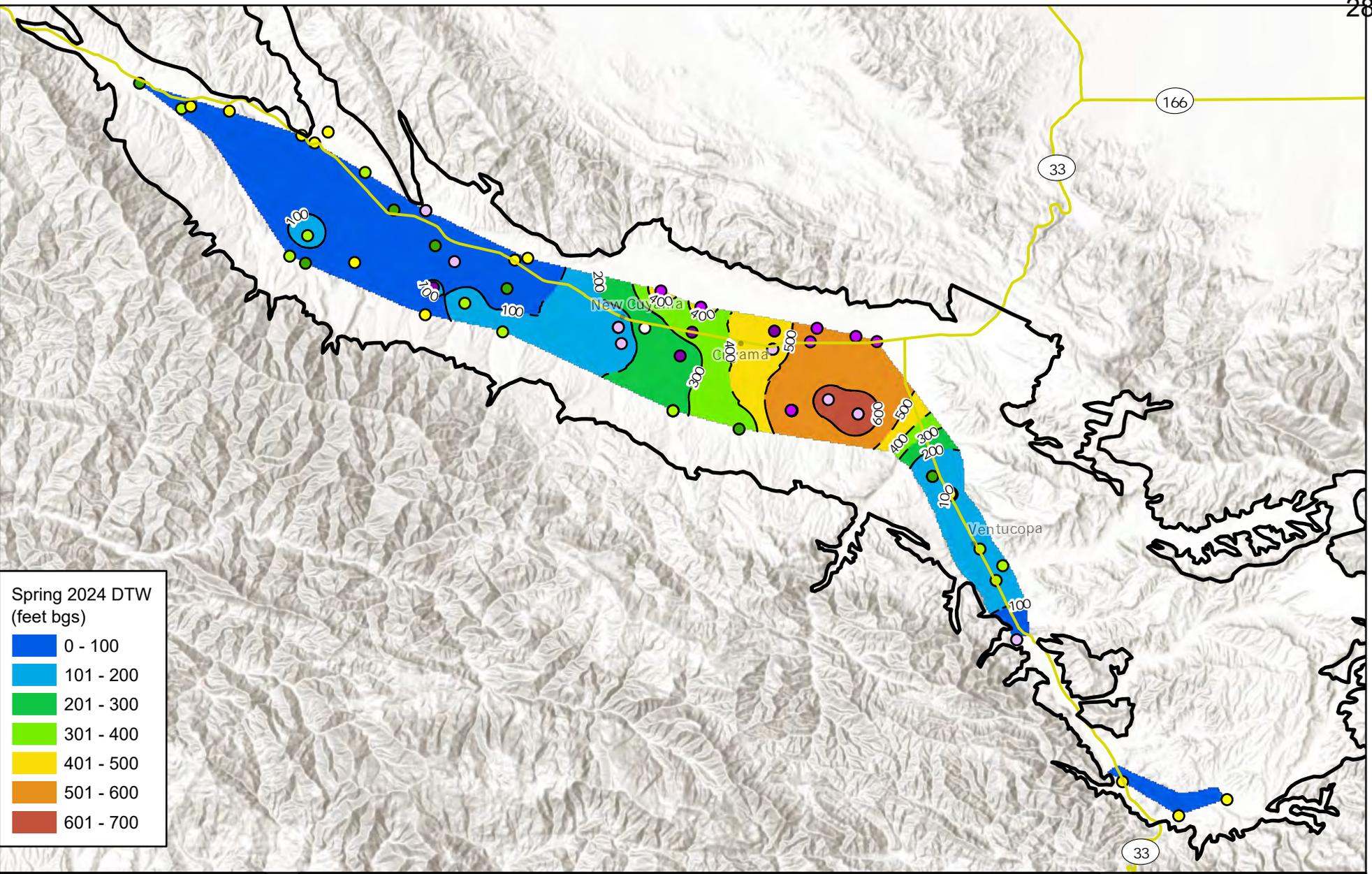
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~~Figure 2-47 shows groundwater elevation contours for fall of 2014. In the southeastern portion of the Basin near the Ozena fire station, groundwater gradients appear to indicate flows that follow the Cuyama River. The contour map shows a steep gradient across the SBCF and flows to an area of lowered groundwater elevation northeast of the town of Cuyama.~~ Basin Wells by Groundwater Surface Elevation in Spring 2024



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Spring 2024 DTW (feet bgs)

- 0 - 100
- 101 - 200
- 201 - 300
- 301 - 400
- 401 - 500
- 501 - 600
- 601 - 700

Figure 2-57: Spring 2024 Depth to Water
Cuyama Valley Groundwater Basin

Legend	Depth to Water Contour	Highway	Well Depth	601 - 800
	Approximate Contour	Local Road	Unknown	801 - 1000
	Town	Cuyama Basin	0 - 200	1001 - 1200
			201 - 400	
			401 - 600	

0 1.25 2.5 5 Miles

Map Created: July 2024

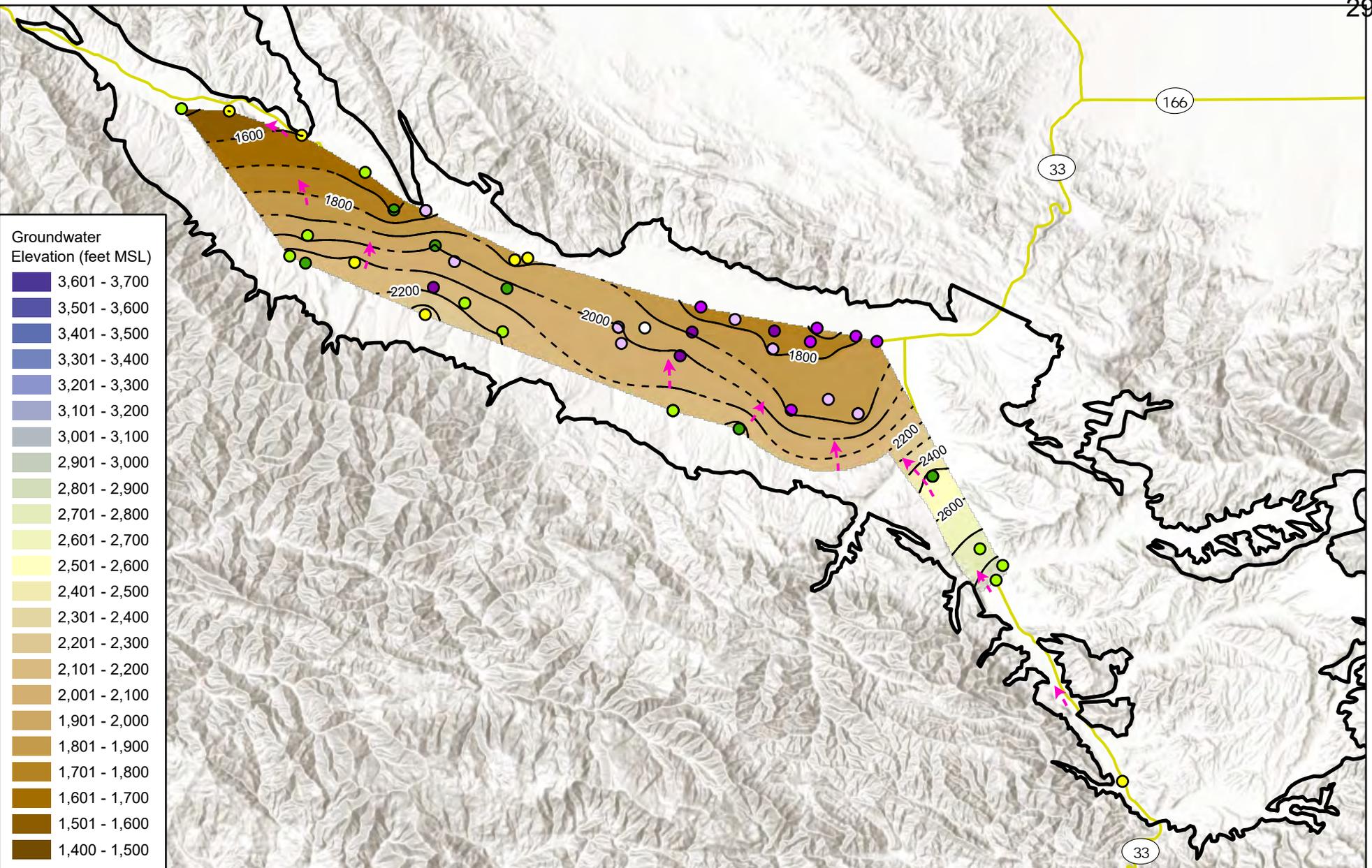
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~~Figure 2-48 shows depth to water contours for fall of 2014. In the southeastern portion of the Cuyama Basin near the Ozena fire station, depth to water is under 50 feet bgs. There is a steep gradient near the SBCF, and groundwater is below 600 feet bgs immediately northwest of the SBCF. The central portion of the Basin generally has a depth to water between 350 and 500 feet bgs, with groundwater levels rising to the west of New Cuyama. These depths are in general less severe than those shown for the fall of 2017, reflecting depth to groundwater conditions in the central portion of the Basin. Interpretation from New Cuyama to monitoring points in the northwest is hampered by a limited set of data points.~~Wells by Depth to Water in Spring 2024



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Groundwater Elevation (feet MSL)

3,601 - 3,700
3,501 - 3,600
3,401 - 3,500
3,301 - 3,400
3,201 - 3,300
3,101 - 3,200
3,001 - 3,100
2,901 - 3,000
2,801 - 2,900
2,701 - 2,800
2,601 - 2,700
2,501 - 2,600
2,401 - 2,500
2,301 - 2,400
2,201 - 2,300
2,101 - 2,200
2,001 - 2,100
1,901 - 2,000
1,801 - 1,900
1,701 - 1,800
1,601 - 1,700
1,501 - 1,600
1,400 - 1,500

Figure 2-58: Fall 2022 Groundwater Elevation

Cuyama Valley Groundwater Basin

Legend

- | | | | |
|---------------------------------|----------------|-------------------|---------------|
| — Groundwater Elevation Contour | — Highway | Well Depth (feet) | ● 401 - 600 |
| - - - Approximate Contour | □ Cuyama Basin | ○ Unknown | ● 601 - 800 |
| - -> Conceptual Flowline | | ● 0 - 200 | ● 801 - 1000 |
| | | ● 201 - 400 | ● 1001 - 1200 |

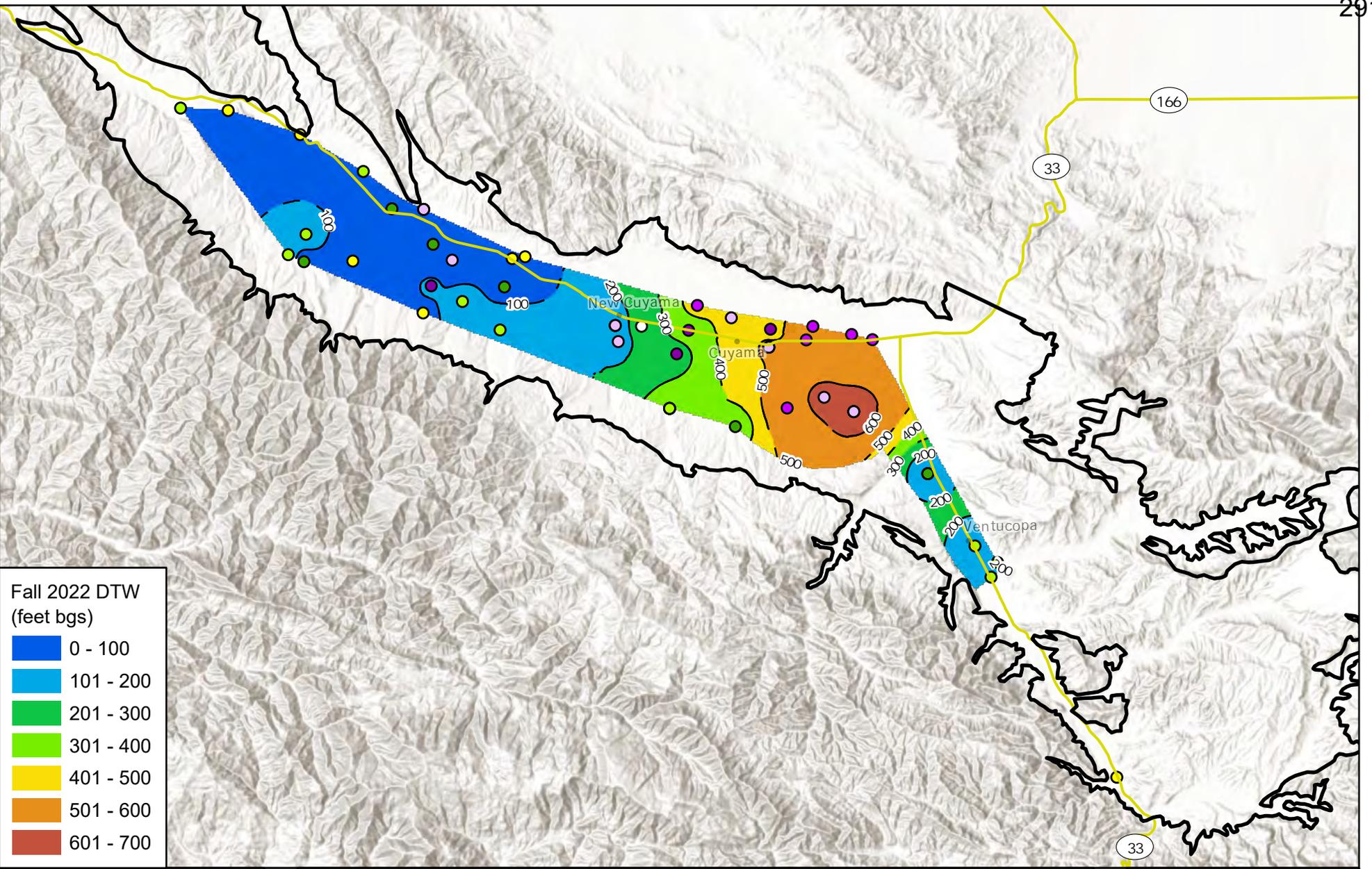


0 1.25 2.5 5 Miles

Map Created: July 2024

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Fall 2022 DTW (feet bgs)

- 0 - 100
- 101 - 200
- 201 - 300
- 301 - 400
- 401 - 500
- 501 - 600
- 601 - 700

Figure 2-59: Fall 2022 Depth to Water

Cuyama Valley Groundwater Basin

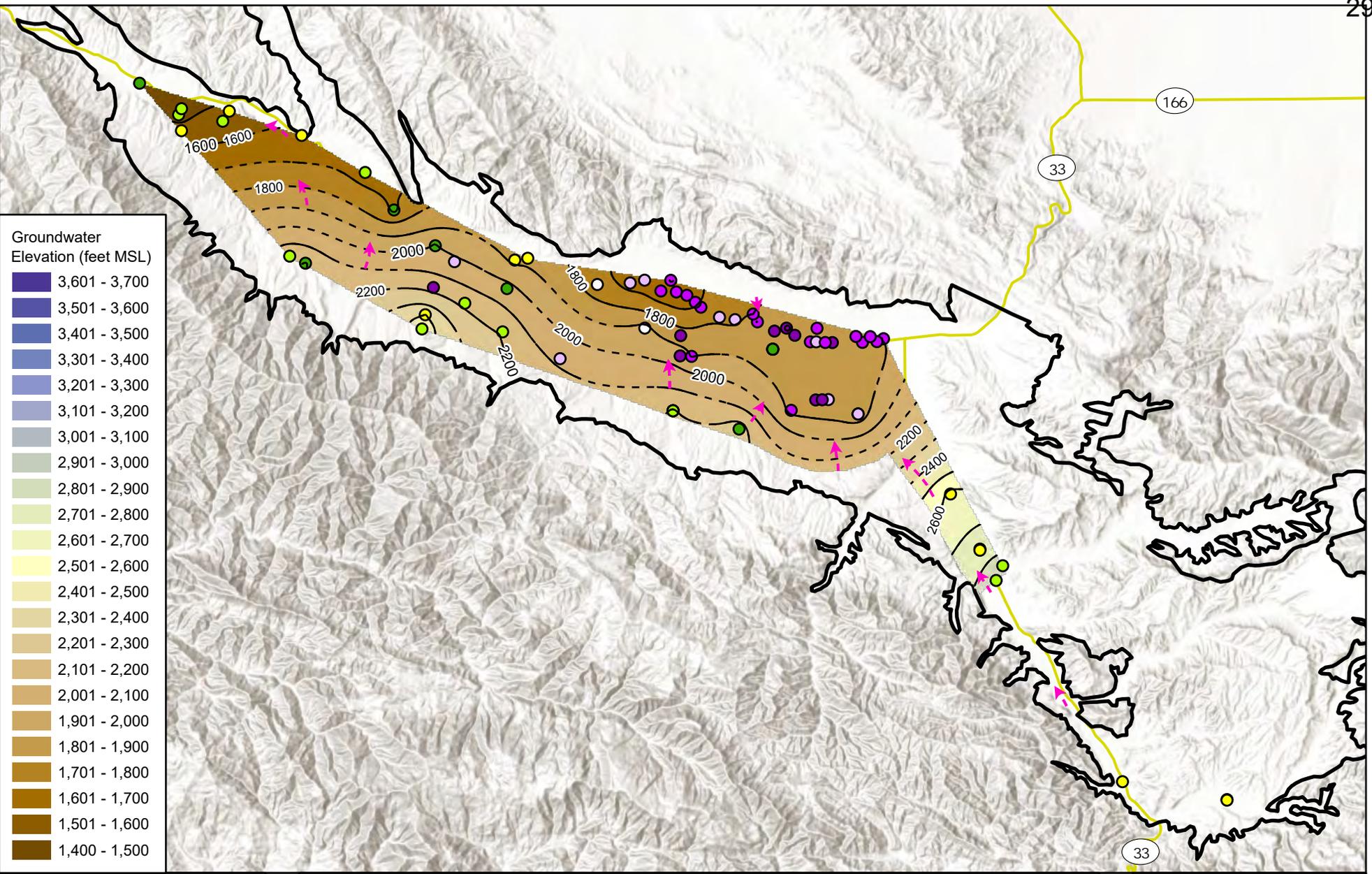
Legend	Depth to Water Contour	Highway	Well Depth	601 - 800
	Approximate Contour	Local Road	Unknown	801 - 1000
	Town	Cuyama Basin	0 - 200	1001 - 1200
			201 - 400	
			401 - 600	

0 1.25 2.5 5 Miles

Map Created: July 2024

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Groundwater Elevation (feet MSL)

3,601 - 3,700
3,501 - 3,600
3,401 - 3,500
3,301 - 3,400
3,201 - 3,300
3,101 - 3,200
3,001 - 3,100
2,901 - 3,000
2,801 - 2,900
2,701 - 2,800
2,601 - 2,700
2,501 - 2,600
2,401 - 2,500
2,301 - 2,400
2,201 - 2,300
2,101 - 2,200
2,001 - 2,100
1,901 - 2,000
1,801 - 1,900
1,701 - 1,800
1,601 - 1,700
1,501 - 1,600
1,400 - 1,500

Figure 2-60 Fall 2020 Groundwater Elevation

Cuyama Valley Groundwater Basin

Legend

— Groundwater Elevation Contour	— Highway	Well Depth (feet)	● 401 - 600
- - - Approximate Contour	□ Cuyama Basin	○ Unknown	● 601 - 800
- -> Conceptual Flowline		● 0 - 200	● 801 - 1000
		● 201 - 400	● 1001 - 1200

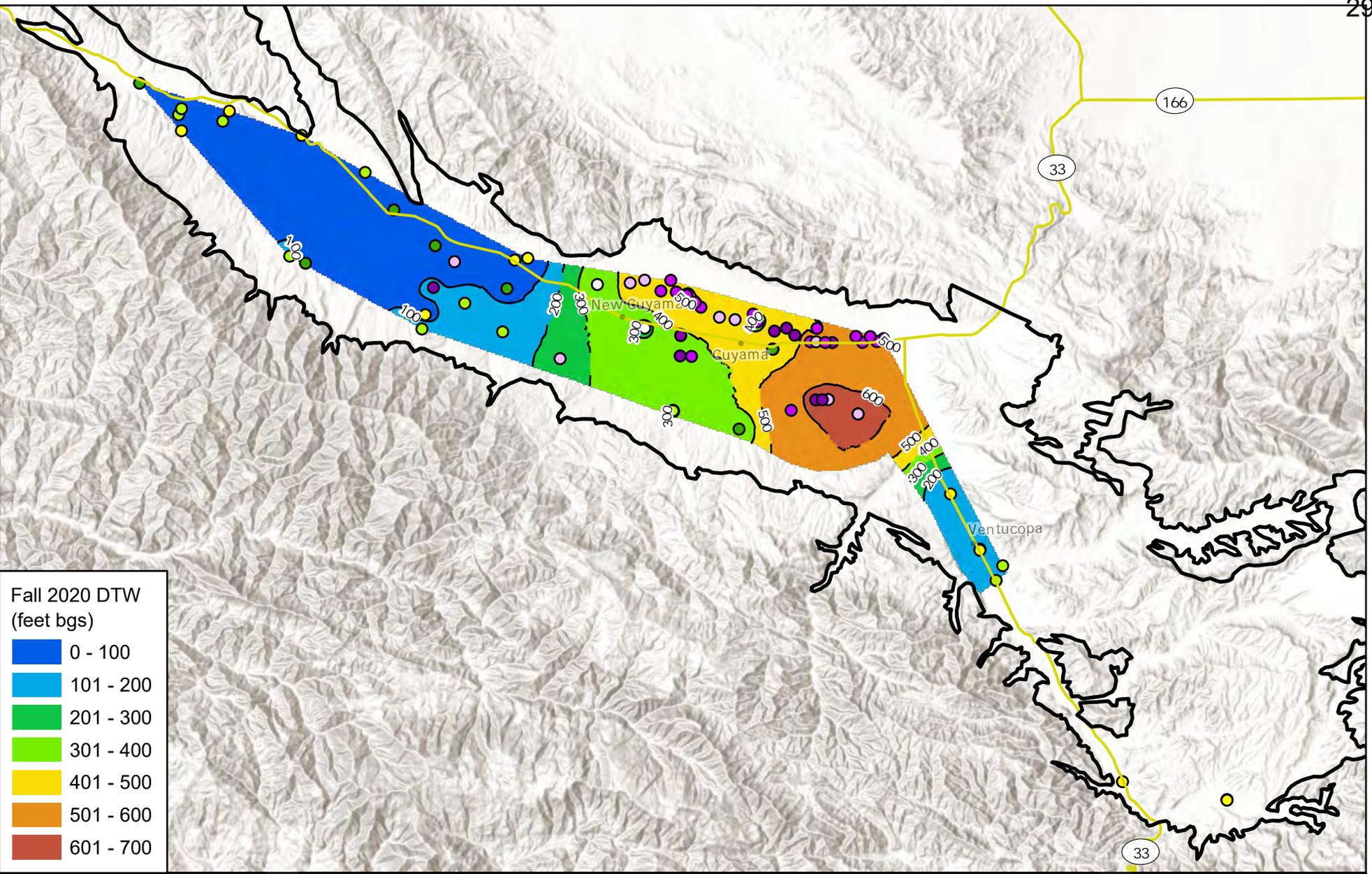


0 1.25 2.5 5 Miles

Map Created: July 2024

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Fall 2020 DTW (feet bgs)

- 0 - 100
- 101 - 200
- 201 - 300
- 301 - 400
- 401 - 500
- 501 - 600
- 601 - 700

Figure 2-61: Fall 2020 Depth to Water

Cuyama Valley Groundwater Basin

Legend	Depth to Water Contour	Highway	Well Depth	601 - 800
	Approximate Contour	Local Road	Unknown	801 - 1000
	Town	Cuyama Basin	0 - 200	1001 - 1200
			201 - 400	
			401 - 600	

Woodard & Curran

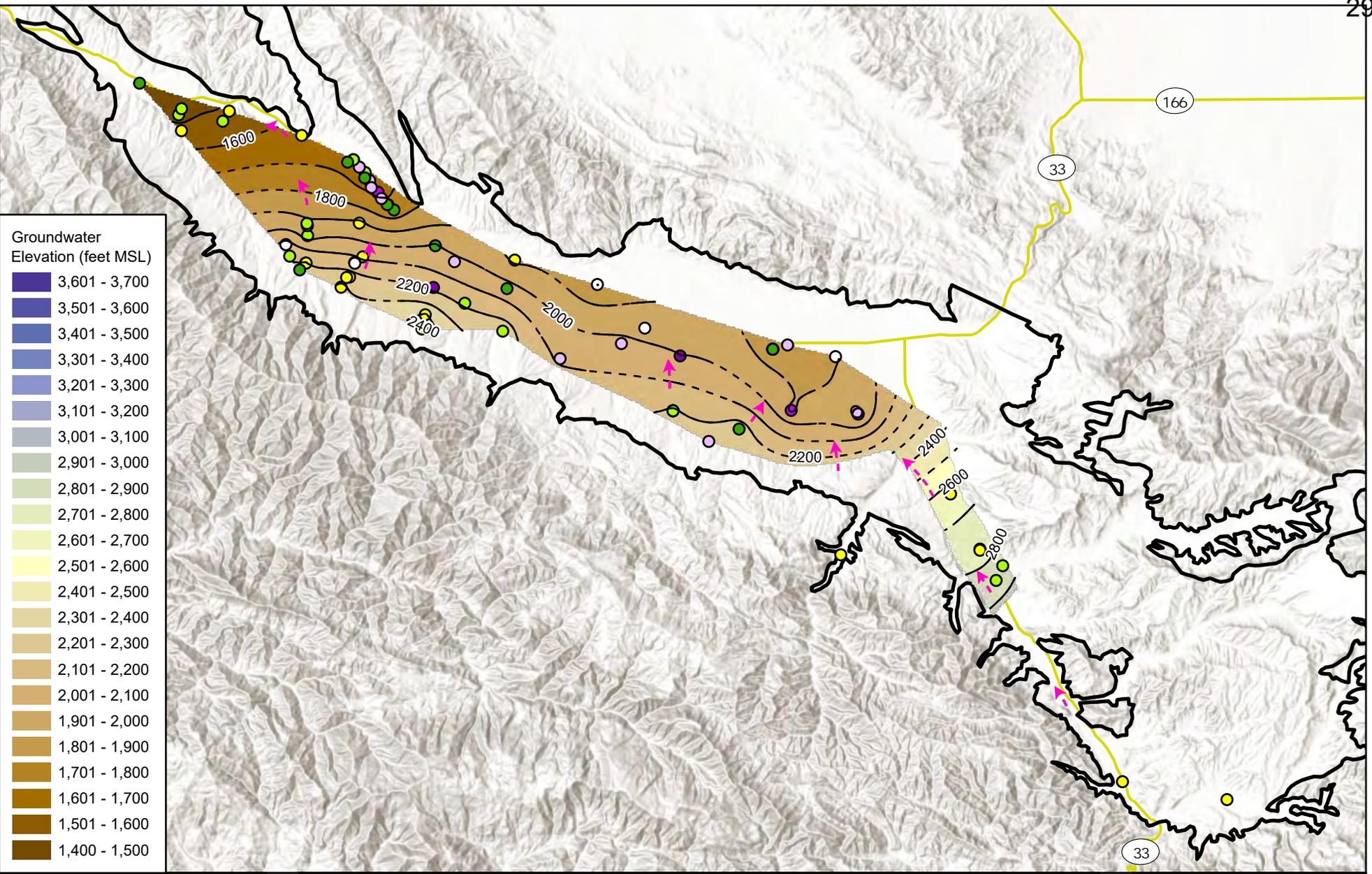
CUYAMA BASIN
GROUNDWATER SUSTAINABILITY AGENCY

0 1.25 2.5 5 Miles

Map Created: July 2024

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Figure Exported: 7/18/2024, By: ceapleken, Using: \\woodandcurran.net\shared\Projects\CA Cuyama Basin_GSA\011078_01_GSP\wp\Z_GIS\2_Map\3_2025_GSP_Update\02_Basin_Setting_Overview\GSP2025_dfw_gvsa2025_dfw_gvsa.aprx



Groundwater Elevation (feet MSL)

3,601 - 3,700
3,501 - 3,600
3,401 - 3,500
3,301 - 3,400
3,201 - 3,300
3,101 - 3,200
3,001 - 3,100
2,901 - 3,000
2,801 - 2,900
2,701 - 2,800
2,601 - 2,700
2,501 - 2,600
2,401 - 2,500
2,301 - 2,400
2,201 - 2,300
2,101 - 2,200
2,001 - 2,100
1,901 - 2,000
1,801 - 1,900
1,701 - 1,800
1,601 - 1,700
1,501 - 1,600
1,400 - 1,500

Figure 2-62: Spring 2018 Groundwater Elevation

Cuyama Valley Groundwater Basin

Legend

- Groundwater Elevation Contour
- - - Approximate Contour
- > Conceptual Flowline
- Highway
- Cuyama Basin
- Unknown
- 401 - 600
- 601 - 800
- 801 - 1000
- 1001 - 1200
- 0 - 200
- 201 - 400

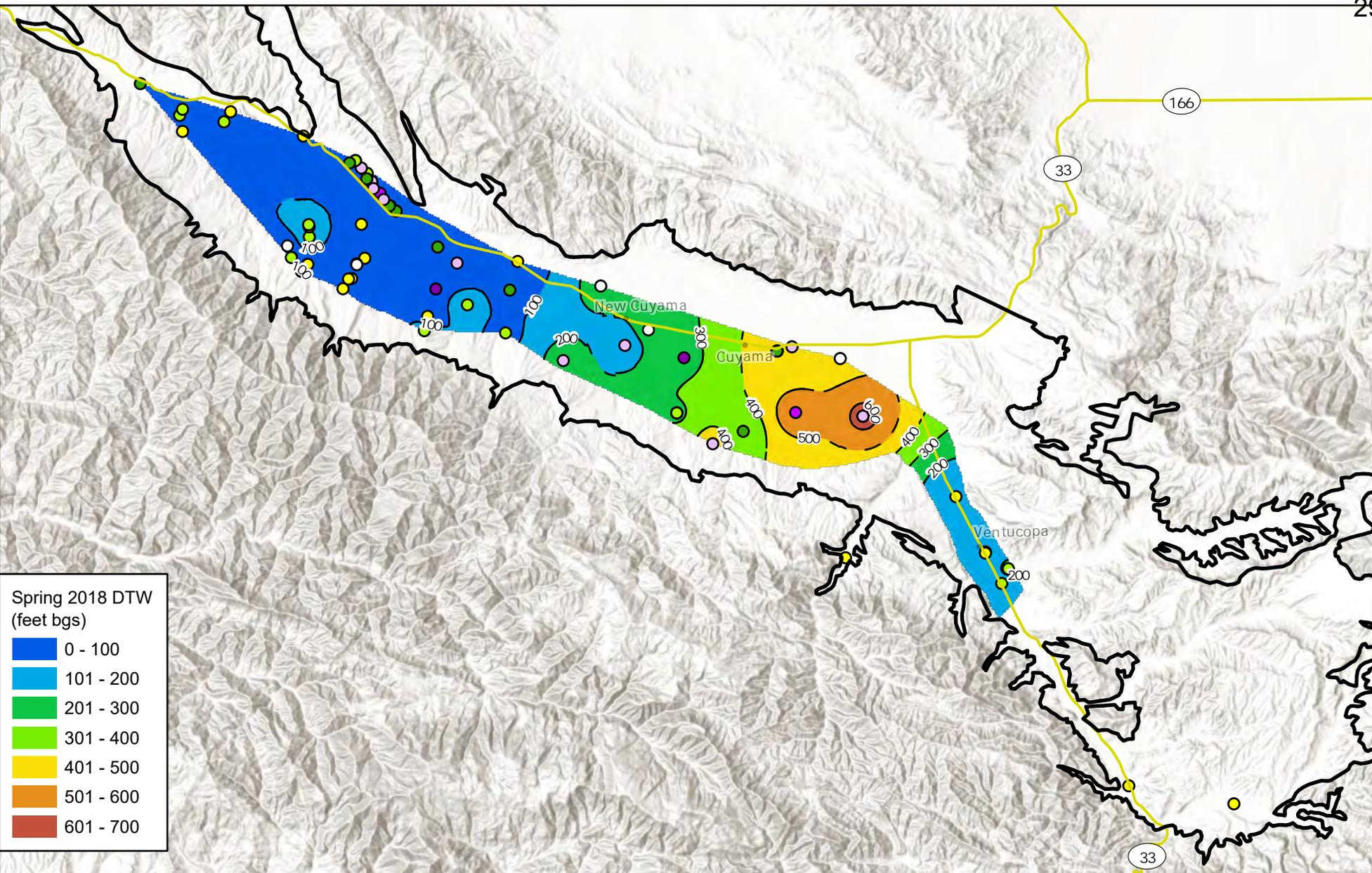


0 1.25 2.5 5 Miles

Map Created: July 2024

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Spring 2018 DTW (feet bgs)

- 0 - 100
- 101 - 200
- 201 - 300
- 301 - 400
- 401 - 500
- 501 - 600
- 601 - 700

Figure 2-63: Spring 2018 Depth to Water

Cuyama Valley Groundwater Basin

Legend

— Depth to Water Contour	— Highway	Well Depth	○ 601 - 800
- - - Approximate Contour	— Local Road	○ Unknown	○ 801 - 1000
• Town	□ Cuyama Basin	● 0 - 200	● 1001 - 1200
		● 201 - 400	
		● 401 - 600	

Woodard & Curran

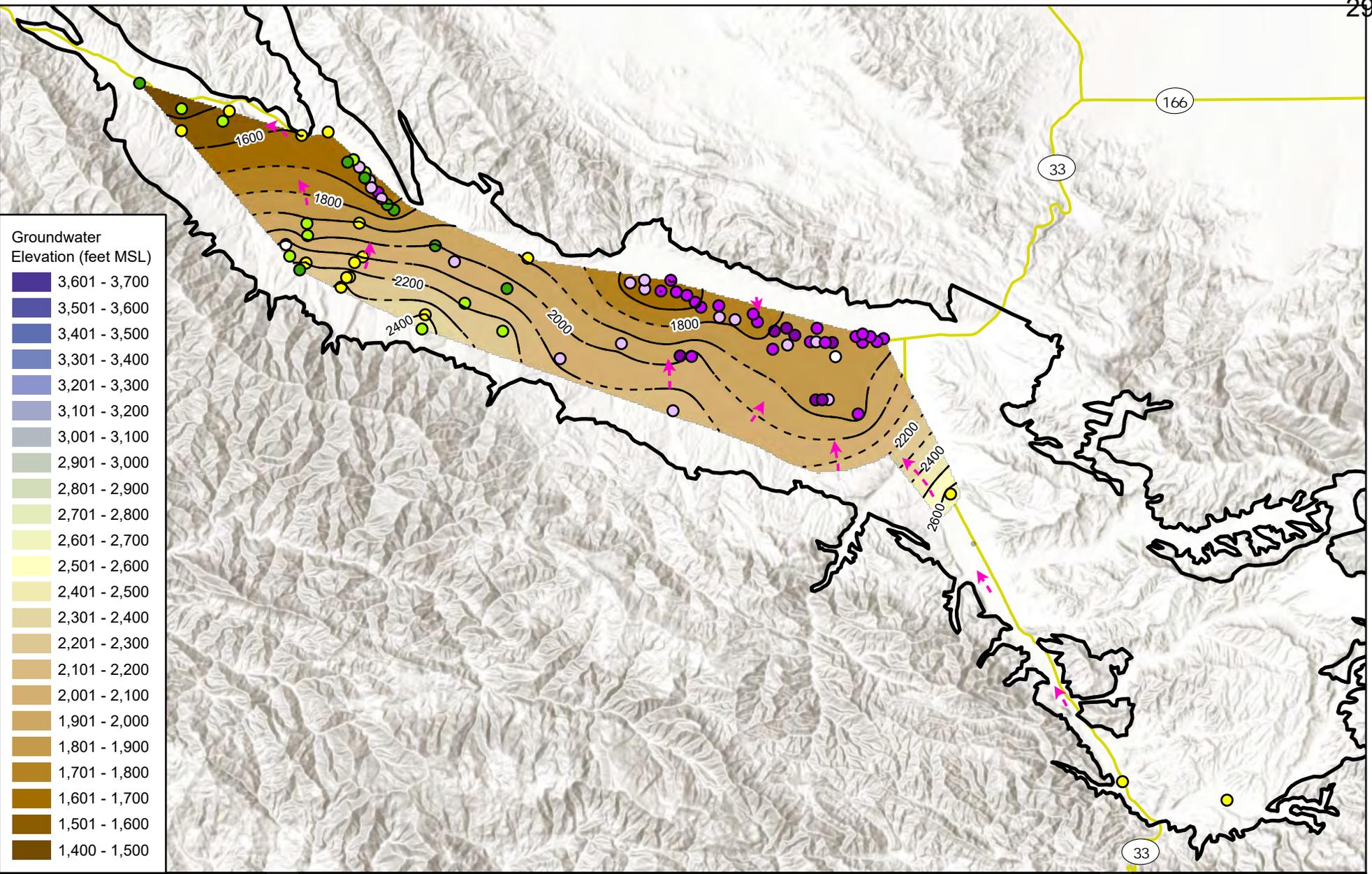
CUYAMA BASIN
GROUNDWATER SUSTAINABILITY AGENCY

0 1.25 2.5 5 Miles

Map Created: July 2024

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Groundwater Elevation (feet MSL)

3,601 - 3,700
3,501 - 3,600
3,401 - 3,500
3,301 - 3,400
3,201 - 3,300
3,101 - 3,200
3,001 - 3,100
2,901 - 3,000
2,801 - 2,900
2,701 - 2,800
2,601 - 2,700
2,501 - 2,600
2,401 - 2,500
2,301 - 2,400
2,201 - 2,300
2,101 - 2,200
2,001 - 2,100
1,901 - 2,000
1,801 - 1,900
1,701 - 1,800
1,601 - 1,700
1,501 - 1,600
1,400 - 1,500

Figure 2-64: Fall 2017 Groundwater Elevation

Cuyama Valley Groundwater Basin

Legend

- Groundwater Elevation Contour
- - - Approximate Contour
- > Conceptual Flowline
- Highway
- Cuyama Basin
- Well Depth (feet)
- Unknown
- 0 - 200
- 201 - 400
- 401 - 600
- 601 - 800
- 801 - 1000
- 1001 - 1200

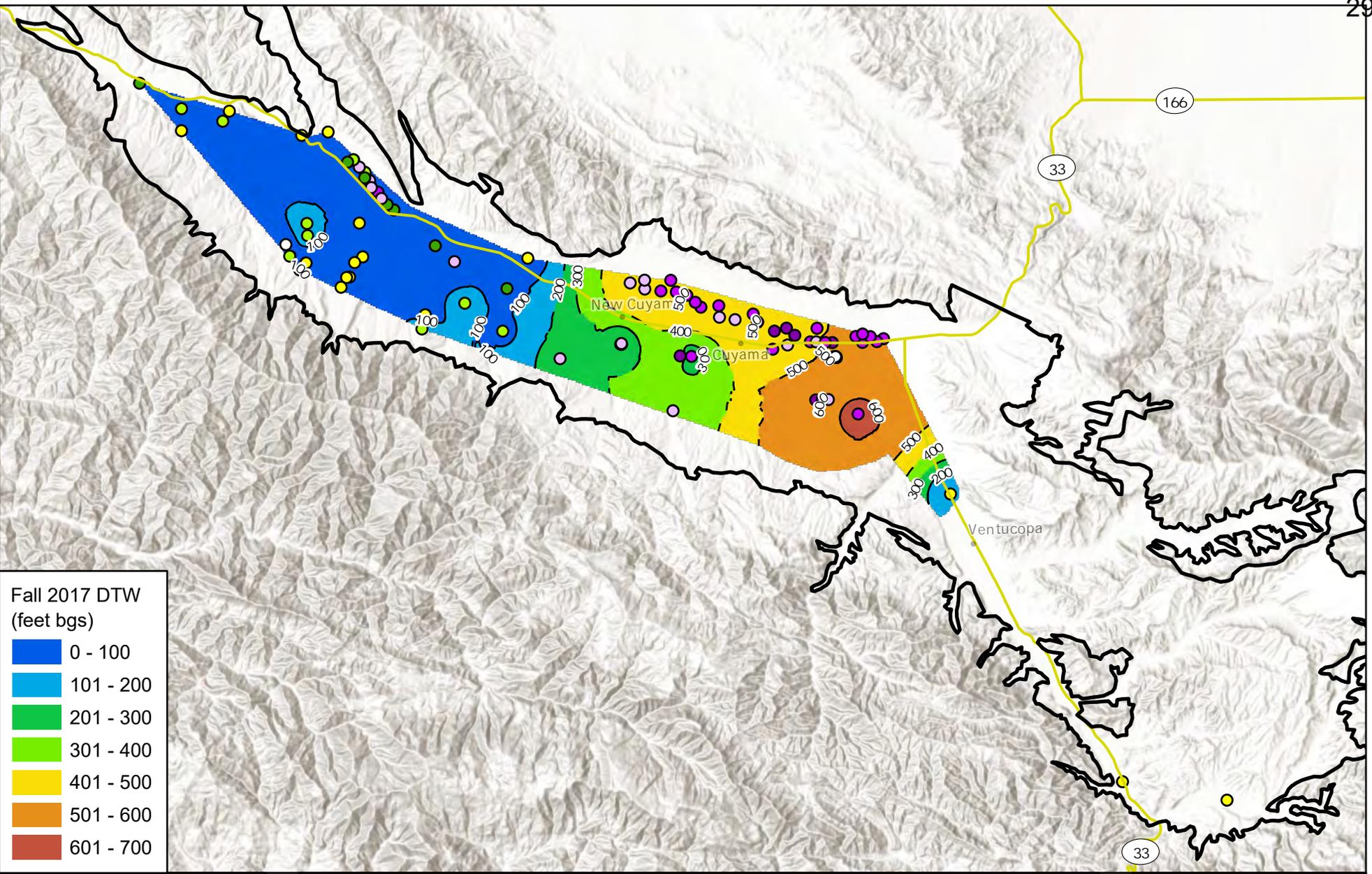


0 1.25 2.5 5 Miles

Map Created: July 2024

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Fall 2017 DTW (feet bgs)

- 0 - 100
- 101 - 200
- 201 - 300
- 301 - 400
- 401 - 500
- 501 - 600
- 601 - 700

Figure 2-65: Fall 2017 Depth to Water

Cuyama Valley Groundwater Basin

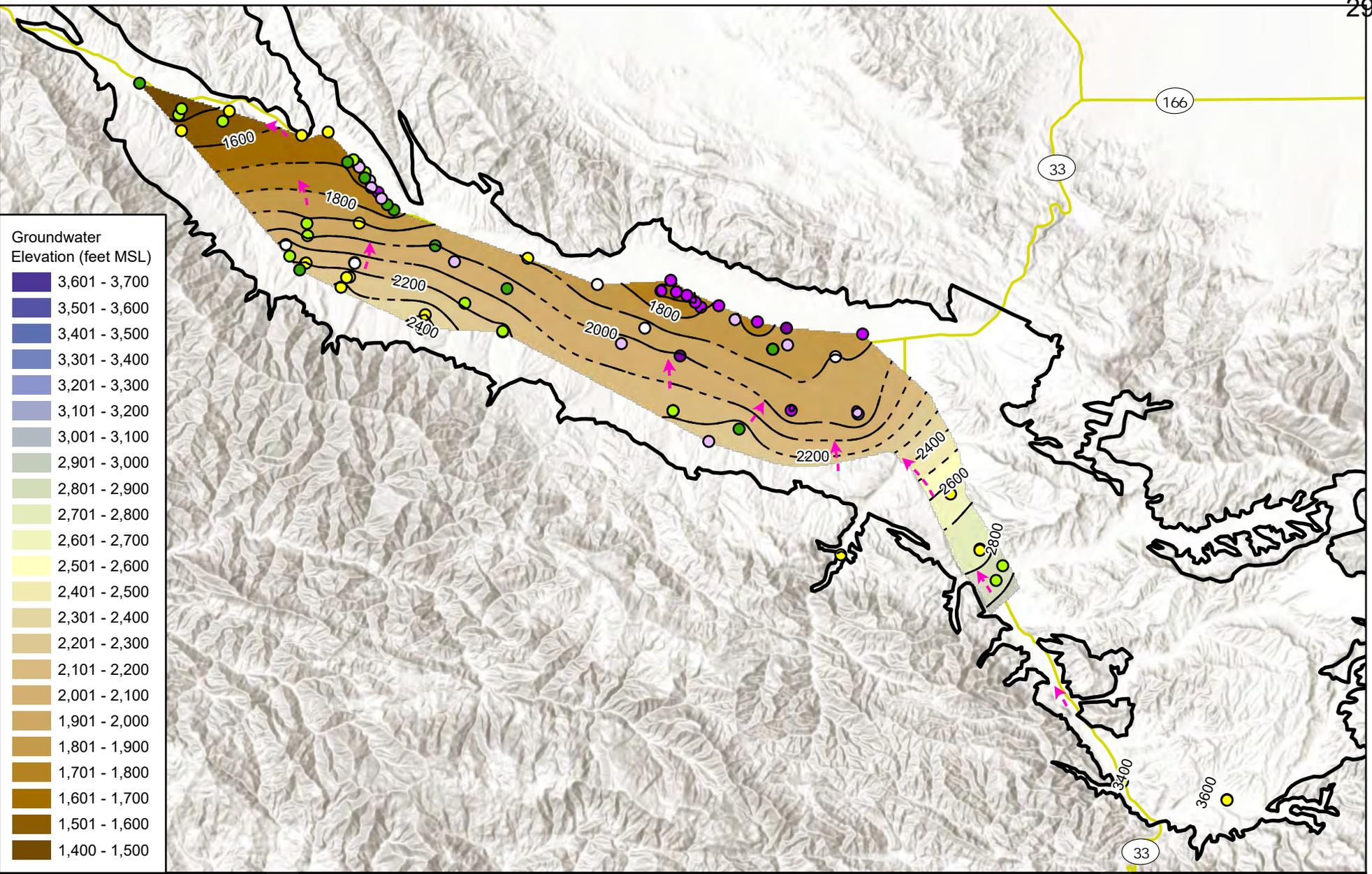
Legend	Depth to Water Contour	Highway	Well Depth	601 - 800
	Approximate Contour	Local Road	Unknown	801 - 1000
	Town	Cuyama Basin	0 - 200	1001 - 1200
			201 - 400	
			401 - 600	

0 1.25 2.5 5 Miles

Map Created: July 2024

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Groundwater Elevation (feet MSL)

3,601 - 3,700
3,501 - 3,600
3,401 - 3,500
3,301 - 3,400
3,201 - 3,300
3,101 - 3,200
3,001 - 3,100
2,901 - 3,000
2,801 - 2,900
2,701 - 2,800
2,601 - 2,700
2,501 - 2,600
2,401 - 2,500
2,301 - 2,400
2,201 - 2,300
2,101 - 2,200
2,001 - 2,100
1,901 - 2,000
1,801 - 1,900
1,701 - 1,800
1,601 - 1,700
1,501 - 1,600
1,400 - 1,500

Figure 2-66: Spring 2017 Groundwater Elevation

Cuyama Valley Groundwater Basin

Legend

- Groundwater Elevation Contour
- - - Approximate Contour
- > Conceptual Flowline
- Highway
- Cuyama Basin
- Well Depth (feet)
- Unknown
- 0 - 200
- 201 - 400
- 401 - 600
- 601 - 800
- 801 - 1000
- 1001 - 1200

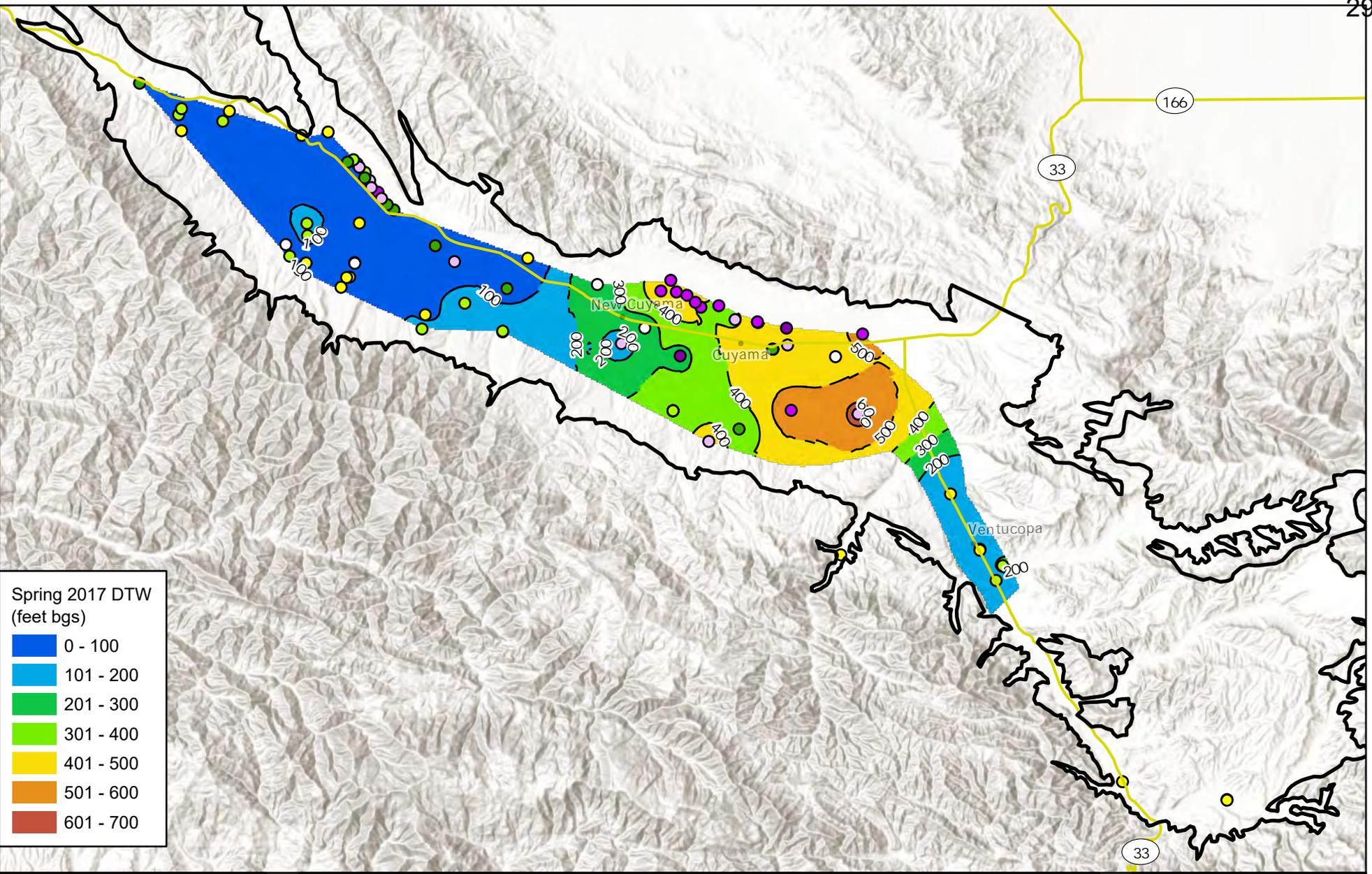
N

0 1.25 2.5 5 Miles

Map Created: July 2024

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Spring 2017 DTW (feet bgs)

- 0 - 100
- 101 - 200
- 201 - 300
- 301 - 400
- 401 - 500
- 501 - 600
- 601 - 700

Figure 2-67: Spring 2017 Depth to Water

Cuyama Valley Groundwater Basin

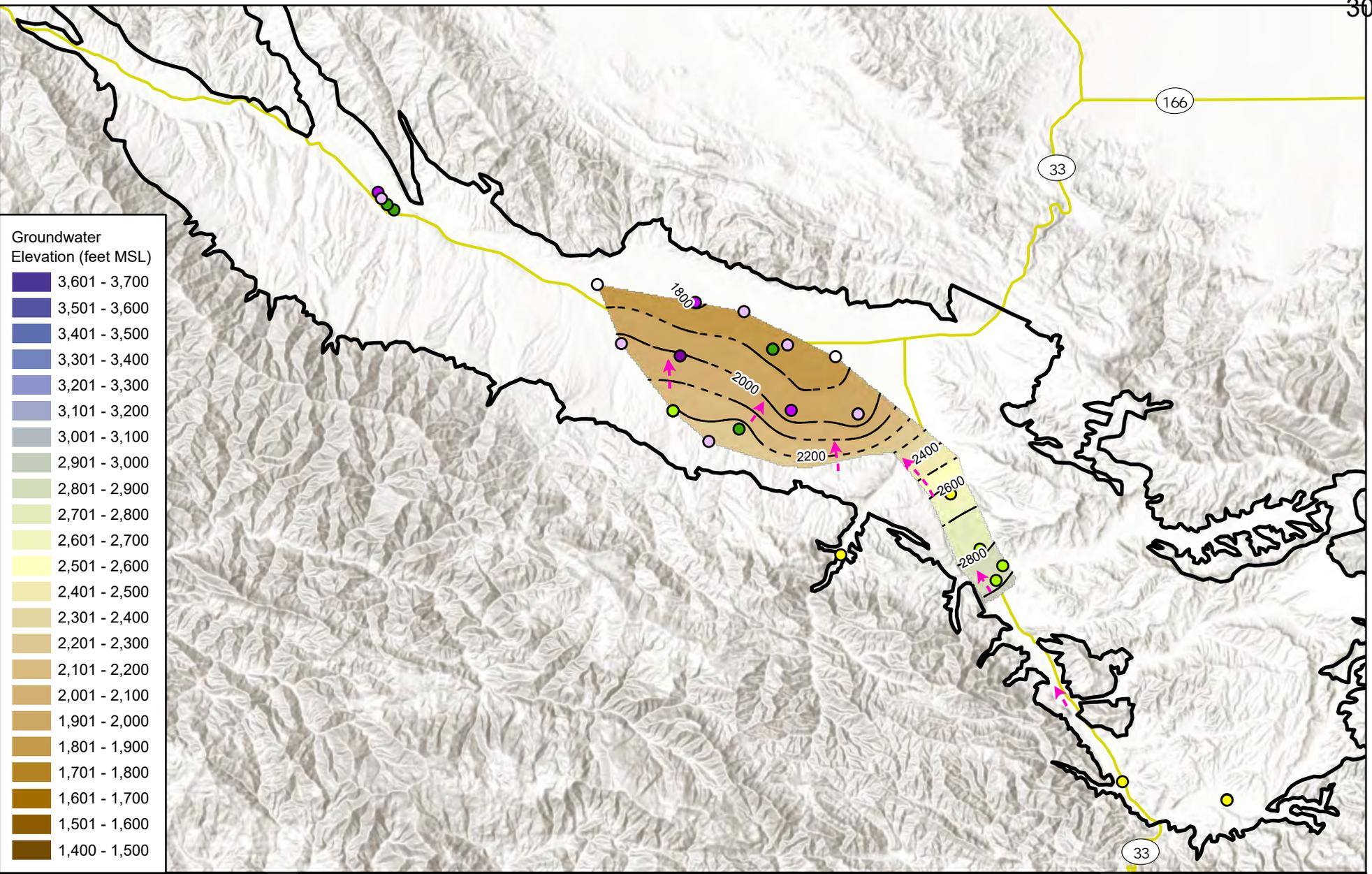
Legend	Depth to Water Contour	Highway	Well Depth	601 - 800
	Approximate Contour	Local Road	Unknown	801 - 1000
	Town	Cuyama Basin	0 - 200	1001 - 1200
			201 - 400	
			401 - 600	

0 1.25 2.5 5 Miles

Map Created: July 2024

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Figure Exported: 7/18/2024, By: ceapleken, Using: \\woodandcurran.net\shared\Projects\CA Cuyama Basin_GSAU0011078_01_GSP\wp\Z_GIS\2_Maps\3_2025_GSP_Update\02_Basin_Setting_Overview\GSP2025_dfw_gvsa2025_dfw_gvsa.aprx



Groundwater Elevation (feet MSL)

3,601 - 3,700
3,501 - 3,600
3,401 - 3,500
3,301 - 3,400
3,201 - 3,300
3,101 - 3,200
3,001 - 3,100
2,901 - 3,000
2,801 - 2,900
2,701 - 2,800
2,601 - 2,700
2,501 - 2,600
2,401 - 2,500
2,301 - 2,400
2,201 - 2,300
2,101 - 2,200
2,001 - 2,100
1,901 - 2,000
1,801 - 1,900
1,701 - 1,800
1,601 - 1,700
1,501 - 1,600
1,400 - 1,500

Figure 2-68: Spring 2015 Groundwater Elevation

Cuyama Valley Groundwater Basin

Legend

— Groundwater Elevation Contour	— Highway	Well Depth (feet)	● 401 - 600
- - - Approximate Contour	□ Cuyama Basin	○ Unknown	● 601 - 800
- -> Conceptual Flowline		● 0 - 200	● 801 - 1000
		● 201 - 400	● 1001 - 1200

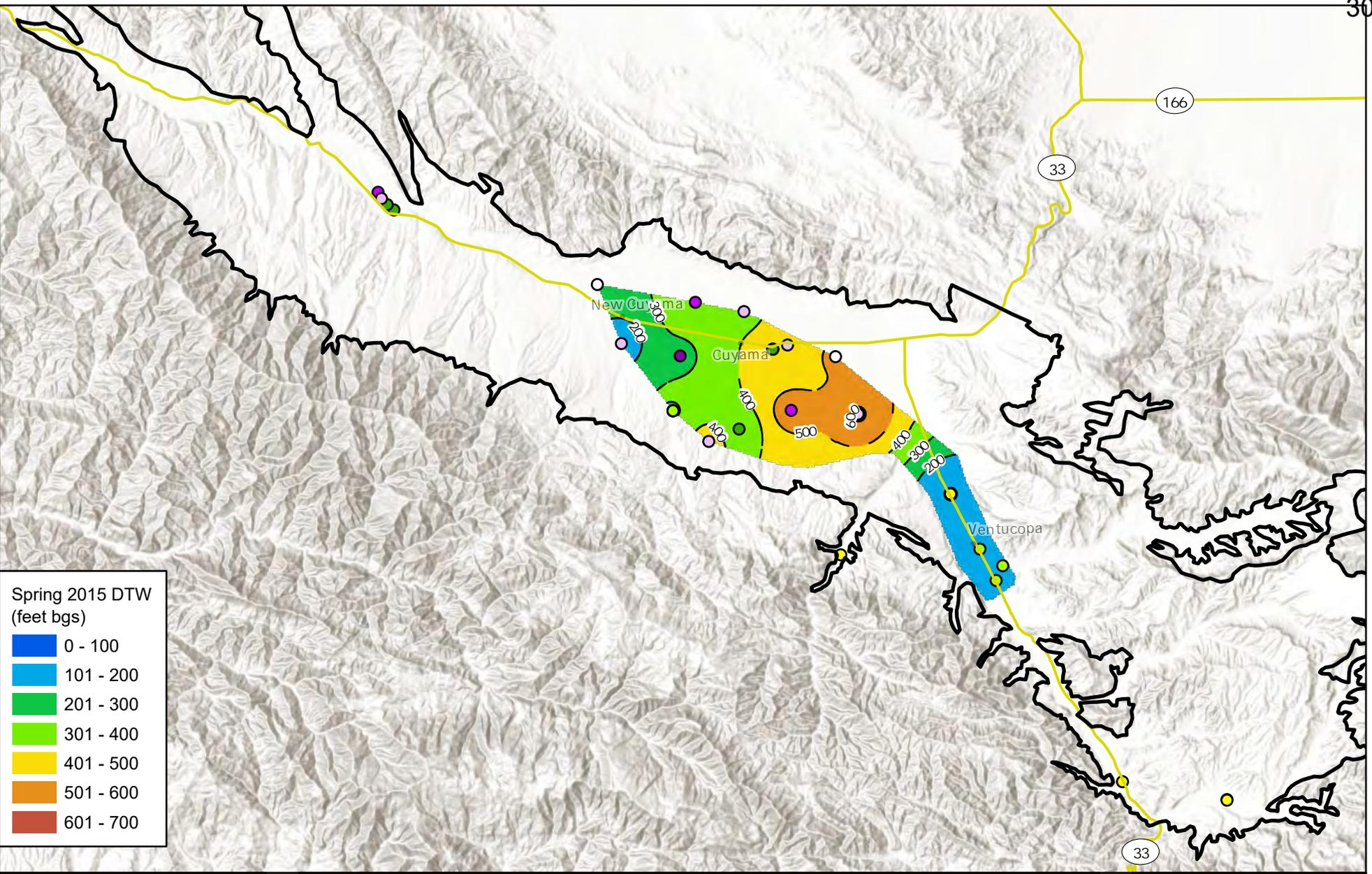


0 1.25 2.5 5 Miles

Map Created: July 2024

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Spring 2015 DTW (feet bgs)

- 0 - 100
- 101 - 200
- 201 - 300
- 301 - 400
- 401 - 500
- 501 - 600
- 601 - 700

Figure 2-69: Spring 2015 Depth to Water

Cuyama Valley Groundwater Basin

Legend	Depth to Water Contour	Highway	Well Depth	601 - 800
	Approximate Contour	Local Road	Unknown	801 - 1000
	Town	Cuyama Basin	0 - 200	1001 - 1200
			201 - 400	
			401 - 600	

0 1.25 2.5 5 Miles

Map Created: July 2024

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2.1.152.2.6 Change in Groundwater Storage

Historical change in Basin groundwater storage has shown a consistent decline. ~~Figure 2-49~~ ~~Figure 2-70~~ ~~270~~ shows change in storage by year, water year type,⁶ and cumulative water volume for the last ~~2026~~ years. Change in storage was calculated using the Cuyama Basin Water Resources Model (CBWRM). Average annual ~~usedepletion of groundwater storage~~ over the ~~2026~~-year period was -~~23,076~~ ~~16,900~~ acre-feet. The color of bar for each year of change in storage correlates a water year type defined by Basin precipitation. Change in storage is negative in ~~18~~ ~~22~~ of the ~~2025~~ years, and was ~~negative~~ ~~positive~~ during ~~two~~ ~~of~~ ~~three~~ ~~of~~ ~~the~~ ~~four~~ wet years, as designated by the water year type.

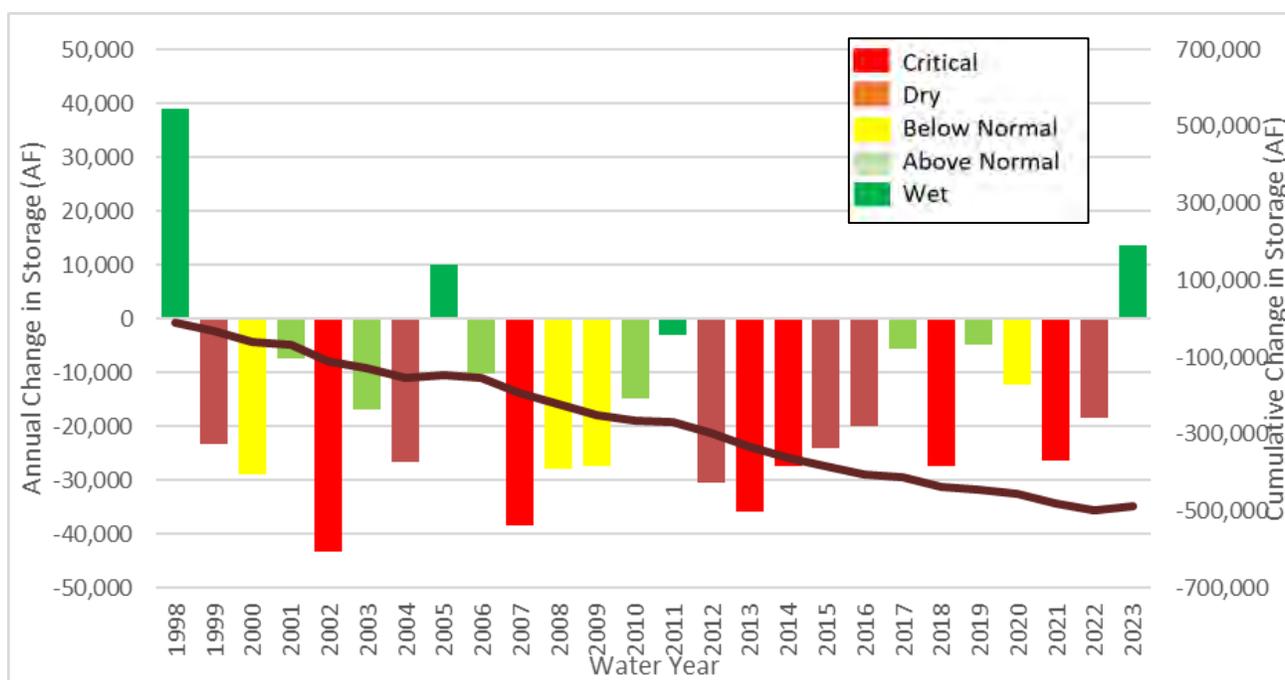


Figure 2-70: Cuyama Groundwater Storage by Year, Water Year Type, and cumulative Water volume

⁶ Water year types are customized for the Basin watershed based on annual precipitation as follows:

- Wet year = more than 19.6 inches
- Above normal year = 13.1 to 19.6 inches
- Below normal year = 9.85 to 13.1 inches
- Dry year = 6.6 to 9.85 inches
- Critical year = less than 6.6 inches.

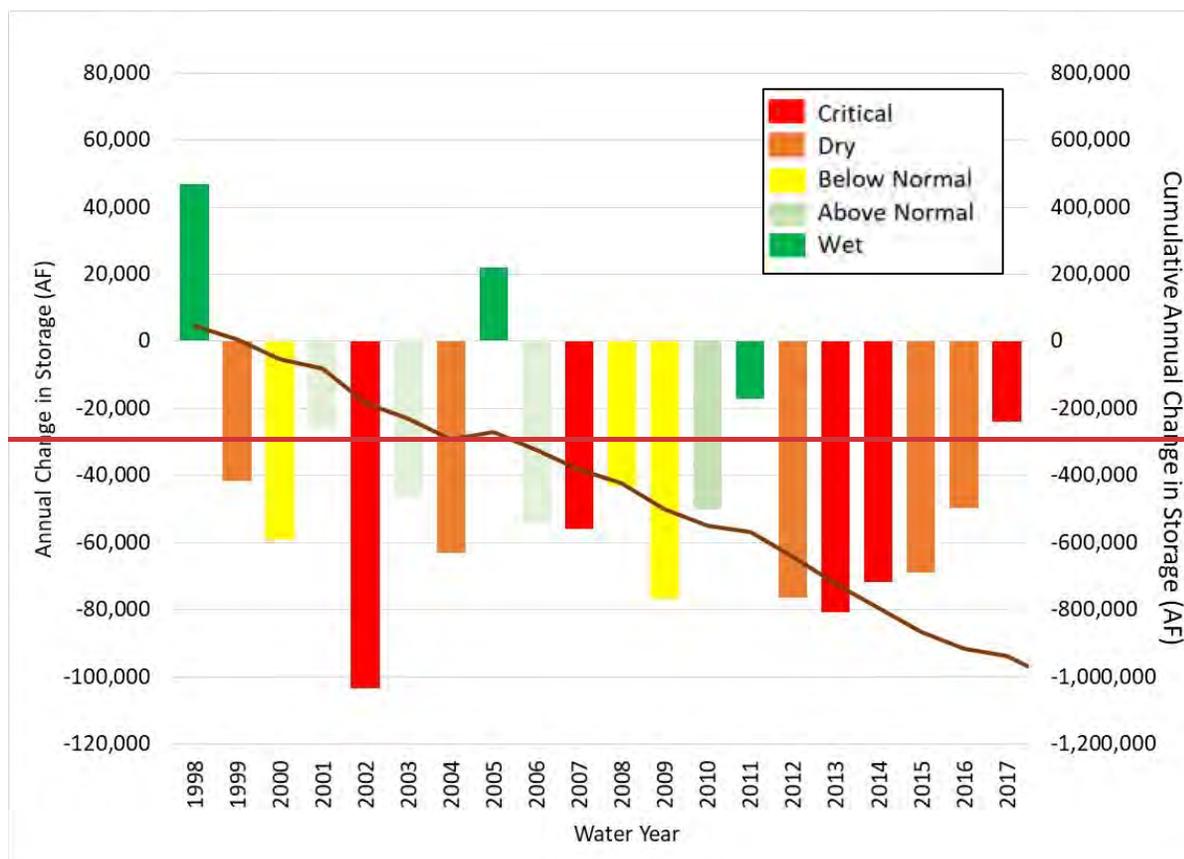


Figure 2-49: Cuyama Groundwater Storage by Year, Water Year Type, and Cumulative Water Volume

2.1.162.2.7 Seawater Intrusion

Seawater intrusion is not an applicable sustainability indicator, because seawater intrusion is not present in the Basin and is not likely to occur due to the distance between the Basin and the Pacific Ocean, its bays, deltas, or inlets.

2.1.172.2.8 Land Subsidence

In 2015, USGS measured land subsidence as part of its technical analysis of the Cuyama Valley. USGS used two continuous global positioning systems (GPS) sites and five reference point InSAR sites, shown in

Figure 2-71

Figure 2-71 (USGS, 2015). There are 308 monthly observations from 2000 to 2012, and total subsidence from 2000 to 2012 ranged from 0.0 to 0.4 feet. USGS simulated subsidence using the CUVHM, and estimated that inelastic subsidence began in the late 1970s (USGS, 2015).



Subsidence data were collected from the University NAVSTAR Consortium (UNAVCO) database. UNAVCO maintains data on five GPS monitoring stations in the area in and around the Basin. ~~Figure 2-43~~~~Figure 2-72~~~~Figure 2-72~~ shows the monitoring stations and their measurements since 1999. Three stations (P521, OZST, and BCWR) are located just outside the Basin. The three stations' measurements show ground surface level as either staying constant or slightly increasing. The increase is potentially due to tectonic activity in the region. Two stations (VCST and CUHS) are located within the Basin. Station VCST is located near Ventucopa and indicates that subsidence is not occurring in that area. Station CUHS indicates that ~~300~~~~339~~ millimeters (approximately ~~12 inches~~)1.1 feet. of subsidence have occurred in the vicinity of New Cuyama over the ~~1925~~ years that were monitored: (1999 - 2023). The subsidence at this station increases in magnitude following 2010, and generally follows a seasonal pattern. The seasonal pattern is possibly related to water level drawdowns during the summer, and elastic rebound occurring during winter periods.

In the fall of 2024, an investigation was completed of the Cuyama Valley High School (CUHS) station. This station is currently operated and maintained by USGS. An onsite inspection was performed and USGS staff were contacted to investigate the construction, sort term and seasonal fluctuations in all position's displacement components. USGS regularly reviews the data collected and did not identify any data quality issues and the site inspection did not identify any potential issue. It was concluded that the longer-term subsidence is occurring consistent with groundwater pumping and drought. Seasonal fluctuations are likely due to rainfall and possible the absence of bedrock anchoring allowing the station to move up and down on a titled axis.

A white paper that provides information about subsidence and subsidence monitoring techniques is in Appendix B.

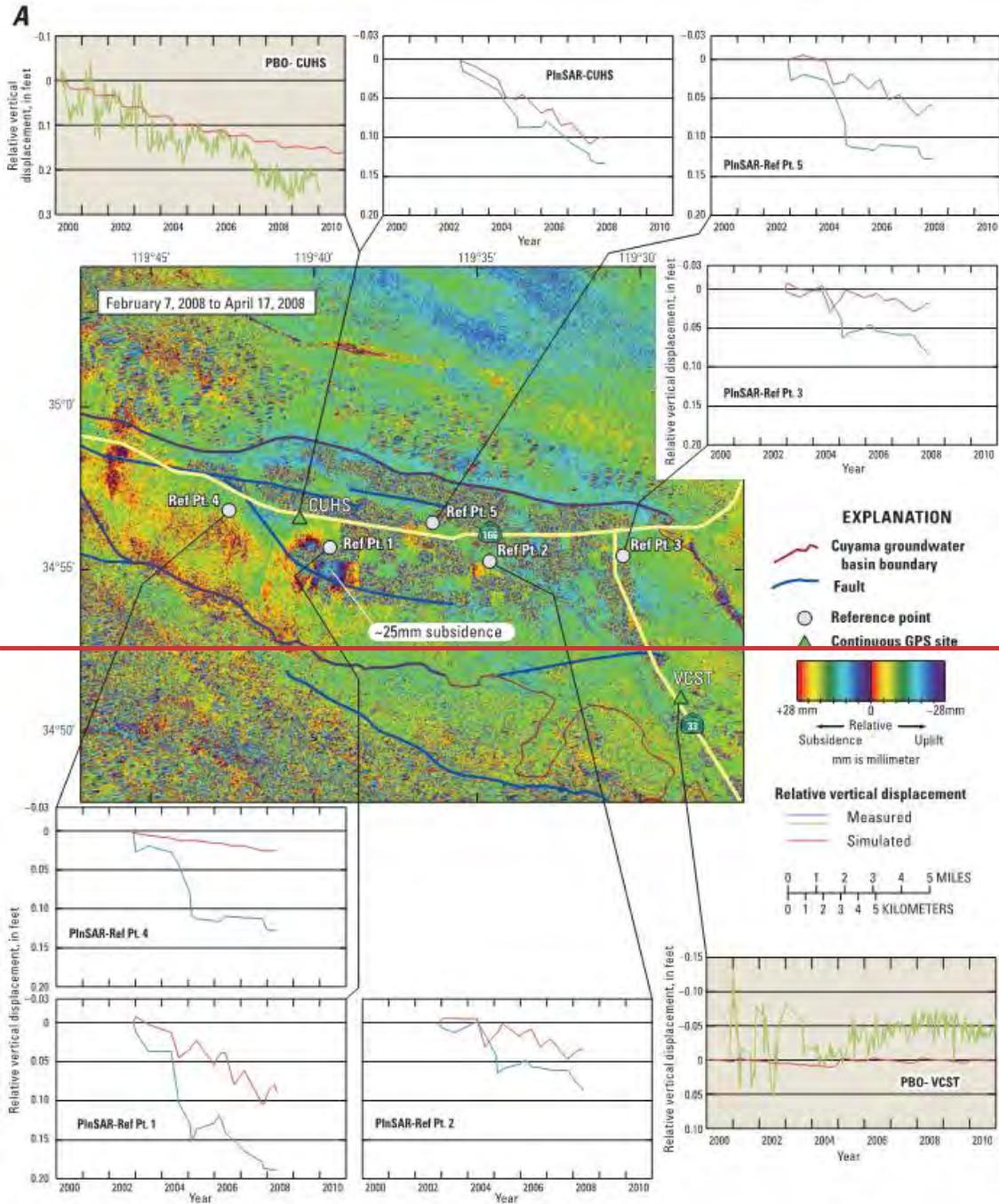


Figure 29. Historical subsidence as A, map of seasonal InSAR with graphs of simulated and measured time series for selected locations of relative land-surface deformation from Plate-Boundary Observation (PBO) sites and Point InSAR targets, and B, simulated total subsidence 1950–2010 for the calibrated hydrologic flow model, Cuyama Valley, California.

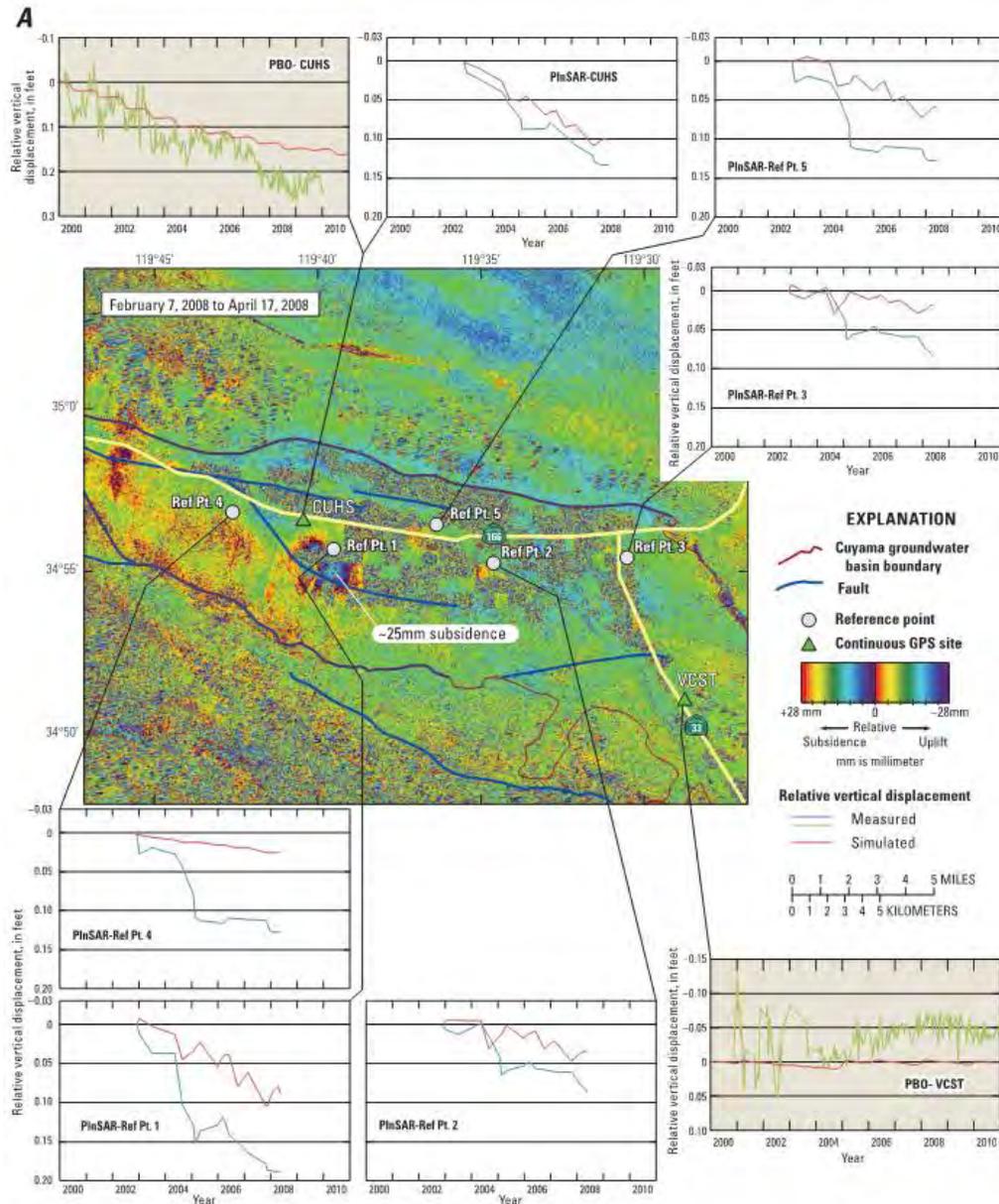


Figure 29. Historical subsidence as A, map of seasonal InSAR with graphs of simulated and measured time series for selected locations of relative land-surface deformation from Plate-Boundary Observation (PBO) sites and Point InSAR targets, and B, simulated total subsidence 1950–2010 for the calibrated hydrologic flow model, Cuyama Valley, California.

Source: USGS, 2015

Figure 2-71: Locations of Continuous GPS and Reference InSAR Sites in the Cuyama Valley

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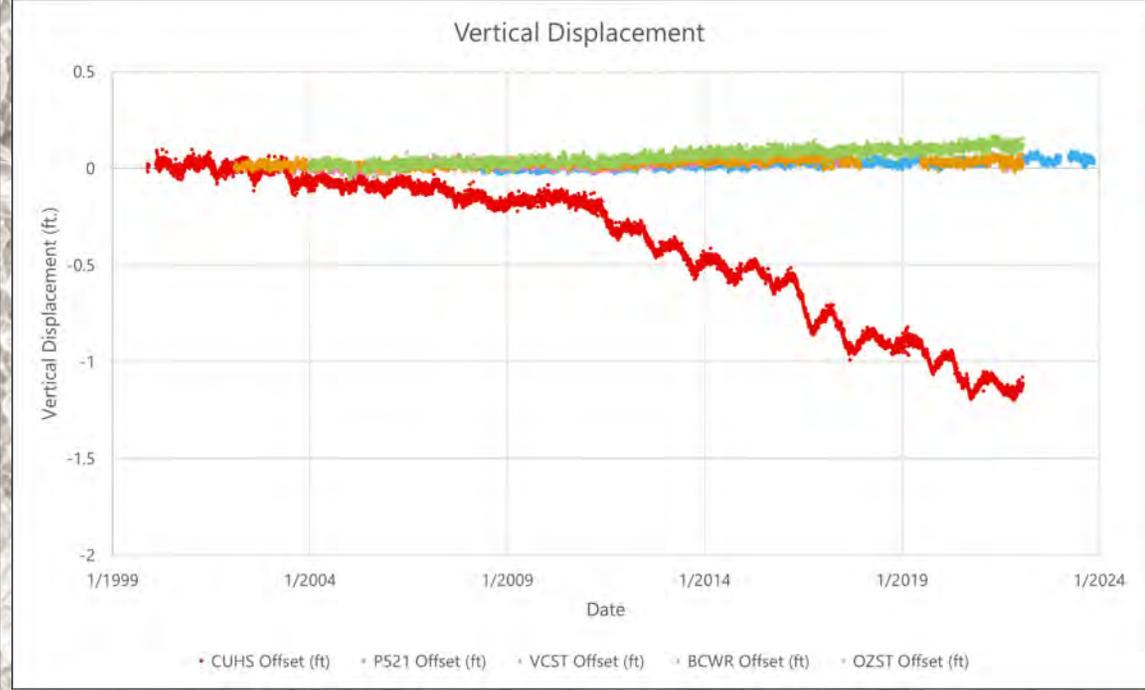
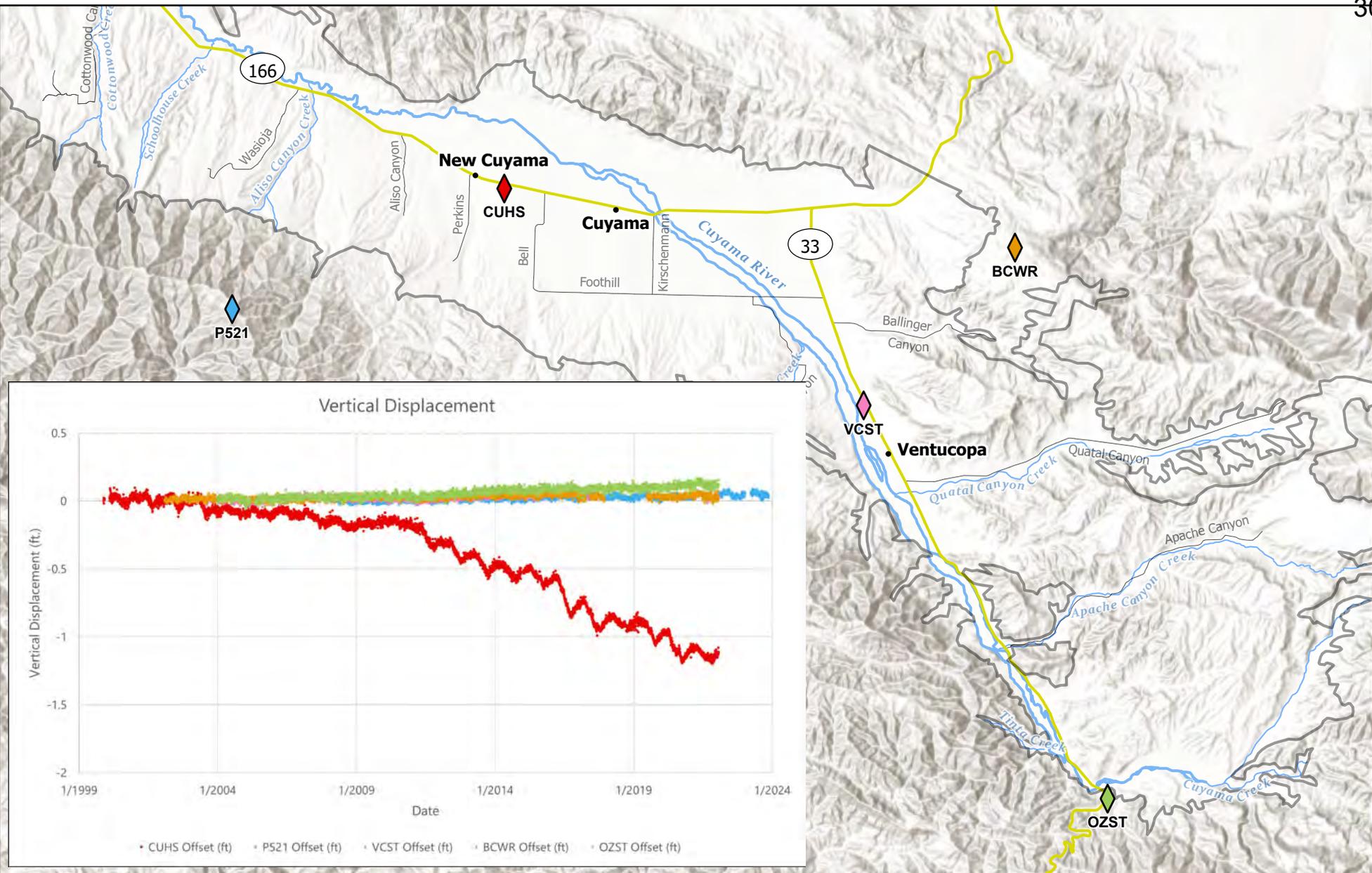


Figure 2-72: Subsidence Monitoring Network

Cuyama Valley Groundwater Basin

Legend

- Plate Boundary Observatory GPS Station
- Highway
- Local Road
- Town
- Cuyama River
- Creek
- Cuyama Basin



0 1 2 4 Miles

Map Created: December 2023

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2.1.182.2.9 Groundwater Quality

This section presents Basin groundwater quality information, including a discussion of available water quality data and references, results of water quality data analysis performed for the GSP, and a literature review of previous studies about water quality in the Basin.

Reference and Data Collection

Data collection was completed as part of the 2020 GSP compilation. References and data related to groundwater quality were collected from the following sources:

- USGS National Water Quality Monitoring Council. Downloaded data from June 1, 2018 from <https://www.waterqualitydata.us/portal/>
- DWR GeoTracker California Groundwater Ambient Monitoring and Assessment (GAMA) Program. Downloaded data on June 5, 2018 for each county, from <http://geotracker.waterboards.ca.gov/gama/datadownload>
- DWR California Natural Resources Agency data. Downloaded on June 14, 2018 from <https://data.cnra.ca.gov/dataset/periodic-groundwater-level-measurements>
- County of Ventura
- Private landowners

In addition to accessing the public portals for each program, CBGSA staff coordinated with RWQCB staff to ensure that all publicly available data was collected. It was confirmed by RWQCB staff that all available data for the ILP program was included in the online GAMA data portal download. Some of these public portals have overlapping data that, where possible, were removed, to develop a comprehensive data set for the Basin. Data were then compiled into a database for analysis.

Analysts also compiled references containing groundwater quality information. The information included in these references were used to enhance understanding of groundwater quality conditions beyond available data. References used in this section include the following:

- Singer and Swarzensky. 1970. *Pumpage and Ground-Water Storage Depletion in Cuyama Valley, 1947-1966*. This report focuses on groundwater depletion, but also includes information about groundwater quality.
- USGS. 2008 *Groundwater-Quality Data in the South Coast Interior Basins Study Unit, 2008: Results from the California Groundwater Ambient Monitoring and Assessment (GAMA) Program*. This study summarizes water quality testing on 12 wells in the Cuyama Valley; wells were tested for a variety of constituents.
- SBCWA. 2011. *Santa Barbara County 2011 Groundwater Report*. This report provides groundwater conditions from throughout the county, and provides water quality information for the Cuyama Valley.



- USGS. 2013c. *Geology, Water-Quality, Hydrology, and Geomechanics of the Cuyama Valley Groundwater Basin, California, 2008-12*. This report investigates a wide variety of groundwater components in the Cuyama Valley, including water quality.

Historical Data Analysis

Collected data were analyzed for TDS, nitrate, and arsenic. These three constituents were included in analysis because they were cited in previous studies of the Basin, and they were discussed during public meetings as being of concern to stakeholders in the Basin. The Figures below show historical measurements of TDS nitrate and arsenic collected prior to GSP development as well as also recent sampling results from the CBGSA's monitoring network and collected from public portals described earlier in this chapter.

~~Figure 2-52~~Figure 2-73~~Figure 2-73~~ shows TDS of groundwater measured in wells in 1966. In 1966, TDS was above the MCL of 1,500 micrograms per liter (mg/L) in over 50 percent of measurements. TDS was over 2,000 mg/L near the Cuyama River in the southeast portion of the Basin near the Ozena Fire Station, Santa Barbara Canyon, and upper Quatal Canyon, indicating that high TDS water was entering the Basin from the watershed above these measurement points. TDS measurements were over the MCL throughout the central portion of the Basin, where irrigated agriculture was operating, near the towns of Cuyama and New Cuyama, and along the Cuyama River to the northwest of New Cuyama. TDS was less than 500 mg/L in a number of measurements between Bitter Creek and Cottonwood Canyon, indicating that lower TDS water was entering the Basin from the watersheds in this area.

~~Figure 2-53~~Figure 2-74~~Figure 2-74~~ shows TDS of groundwater measured in wells between 2011 and 2018. Multiple years of collected data were used to generate enough mapped data density for comparison to 1966 data. From 2011 to 2018 period, TDS was above the MCL in over 50 percent of measurements. TDS was over 1,500 mg/L near the Cuyama River in the southeast portion of the Basin near the Ozena Fire Station, and in Santa Barbara Canyon, indicating that high TDS water was entering the Basin from the watershed above these measurement points. TDS measurements were over the MCL throughout the central portion of the Basin where irrigated agriculture was operating. A number of 500 to 1,000 mg/L TDS concentrations were measured near New Cuyama and in upper Quatal Canyon, and along the Cuyama River between Cottonwood Canyon and Schoolhouse Canyon.

~~Figure 2-54~~



~~Figure 2-75~~ Figure 2-75 shows measurements of TDS for selected monitoring points over time. Monitoring points were selected by the number of measurements, with higher counts of measurements selected to be plotted. The charts indicate that TDS in the vicinity of New Cuyama has been over 800 mg/L TDS throughout the period of record, and that TDS has either slightly increased or stayed stable over the period of record. The chart for Well 85 at the intersection of Quatal Canyon and the Cuyama River is generally below 800 mg/L TDS with rapid spikes of TDS increases above that level. The timing of rapid increases in measured TDS correspond with Cuyama River flow events, indicating a connection between rainfall and stream flow and an increase in TDS. This is the only location where this trend was detected.

~~Figure 2-55~~ Figure 2-76 shows measurements of nitrate in 1966. This figure also shows that data collected in 1966 shows the Basin was below the MCL of 10 mg/L throughout, with some measurements above the MCL in the central portion of the Basin where irrigated agriculture was operating.

~~Figure 2-56 shows measurements of nitrate in groundwater measured in wells between 2011 and 2018. Multiple years of collected data were used to generate enough mapped data density for comparison to 1966 data. This figure also shows that data collected over this period show the Basin was generally below the MCL, with two measurements that were over 20 mg/L.~~

~~Figure 2-57 shows arsenic measurements from 2008 to 2018. Data were not available prior to this time in significant amounts.~~

~~Figure 2-57 also shows that arsenic measurements were below the MCL of 10 micrograms per liter ($\mu\text{g/L}$) in the majority of the Basin where data was available. However, high arsenic values exceeding 20 $\mu\text{g/L}$ were recorded at three well locations in the area south of New Cuyama; all of these high concentration samples were taken at depths of 700 feet or greater, and readings in the same area taken at shallower depths were below the MCL.~~

~~Figure 2-58~~ Figure 2-77 shows the locations of wells with monitoring measurements for nitrates during the 2010-2020 period and the average concentrations measured in each well. For nitrate, 41 of the 102 wells recorded MCL exceedances from 2010-2020. A review of the data for wells with measurements both before and after 2015 showed little change in concentrations, with no wells showing water quality degradation for nitrate or arsenic.



Figure 2-78 shows the locations of wells with monitoring measurements for arsenic during the 2010-2020 period and the average concentrations measured in each well. For arsenic, five of the 23 wells with measurement recorded a measurement exceeding the MCL of 10 $\mu\text{g/L}$. A review of the data for wells with measurements both before and after 2015 showed little change in concentrations, with no wells showing water quality degradation for arsenic.

Figure 2-79 shows the results of a query using the Regional Water Quality Control Board (RWQCB)'s GeoTracker website. GeoTracker documents RWQCB contaminant concerns and mitigation projects. As shown in the figure, most GeoTracker sites show that gasoline, oil and/or diesel fuel have been cited as the contaminant of concern.



Analysis of Recent Data

Since the GSP adoption, the CBGSA has started collecting its own water quality results through the development of a water quality monitoring network. The CBGSA conducts its own sampling for TDS annually and samples for nitrate and arsenic once every five years. In the interim years, the CBGSA leverages existing monitoring programs for nitrate and arsenic through the California State Water Resource Control Board Groundwater Ambient Monitoring and Assessment (GAMA) Database, which includes data from the Central Coast Regional Water Board's Irrigated Lands Program for nitrates as part of its database.

Figure 2-80~~280~~ shows TDS measurements as part of the water quality monitoring network sampled by the CBGSA in 2023. TDS ranges from less than 500 in the eastern part of the Basin to over 1700 in the central part of the Basin, where most of the agricultural production is located.

Figure 2-81~~281~~ shows nitrate concentrations from 2022 and 2023 from the CBGSA monitoring and results from the GAMA database. Nitrate concentrations over the MCL are located in the central part of the basin where most of the agricultural production is located.

Figure 2-82~~282~~ shows arsenic concentrations from 2022 and 2023 from CBGSA monitoring and results from the GAMA database. All wells with arsenic concentrations exceeding MCLs are located in the Central Threshold Region. The locations of high arsenic concentrations are focused south of New Cuyama near the existing Cuyama Community Services District (CCSD) well. This is a known issue for the CCSD that has been mitigated by the construction of a replacement well for the district, which is included as a project in the GSP (see Chapter 7).

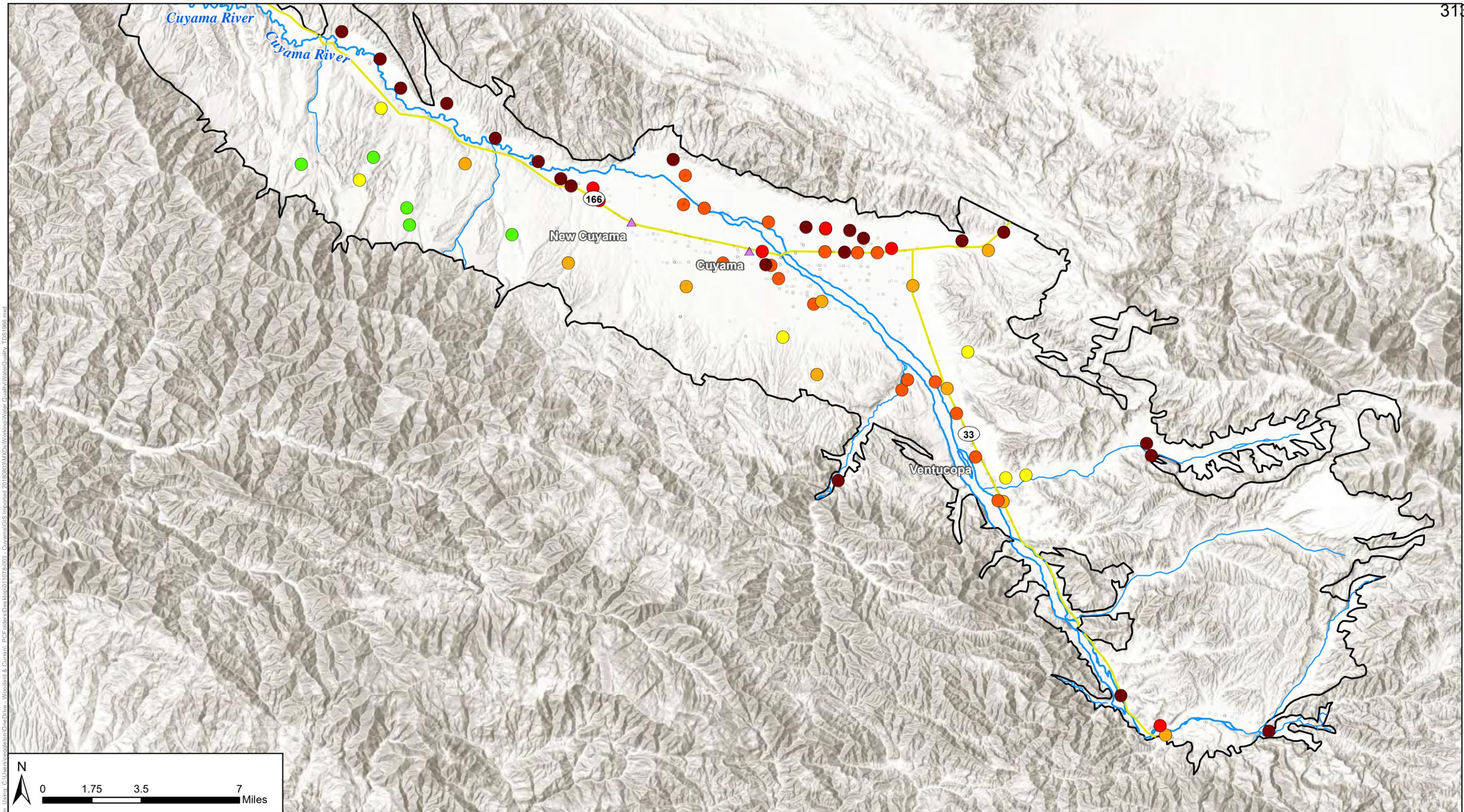


Figure 2-73: 1966 Average Well Measurements of Total Dissolved Solids, mg/L
 Cuyama Basin Groundwater Sustainability Agency
 Cuyama Valley Groundwater Basin Groundwater Sustainability Plan
 December 2019



Legend

TDS, mg/L	
○ No Measurements	● 1,500 - 1,750 mg/L
● < 500 mg/L	● 1,750 - 2,000 mg/L
● 500 - 1,000 mg/L	● >2,000 mg/L
● 1,000 - 1,500 mg/L	

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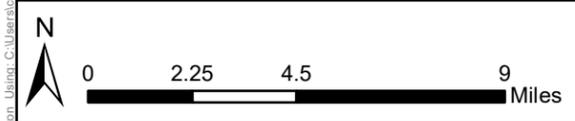
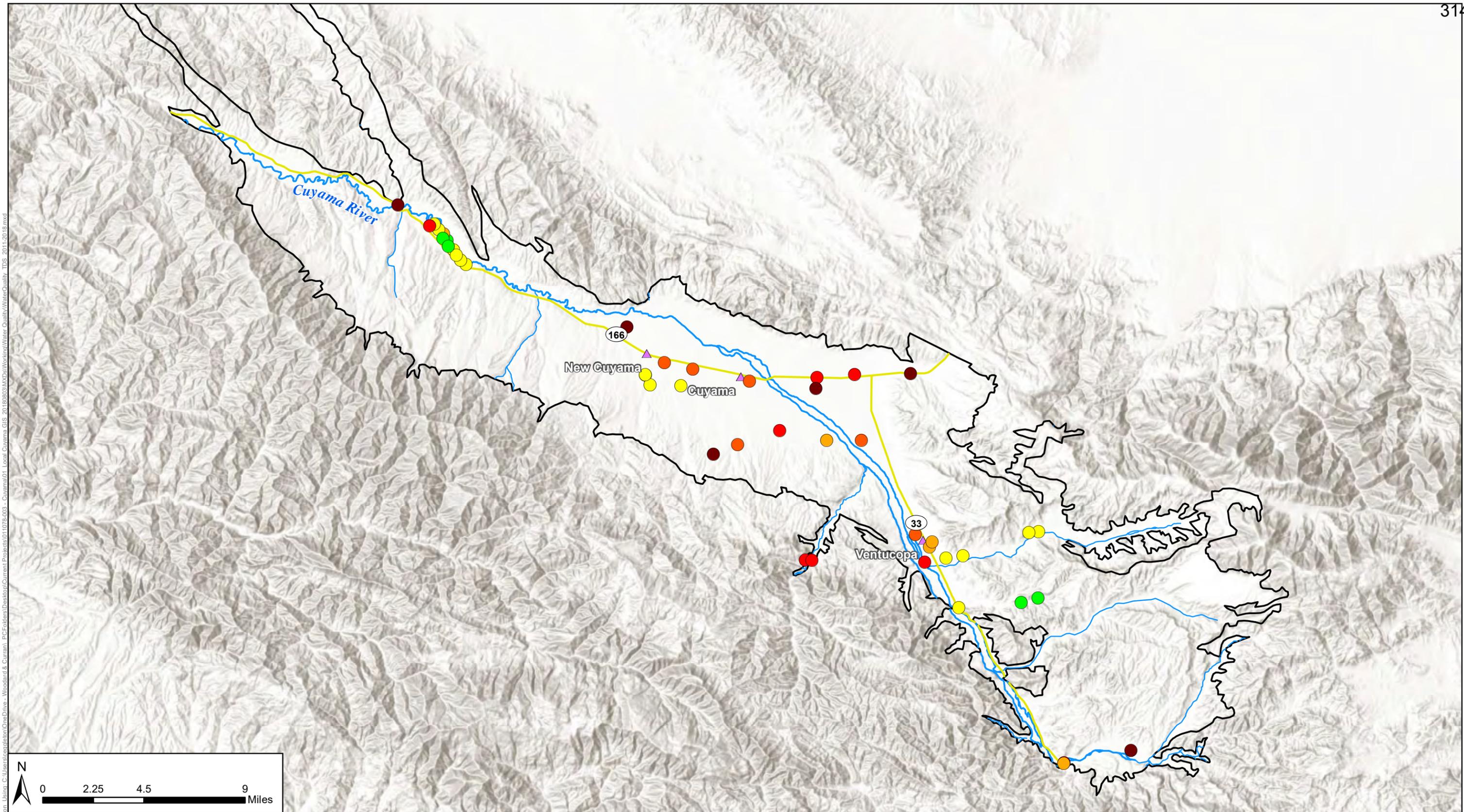


Figure 2-74: 2011-2018 Average Well Measurements of Total Dissolved Solids, mg/L
 Cuyama Basin Groundwater Sustainability Agency
 Cuyama Valley Groundwater Basin Groundwater Sustainability Plan
 December 2019



Legend

TDS, mg/L	
Average_Re	
● < 500 mg/L	● 1,500 - 1,750 mg/L
● 500 - 1,000 mg/L	● 1,750 - 2,000 mg/L
● 1,000 - 1,500 mg/L	● > 2,000 mg/L

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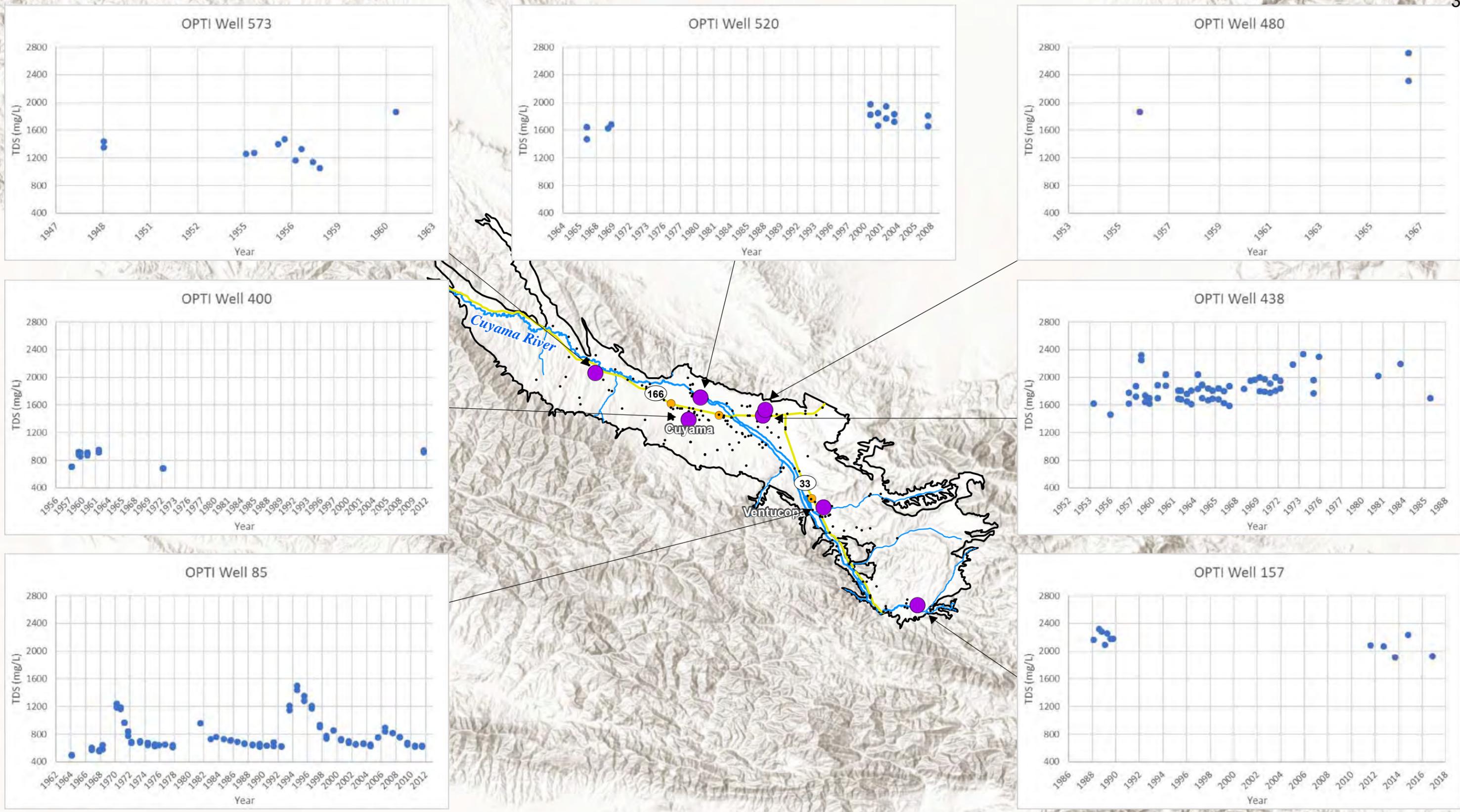


Figure 2-75: Cuyama Groundwater Basin Historic TDS Levels in Selected Wells

Cuyama Basin Groundwater Sustainability Agency

Cuyama Valley Groundwater Basin Groundwater Sustainability Plan

December 2019



Legend

- Cuyama Basin
- Cuyama River
- Wells with Graphed Data
- Towns
- Streams
- Location of TDS WQ Measurements
- Highways

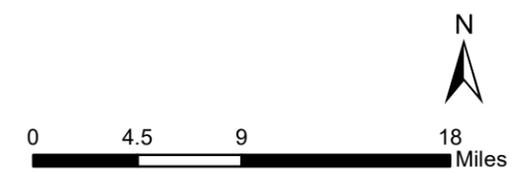


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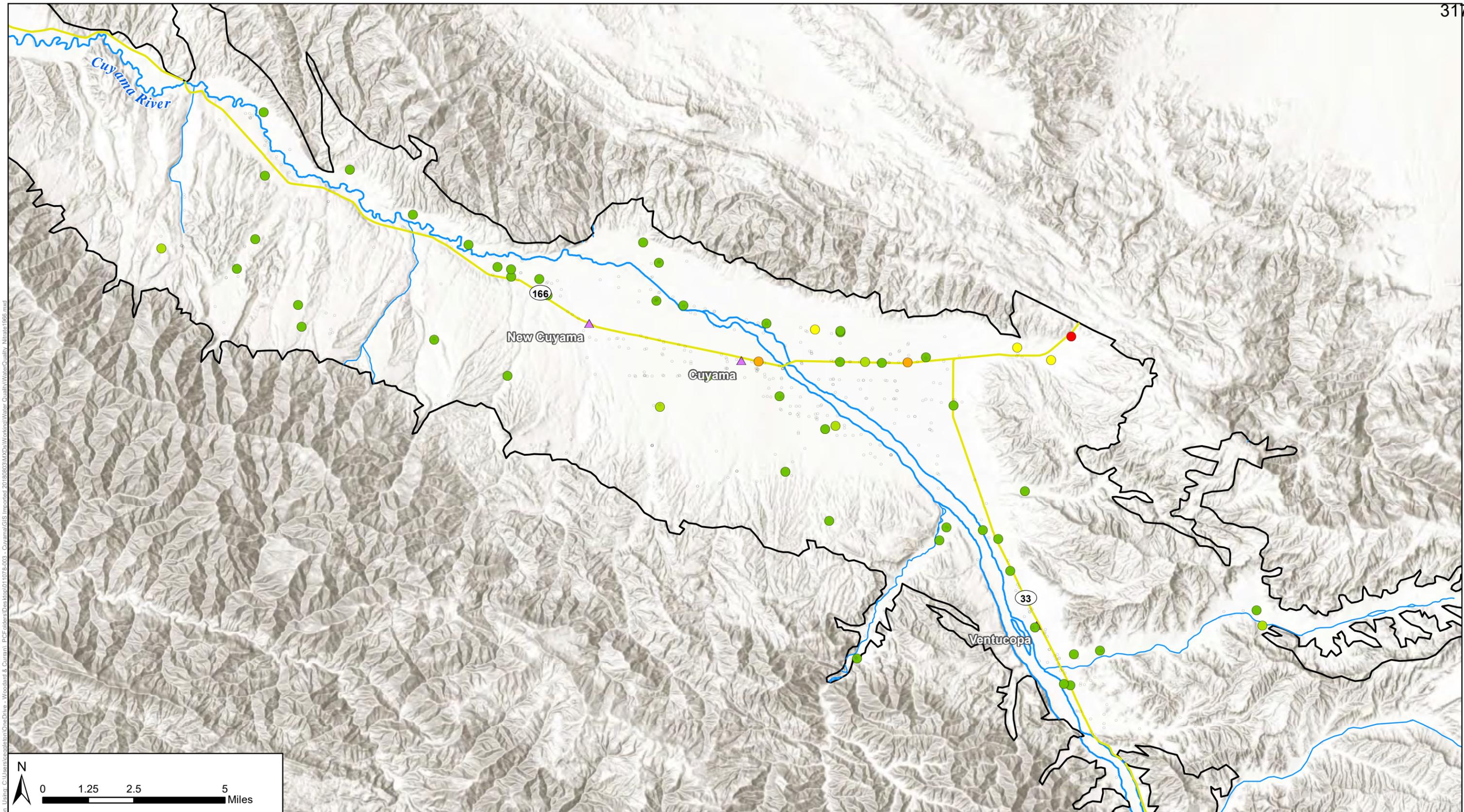


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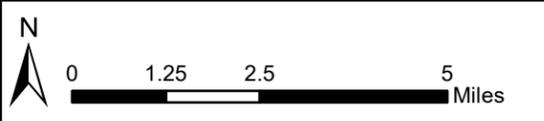
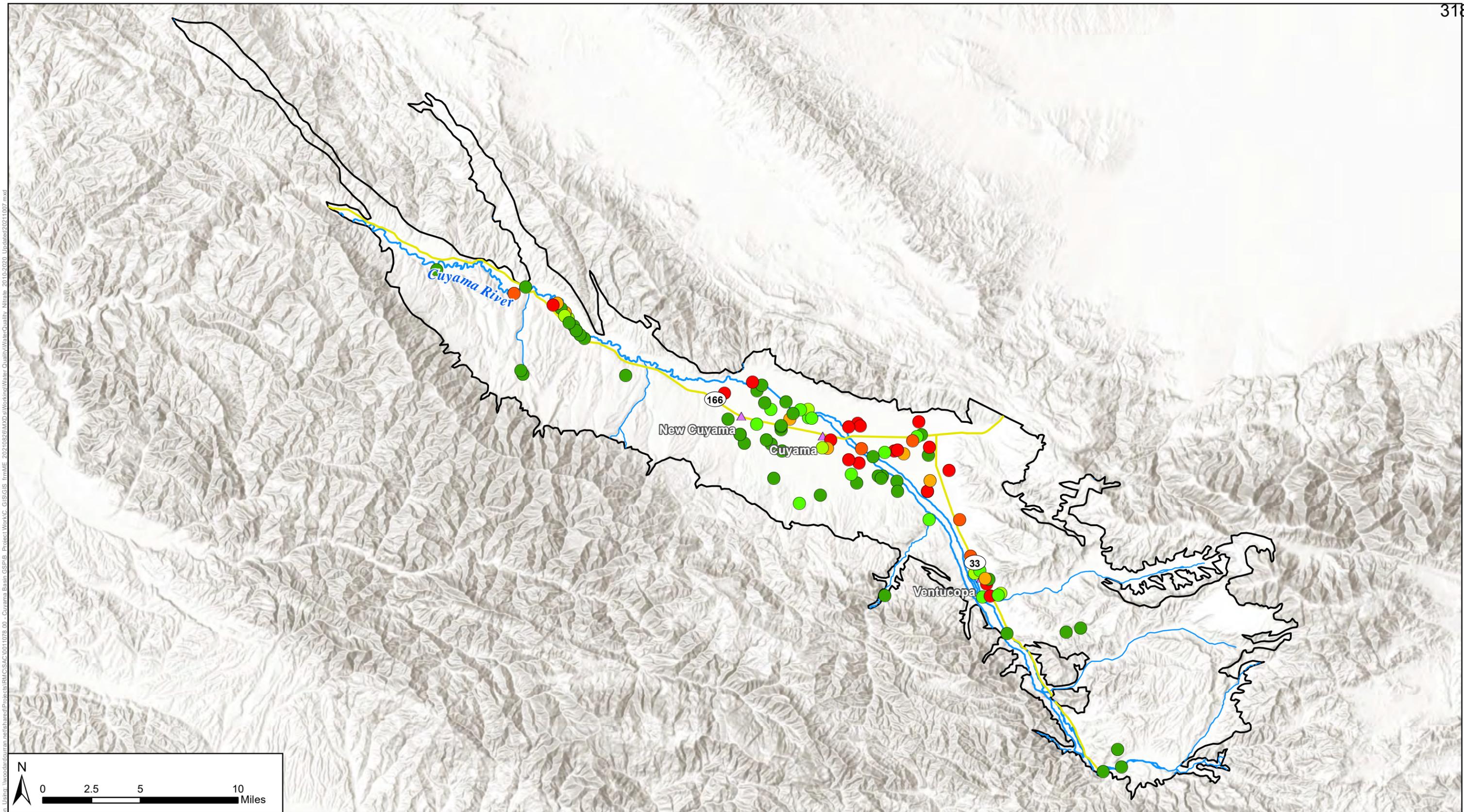


Figure 2-76: 1966 Average Well Measurements of Nitrate (NO3) as Nitrogen
 Cuyama Basin Groundwater Sustainability Agency
 Cuyama Valley Groundwater Basin Groundwater Sustainability Plan
 December 2019



Legend

Nitrate (NO3) as N, mg/L	
○ No Measurements	● 10 - 15 mg/L
● < 5 mg/L	● 15 - 20 mg/L
● 5 - 8 mg/L	● > 20 mg/L
● 8 - 10 mg/L	



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Figure 2-77: 2010-2020 Average Well Measurements of Nitrate (NO₃) as Nitrogen

Cuyama Basin Groundwater Sustainability Agency

Cuyama Valley Groundwater Basin Groundwater Sustainability Plan

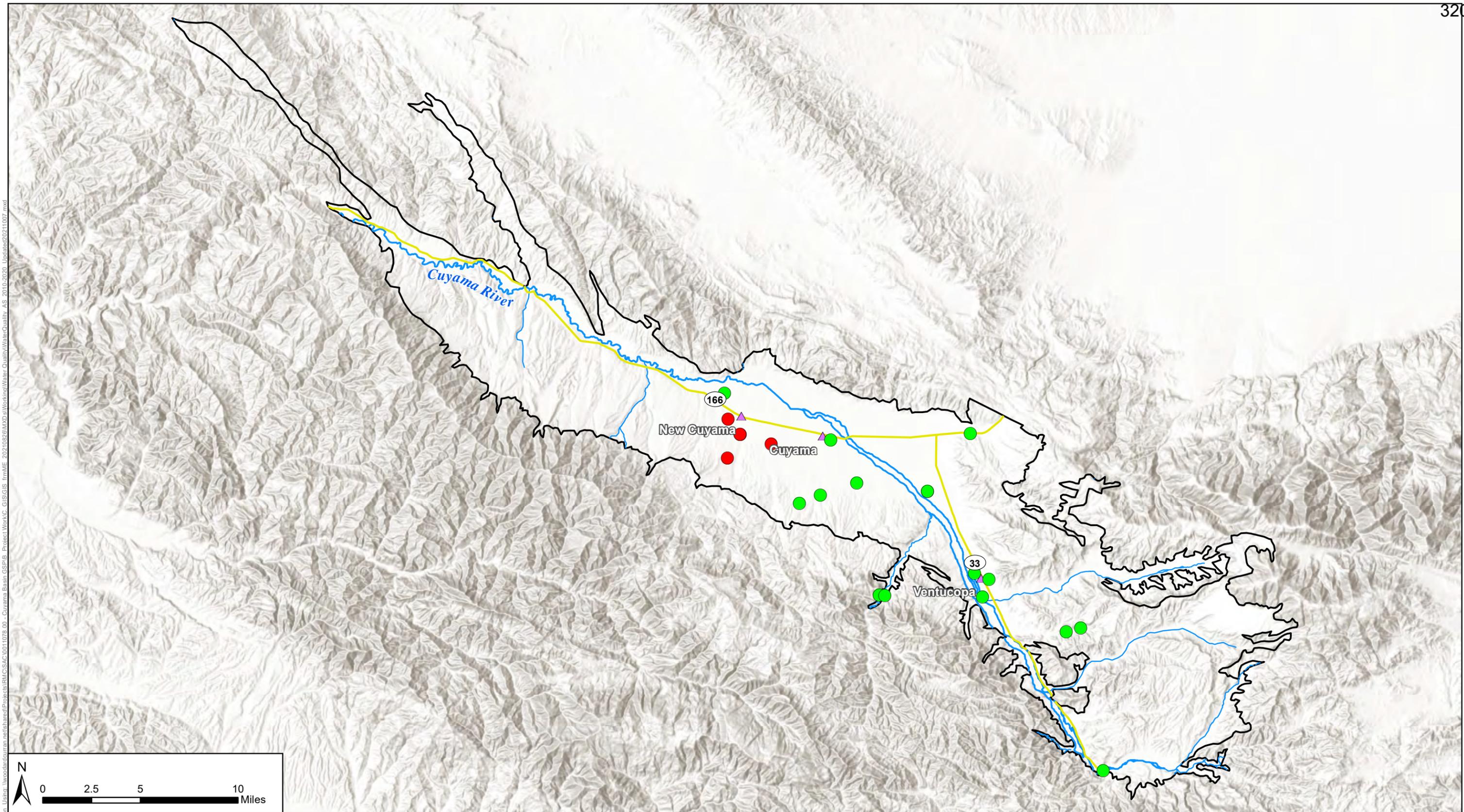
October 2021



Legend

Nitrate (NO ₃) as N, mg/L	
● < 5 mg/L	● 10 - 15 mg/L
● 5 - 8 mg/L	● 15 - 20 mg/L
● 8 - 10 mg/L	● > 20 mg/L





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Figure 2-78: 2010-2020 Average Well Measurements of Arsenic, $\mu\text{g/L}$

Cuyama Basin Groundwater Sustainability Agency
 Cuyama Valley Groundwater Basin Groundwater Sustainability Plan
 October 2021



Legend

- Arsenic (As), $\mu\text{g/L}$**
- < 5 $\mu\text{g/L}$
 - 10 - 20 $\mu\text{g/L}$
 - 5 - 10 $\mu\text{g/L}$
 - > 20 $\mu\text{g/L}$

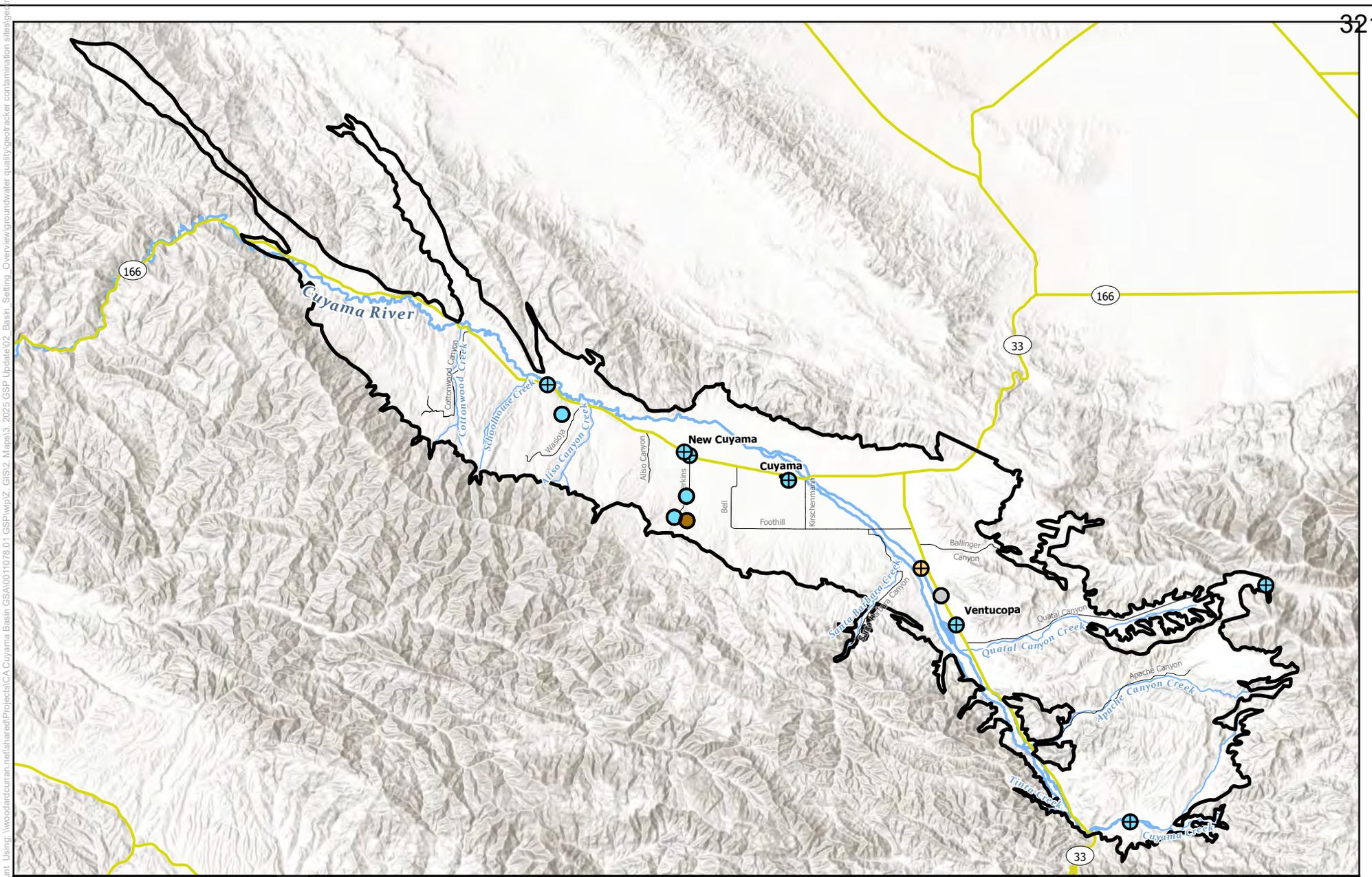


Figure 2-79: Sites with Water Quality Concerns

Cuyama Valley Groundwater Basin

Legend

Contaminant of Concern	Site Status	Highway	Creek
Alcohol	Closed	Highway	Cuyama River
Gas	Open	Local Road	Cuyama Basin
Lead	Town		
Oil			



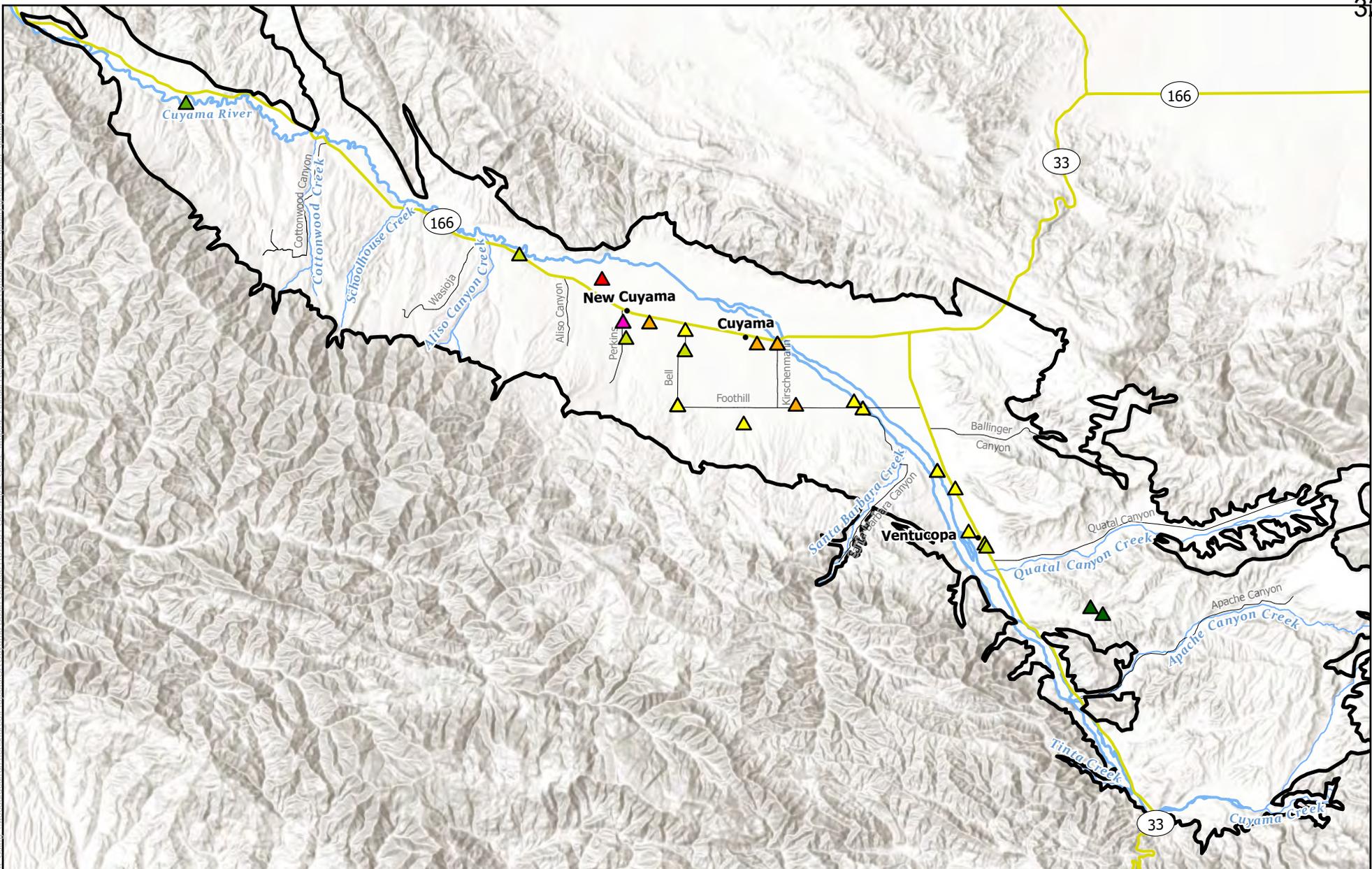
0 1.75 3.5 7 Miles

Map Created: April 2024

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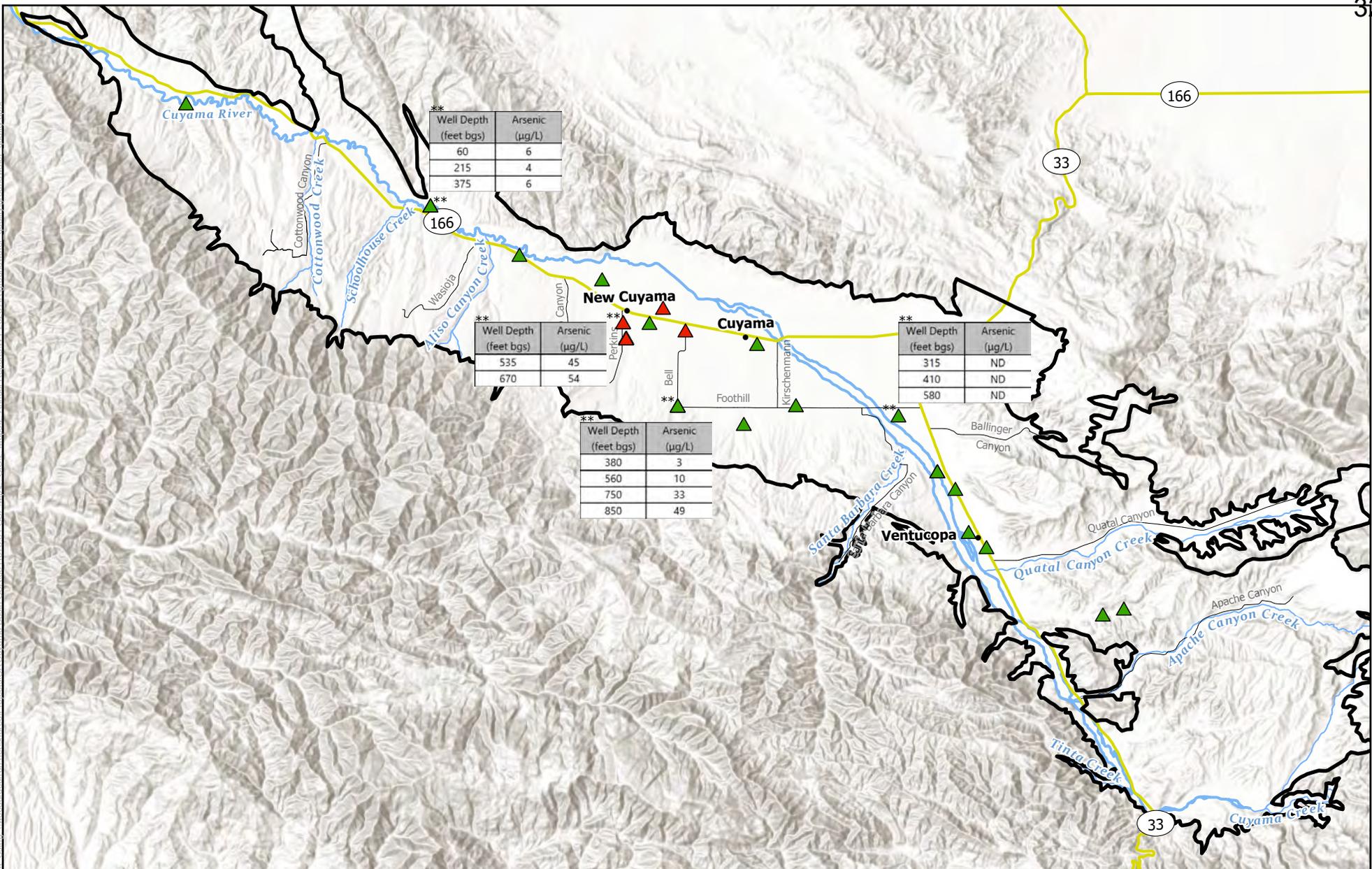


<p>Figure 2-80: Groundwater Quality Measurements - TDS</p> <p>2023 Data</p> <p>Cuyama Valley Groundwater Basin</p>	<p>Legend</p>	<p>▲ < 500 mg/L</p>	<p>▲ 1,251 - 1,500 mg/L</p>	<p>— Highway</p>	<p>— Creek</p>
		<p>▲ 501 - 750 mg/L</p>	<p>▲ 1,501 - 1,750 mg/L</p>	<p>— Local Road</p>	<p>— Cuyama River</p>
		<p>▲ 751 - 1,000 mg/L</p>	<p>▲ 1,751 - 2,000 mg/L</p>	<p>• Town</p>	<p>□ Cuyama Basin</p>
		<p>▲ 1,001 - 1,250 mg/L</p>	<p>▲ 2,001 - 2,250 mg/L</p>		

Map Created: March 2024

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**

Well Depth (feet bgs)	Arsenic (µg/L)
60	6
215	4
375	6

**

Well Depth (feet bgs)	Arsenic (µg/L)
535	45
670	54

**

Well Depth (feet bgs)	Arsenic (µg/L)
315	ND
410	ND
580	ND

**

Well Depth (feet bgs)	Arsenic (µg/L)
380	3
560	10
750	33
850	49

Figure 2-82: Groundwater Quality Measurements - Arsenic
 Years 2022 and 2023
Cuyama Valley Groundwater Basin

Legend	▲ < 5 µg/L	▲ 10 - 15 µg/L	— Highway	— Creek
	▲ 5 - 8 µg/L	▲ 15 - 20 µg/L	— Local Road	— Cuyama River
	▲ 8 - 10 µg/L	▲ > 20 µg/L	• Town	 Cuyama Basin

*Values from monitoring wells with multiple observations were averaged with respect to year sampled. **Nestled well at this location.
 Third Party GIS Disclaimer: This map is for reference and graphical purposes only and should not be relied upon by third parties for any legal decisions. Any reliance upon the map or data contained herein shall be at the users' sole risk. **Data sources: CA DWR, Esri, USGS**

Map Created: April 2024



Literature Review

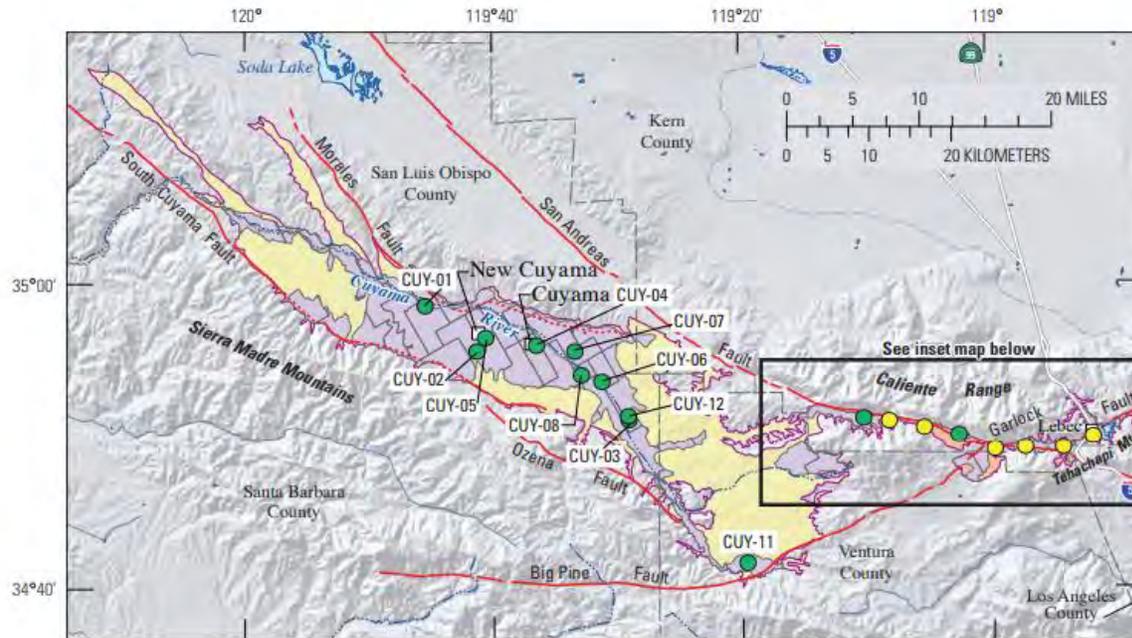
The information contained in this literature review was compiled during the development of the GSP. In 1970, Singer and Swarzenski reported that TDS in the central basin portion of the Basin was in the range of 1,500 to 1,800 mg/L TDS, and that the cations that contributed to the TDS and the amount of TDS varied by location in the Basin. They also reported that TDS was lower (i.e., from 400 to 700 mg/L) in areas downstream from the Sierra Madre Mountains where TDS was made up of sodium or calcium bicarbonate, and higher (i.e., from 3,000 to 6,000 mg/L) in wells close to the Caliente Range and in the northeastern part of the valley. Singer and Swarzenski stated that the high TDS was generated by mixing of water from marine rocks with more recent water from alluvium. They determined that groundwater movement favors movement of brackish water from the north of the Cuyama River toward areas of groundwater depletion, and that return of some water applied during irrigation and needed for leaching the soil carries dissolved salts with it to the water table (Singer and Swarzensky, 1970).

In 2008, USGS reported GAMA Program results. The GAMA Program sampled 12 Basin wells for a wide variety of constituents. Figure 2-59~~Figure 2-83~~²⁸³ shows the location of GAMA Program wells. The GAMA Program identified that specific conductance, which provides an indication of salinity, ranged from 637 to 2,380 microsiemens per centimeter ($\mu\text{S}/\text{cm}$) across the study's 12 wells. The GAMA Program study reported that the following constituents were not detected at levels above the MCL for each constituent in any samples for the following constituents:

- Pesticides or pesticide degradates
- Gasoline and refrigerants
- Aluminum, antimony, barium, beryllium, boron, cadmium, copper, iron, and lead
- Ammonia and phosphate
- Lithium, molybdenum, nickel, selenium, strontium, thallium, tungsten, uranium, vanadium, and zinc
- Bromide, calcium, chloride, fluoride, iodide, magnesium, potassium, silica, and sodium

The GAMA Program reported that there were detections at levels above the MCL for the following constituents:

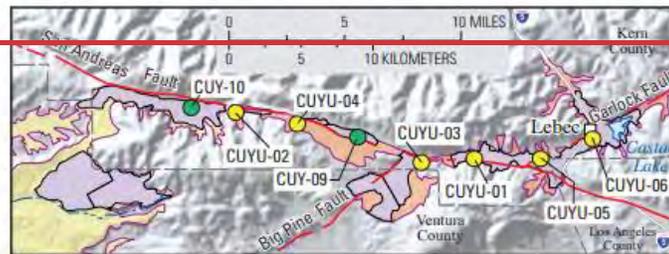
- Manganese exceeded its MCL in two wells
- Arsenic exceeded the MCL in one well
- Nitrate exceeded the MCL in two wells
- Sulfate exceeded its MCL in eight wells
- TDS exceeded its MCL in seven wells
- VOCs detected in one well



Base from U.S. Geological Survey National Elevation Dataset, 2006, Albers Equal-Area Conic Projection



Location of groundwater basins in this study



EXPLANATION

- Cuyama Valley groundwater basin (from California Department of Water Resources, CDWR)
- Castaic Lake Valley, Cuddy Canyon Valley, Cuddy Ranch Area, Cuddy Valley, and Mil Potrero groundwater basins included in this study (from California Department of Water Resources, CDWR)
- Randomized sampling grid cell
- Fault
- CUY-09 Grid well
- CUYU-02 Understanding well
- Water bodies
- Stream or river

Figure 5. The South Coast Interior Basins Groundwater Ambient Monitoring and Assessment (GAMA) study unit showing the distribution of the Cuyama study-area grid cells, the location of sampled grid wells and understanding wells, the Cuyama Valley, Castaic Lake Valley, Cuddy Canyon Valley, Cuddy Ranch Area, Cuddy Valley, and Mil Potrero groundwater-basin boundaries (as defined by the California Department of Water Resources, CDWR), major cities, major roads, topographic features, and hydrologic features. Alphanumeric identification numbers for grid wells

Source: USGS, 2008

Figure 2-59: Locations of GAMA Sample Locations



In 2011, SBCWA reported that TDS in the Basin typically ranged from 1,500 to 1,800 mg/L in the main part of the Basin, while the eastern portion of the Cuyama Badlands near Ballinger, Quatal, and Apache Canyons had better water quality with TDS typically ranging from 400 to 700 mg/L. SBCWA noted spikes in TDS in the Badlands Well following the wet rainfall years of 1969 and 1994 and stated that the spikes are attributable to overland flow from rainfall which is flushing the upper part of the Basin after dry periods.

SBCWA reported that boron is generally higher in the upper part of the Basin and is of higher concentration in the uplands than in the deeper wells in the central part of the Basin. Toward the northeast end of the Basin at extreme depth there exists poor quality water, perhaps connate (trapped in rocks during deposition) from rocks of marine origin.

SBCWA also reported: “There was little change in TDS, calcium, magnesium, nitrates and sulfates during the 2009- 2011 period. In some cases, concentrations of these nutrients actually fell during the period, most likely due to a lack of rainfall, recharge and flushing of the watershed. As the Cuyama watershed is mostly dry, water quality data must be examined with caution as sometimes overland flow from rainfall events “flushes” the watershed and inorganic mineral concentrations actually peak during storm flows. Typically, in other areas of Santa Barbara County mineral concentrations are diluted during widespread storm runoff out of natural watersheds.”

In 2013, USGS reported that they collected groundwater quality samples at 12 monitoring wells, 27 domestic wells, and two springs for 53 constituents including: field parameters (water temperature, specific conductance, pH, DO, alkalinity), major and minor ions, nitrate, trace elements, stable isotopes of hydrogen and oxygen, tritium and carbon-14 activities, arsenic, iron, and chromium. Figure 2-60 Figure 2-84 shows the USGS sampling locations, which were presented in a figure from their report. The USGS reported sampling result as follows:

- Groundwater in the alluvial aquifer system has high concentrations of TDS and sulfate
- 97 percent of samples had concentrations greater than 500 mg/L for TDS
- 95 percent of samples had concentrations greater than 250 mg./L for sulfate
- 13 percent of samples had concentrations greater than 10 mg/L for nitrate
- 12 percent of samples had concentrations greater than 10 ug/L for arsenic
- One sample had concentrations greater than the MCL for fluoride
- Five samples had concentrations greater than 50 mg/L for manganese
- One sample had concentration of iron greater than 300 mg/L for iron
- One sample had concentration of aluminum greater than 50 mg/L

USGS reported that nitrate was detected in five locations above the MCL of 10 mg/L. Four wells where nitrate levels were greater than the MCL were in the vicinity of the center of agricultural land-use area. Irrigation return flows are a possible source of high nitrate concentrations. There was a decrease in



concentrations with depth in the agricultural land use area which indicated the source of higher nitrate concentrations likely to be near the surface. The lowest nitrate levels were outside the agricultural use area, and low concentrations of nitrate (less than 0.02 mg/L) in surface water samples indicated surface water recharge was not a source of high nitrate

The USGS reported that arsenic was found in greater concentration than the MCL of 10 ug/L in four of the 33 wells sampled, and samples of total chromium ranged from no detections to 2.2 ug/L, which is less than the MCL of 50 ug/L. Hexavalent chromium ranged from 0.1 to 1.7 ug/L which is less than the MCL of 50 ug/L.

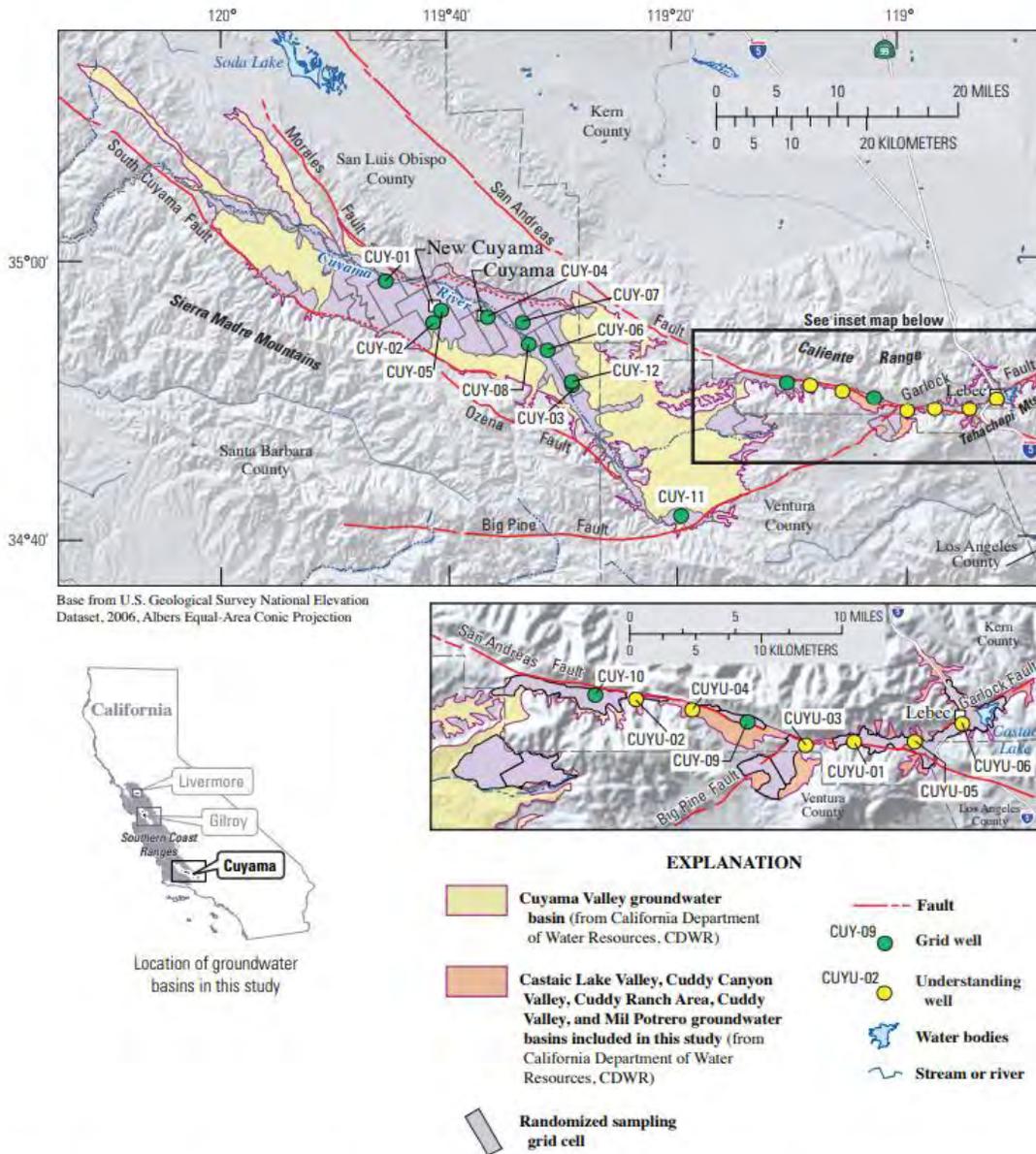


Figure 5. The South Coast Interior Basins Groundwater Ambient Monitoring and Assessment (GAMA) study unit showing the distribution of the Cuyama study-area grid cells, the location of sampled grid wells and understanding wells, the Cuyama Valley, Castaic Lake Valley, Cuddy Canyon Valley, Cuddy Ranch Area, Cuddy Valley, and Mil Potrero groundwater-basin boundaries (as defined by the California Department of Water Resources, CDWR), major cities, major roads, topographic features, and hydrologic features. Alphanumeric identification numbers for grid wells

Source: USGS, 2008

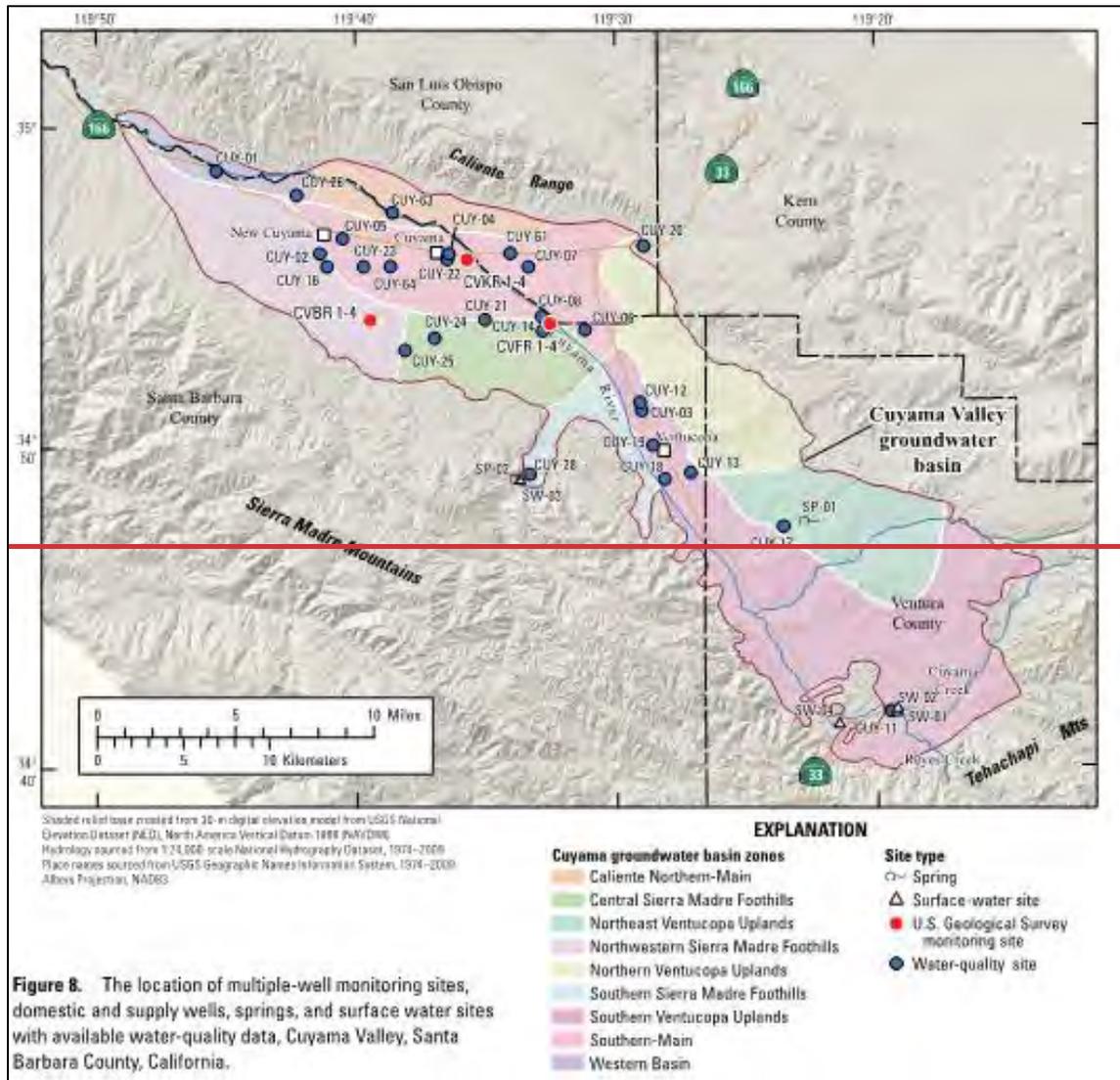
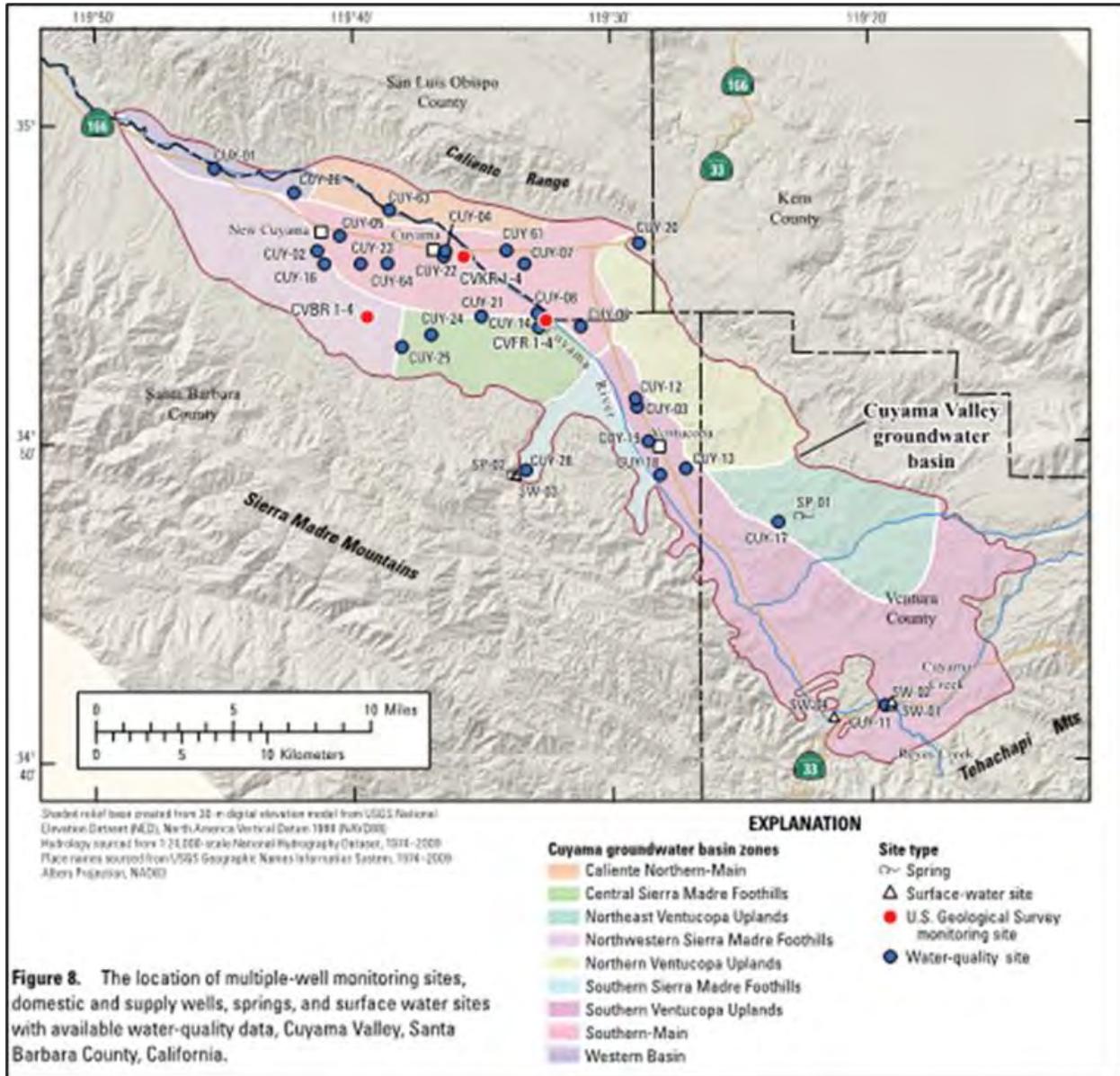


Figure 2-83: Locations of GAMA Sample Locations



USGS 2013c

Figure 2-84: USGS 2013c Water Quality Monitoring Sites



2.1.192.2.10 Interconnected Surface Water Systems

The CBWRM, described in Appendix C, was used to analyze interactions between surface water flows in the Basin. Surface water flows in the model were assigned reaches, five on the Cuyama River, and four for creeks that run off into the river. These reaches are shown in Figure 2-51, with each reach assigned a number. Results of the analysis are shown in Table 2-2 in AF for each reach. Seven years had higher total depletions than 2017, which had a depletion estimate of 5,016 AF. Reach characteristics are listed below:

- ~~**Reach 1 — Alamo Creek:** This reach was gaining in each year analyzed, with an average gain of 380 AF per year. The highest gain of 692 AF was in 1998, and the lowest gain was 192 AF in 2016.~~
- ~~**Reach 2 — Cuyama River, from edge of basin to Alamo Creek:** This reach was losing in each year analyzed, with an average loss of 26 AF. The smallest loss was 1 AF in 2007, and the largest loss was 109 AF in 2005.~~
- ~~**Reach 3 — Cuyama River from Alamo Creek, to Quatal Canyon Creek:** This reach was mostly gaining in each year, and lost in one year. The average of gains and losses was a gain of 931 AF. The highest gain of 2,781 was in 1998, and the loss of 300 AF occurred in 2017.~~
- ~~**Reach 4 — Quatal Canyon Creek:** This reach was losing in each year analyzed, with an average loss of 83 AF. The smallest loss was 1 AF in 2007, and the largest loss was 347 AF in 1998.~~
- ~~**Reach 5 — Cuyama River from Quatal Canyon Creek to Santa Barbara Canyon Creek:** This reach was losing in each year analyzed, with an average loss of 926 AF. The smallest loss was 180 AF in 2013, and the largest loss was 2,394 AF in 2005.~~
- ~~**Reach 6 — Santa Barbara Canyon Creek:** This reach was gaining in each year analyzed, with an average gain of 95 AF per year. The highest gain of 222 AF was in 1999, and the lowest gain was 222 AF in 2016.~~
- ~~**Reach 7 — Cuyama River from Santa Barbara Canyon Creek to Schoolhouse Canyon Creek:** This reach was losing in each year analyzed, with an average loss of 5,218 AF. The smallest loss was 797 AF in 2013, and the largest loss was 16,472 AF in 1998.~~
- ~~**Reach 8 — Schoolhouse Canyon Creek:** This reach was gaining in each year analyzed, with an average gain of 175 AF/year. The highest gain of 249 AF was in 1998, and the lowest gain was 134 AF in 2017.~~
- ~~**Reach 9 — Cuyama River west of Schoolhouse Canyon Creek:** This reach was gaining in each year analyzed, with an average gain of 1,333 AF/year. The highest gain of 2,743 AF was in 1998, and the lowest gain was 750 AF in 2015.~~



Figure 2-61: Assigned Surface Water Flow Reaches



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Table 2-2: Stream Depletion by Reach

Year	Reach-1 (AF)	Reach-2 (AF)	Reach-3 (AF)	Reach-4 (AF)	Reach-5 (AF)	Reach-6 (AF)	Reach-7 (AF)	Reach-8 (AF)	Reach-9 (AF)	Total (AF)
1998	692.9	-100.7	2780.8	-346.8	-2182.5	164	-16471.5	249.3	2742.9	-12471.6
1999	547.1	-4.3	2636.1	-15.1	-561.3	222.1	-3060.8	234.1	2383.5	2381.4
2000	492.6	-19.3	1915.6	-60.8	-973.6	150	-4602.7	218.3	2152.4	-727.5
2001	460.6	-55.1	1300.5	-194.6	-1369.1	134	-7776	197.8	1906.3	-5395.6
2002	376.6	-1.2	1519.8	-2	-268.8	99.3	-1215.9	198.7	1783.1	2489.6
2003	340	-25.8	463.2	-78	-1247.9	75.8	-6156.6	189.6	1320.9	-5118.8
2004	293	-13.5	706.4	-37.2	-711.3	61.6	-3370.3	183.1	1447.5	-1440.7
2005	525.5	-109	668.7	-254.7	-2394	152.8	-14950.5	178	1115.9	-15067.3
2006	583.8	-23	1112.7	-106.3	-1302.3	155.6	-7026.4	172.2	1089.5	-5344.2
2007	455.6	-0.7	1542.1	-0.8	-269.9	114.1	-1327.9	172.3	1328.8	2013.6
2008	426.3	-26.6	797.8	-92.4	-1204.7	103.2	-5902.4	160.6	1105.7	-4632.5
2009	361.8	-8.3	956.6	-33.7	-540.2	77.5	-3191.7	164.2	997.3	-1216.5
2010	347.2	-29.4	294.2	-74.9	-1091.6	72.6	-5843.1	158.2	836	-5330.8
2011	332.3	-48.6	397.4	-191.5	-1518.5	79.5	-7937.3	143.2	899.7	-7843.8
2012	274.1	-7.7	650.6	-28.2	-457.8	60.6	-2720.4	153.9	1091.8	-983.1
2013	244.9	-0.9	768.7	-4.7	-180.2	46.9	-797.2	150.9	1169	1397.4
2014	226.4	-11	183.1	-31.2	-548	37	-2429.6	147.9	971.8	-1453.6
2015	211.9	-7.7	211.7	-16.5	-350.6	30.2	-1968.7	143.9	749.5	-996.3
2016	191.5	-8.6	16.8	-23	-447.1	27.1	-2713	141.1	766.7	-2048.5
2017	208.2	-19.9	-300.4	-67.8	-906	34.5	-4900.3	133.7	801.8	-5016.2
Annual Average	379.6	-26.1	931.1	-83.0	-926.3	94.9	-5218.1	174.6	1333.0	-3340.3



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The ISW section will be developed once guidance documents are available from DWR.

2.1.202.2.11 Groundwater Dependent Ecosystems

A groundwater dependent ecosystem (GDE) is defined by SGMA emergency regulations in Section- 351(m) as referring “to ecological communities or species that depend on groundwater emerging from aquifers or on groundwater occurring near the ground surface.” Section 354.16(g) of the same regulations requires identification of GDEs in the Basin using data available from DWR, or the best available information. GDEs are not mentioned elsewhere in the emergency regulations. Because the Natural Communities Commonly Associated with Groundwater (NCCAG) dataset includes a number of estimates, DWR recommends the verification of NCCAG-identified locations by a licensed biologist.

DWR provided the NCCAG dataset through the SGMA data portal at <https://gis.water.ca.gov/app/NCDataSetViewer/>. The NCCAG dataset was compiled using a set of six pre-existing dataset sources, and is explained in detail at: <https://gis.water.ca.gov/app/NCDataSetViewer/sitedocs/#>. ~~Figure 2-62~~ Figure 2-85 shows the locations of areas identified as NCCAG in the dataset.

A Woodard & Curran licensed wetlands biologist verified the NCCAG dataset using remote sensing techniques supported by in-person field verification. This work is documented in a Technical Memorandum (Appendix D). The analysis was performed by groupings, and the results of analysis at the groupings level is shown in Figure 2-86. Analysis concluded that there were 123 probable GDEs and 275 probable non-GDEs in the Basin, ~~as shown in Figure 2-64.~~

The installation of piezometers

Since the GSP was adopted, the CBGSA has installed 3 new wells in the vicinity of GDEs to measure groundwater depths near GDE locations would be levels and their impact on beneficial users. These are shallow wells, which are often called piezometers. These wells include:

- Opti well 910 is completed to help monitor the health of GDEs, especially in the western portion a depth of 50 feet bgs with a screen interval from 25-45 feet bgs.
- Opti well 911 is completed to a depth of the Basin. During GSP implementation, the CBGSA will solicit the assistance 45 feet bgs with a screen interval from 10-40 feet bgs.
- Opti well 909 is completed to a depth of private landowners in the western portion 90 feet bgs with a screen interval from 50-80 feet bgs.

Figure 2-87 shows the well locations of these new GDE wells. Additionally, this figure shows seven representative monitoring wells identified as wells that monitor groundwater levels near GDEs and have minimum thresholds based on a GDE protection depth as described in Section 5.2.2. These wells were identified because they fall within 2000 feet of potential GDEs, with some exceptions for topography. These representative monitoring wells are Opti wells 2, 114, 568, 830, 832, 833, and 836.



The CBGSA now uses these 10 wells (three new wells and seven existing groundwater level representative monitoring wells) to monitor groundwater levels that help identify potential impacts to groundwater dependent ecosystems. Through these monitoring wells and the results of the fieldwork and analysis conducted by the Basin to help support installation of piezometers, licensed wetlands biologist, the CBGSA no longer relies on the NCAA remote sensing database for estimating or monitoring probable GDE locations.



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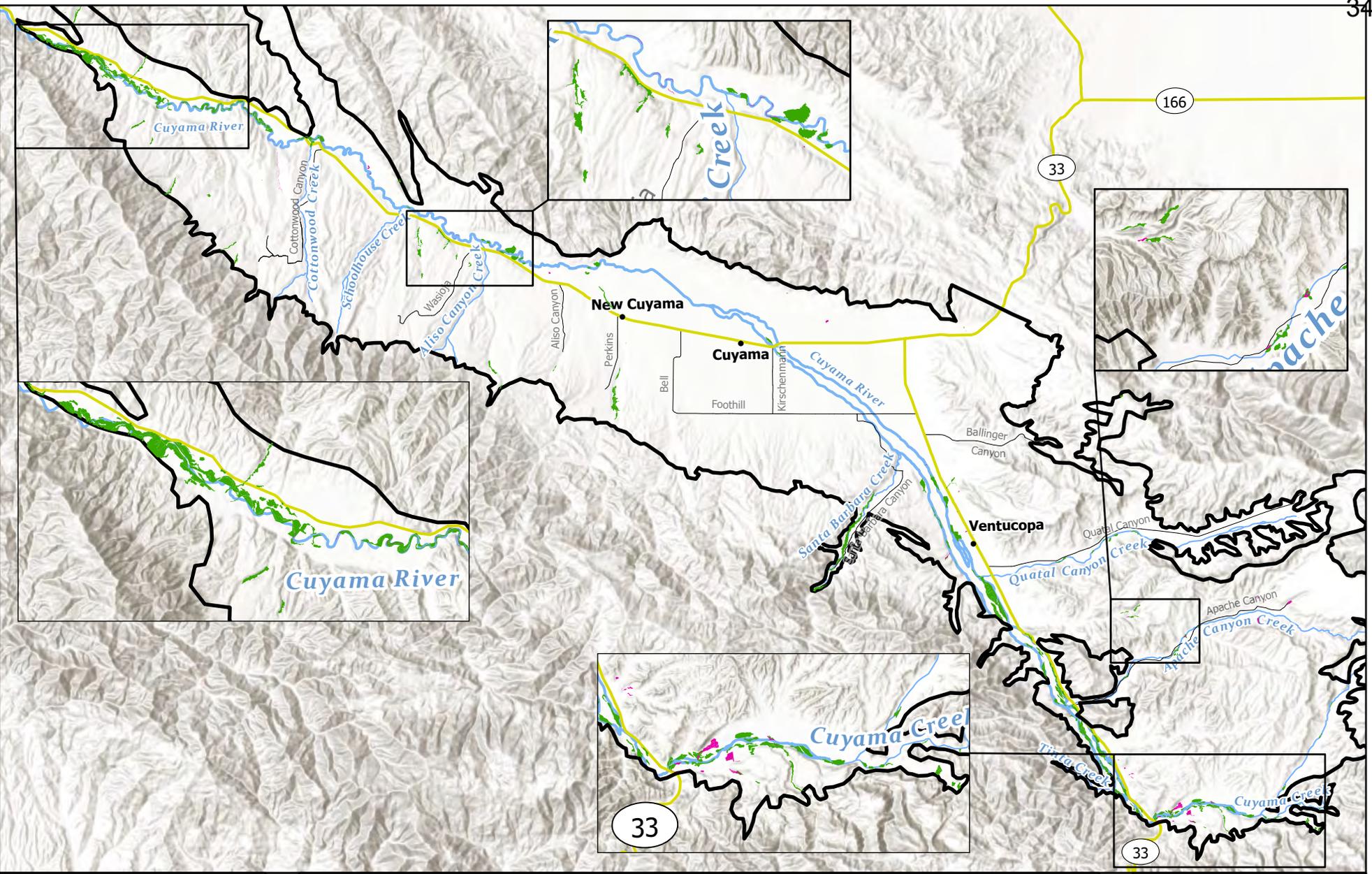


Figure 2-85: Potential GDEs Identified
 2018 i02 NCCAG
 Cuyama Valley Groundwater Basin

Legend	GDE Vegetation	Local Road	Cuyama River
	GDE Wetland	Town	Cuyama Basin
	Highway	Creek	

0 1.25 2.5 5 Miles

Map Created: March 2024

Third Party GIS Disclaimer: This map is for reference and graphical purposes only and should not be relied upon by third parties for any legal decisions. Any reliance upon the map or data contained herein shall be at the users' sole risk. **Data sources: CA DWR, Esri, TNC, USGS**

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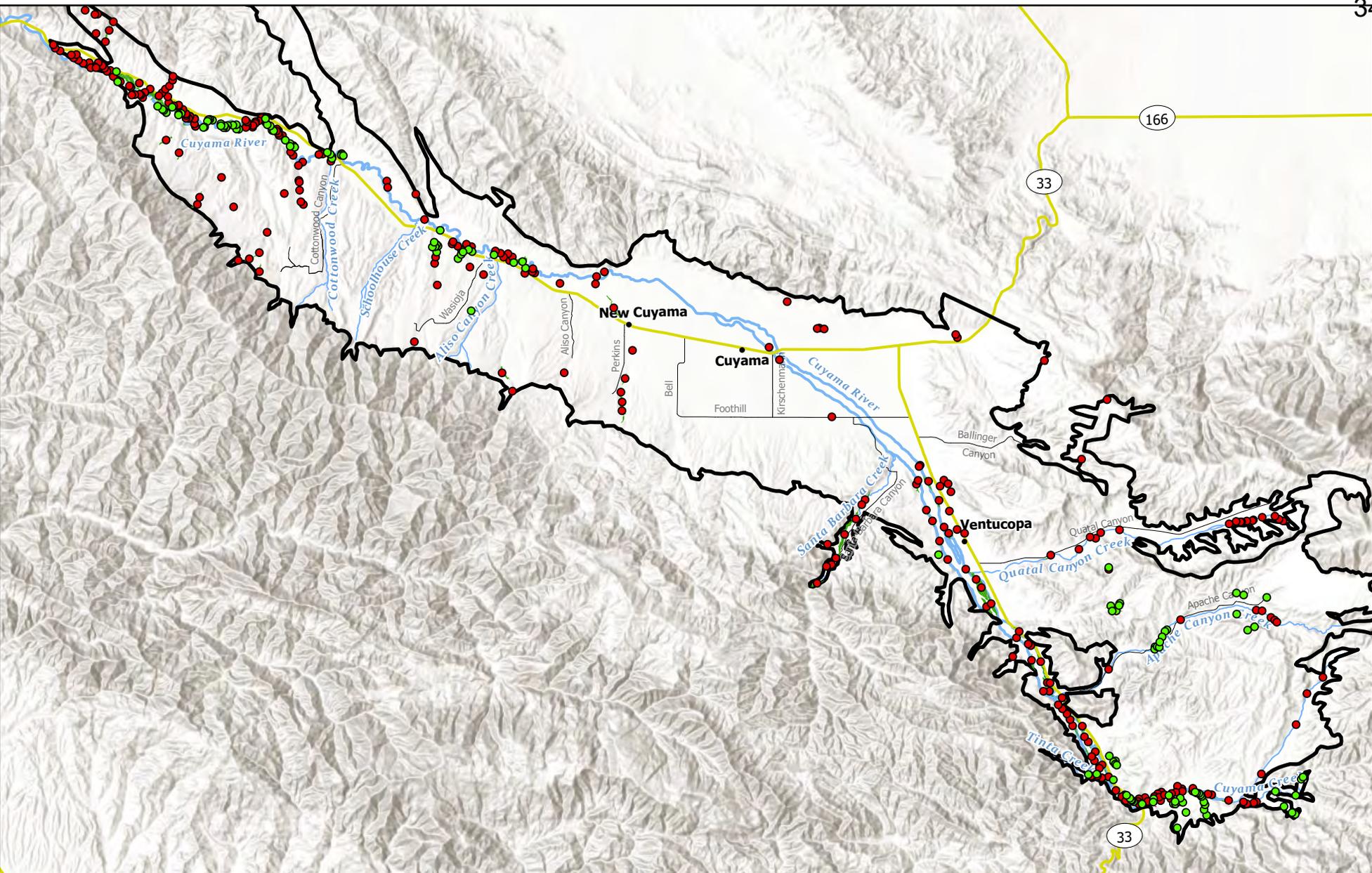


Figure 2-86: GDE Ground Truthing Analysis Results

Cuyama Valley Groundwater Basin

Legend

- Probable GDEs
- Probable Non-GDEs
- GDE Vegetation
- GDE Wetland
- Highway
- Local Road
- Town
- Creek
- Cuyama River
- Cuyama Basin



0 1.25 2.5 5 Miles

Map Created: March 2024

Third Party GIS Disclaimer: This map is for reference and graphical purposes only and should not be relied upon by third parties for any legal decisions. Any reliance upon the map or data contained herein shall be at the users' sole risk. **Data sources: CA DWR, Esri, TNC, USGS**

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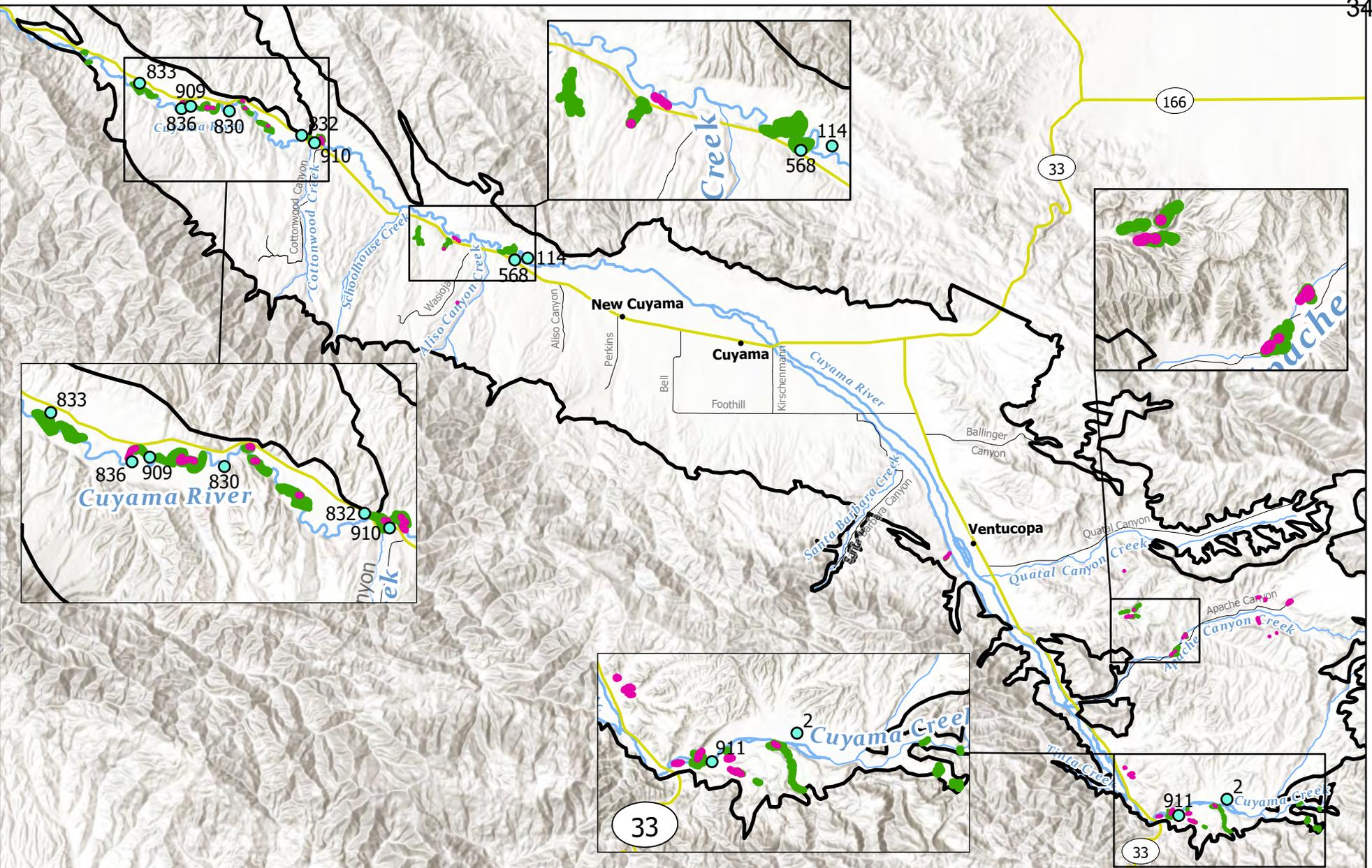


Figure 2-87: Probable GDEs Based on Analysis

Cuyama Valley Groundwater Basin

Legend

- Monitoring Well
- GDE Vegetation*
- GDE Wetland*
- Highway
- Local Road
- Town
- Creek
- Cuyama River
- Cuyama Basin

*GDE Vegetation and Wetland boundaries have been buffered 300 feet to improve visibility.



0 1.25 2.5 5 Miles

Map Created: June 2024

Third Party GIS Disclaimer: This map is for reference and graphical purposes only and should not be relied upon by third parties for any legal decisions. Any reliance upon the map or data contained herein shall be at the users' sole risk. **Data sources: CA DWR, Esri, TNC, USGS**



2.1.212.12 Data Gaps

Groundwater conditions data gaps were identified during the development of this GSP, and when additional questions were asked by stakeholders during GSP development. Data gaps are summarized below. Since that time, many of these data gaps have been addressed. This section summarizes the data gaps that were described in the GSP and subsequent CBGSA actions to address them.

- Due to sporadic monitoring by a variety of monitoring entities, a long period of record of monitoring for groundwater levels does not exist in many areas in the Basin.
 - The CBGSA has implemented a quarterly monitoring program for the measurement of groundwater levels throughout the Basin. This program allows the CBGSA to have consistent and regular monitoring going forward. This data gap has been addressed to the extent possible. The monitoring program is described in Chapter 4. Additionally, the CBGSA has reclassified the lack of historical data as a data limitation, but not a data gap. As outlined in the SGMA regulations, a “data gap” must be addressed by a GSA. However, historical data is out of the CBGSA’s ability to rectify, and therefore, it is inappropriate to label a lack of historical data as such
- The depths where arsenic occurs are not known, making setting sustainability thresholds for arsenic not feasible.
 - There is limited information on depth and location of elevated arsenic in the Basin. The one public water supply well owned and operated by CCSD, which has levels of arsenic above the EPA standards, is currently in the process of being replaced with a new in a location where arsenic concentrations are much lower. The CCSD is also looking at implementing treatment options for the current municipal water supply well. Through these changes, arsenic is not impacting beneficial uses or users within the Basin and therefore the CBGSA is not setting sustainability thresholds for arsenic.
- The Cuyama River is not gaged inside the Cuyama Basin, so flows of the river in the Basin have been estimated based on available precipitation data and flow measurements at downstream gages.
 - The CBGSA has installed a new stream gage on the Cuyama River and worked to re-activate an additional gage located within the Basin. Data is currently being collected by the USGS and monitored by the CBGSA.
- Subsidence in the central portion of the Basin where groundwater levels are lowest is not monitored nor understood.



- The state provides InSAR data that can now be used to monitor subsidence within the Basin. Additionally, there are several CGPS stations in and around the Basin, with one in the central portion near the Cuyama High School which was verified in 2024 as active and accurate. After additional analysis during GSP implementation, results indicated that there were no impacts to critical infrastructure in the Basin due to subsidence, nor impact to any other beneficial uses or users of groundwater in the Basin. While additional monitoring in the central portion of the Basin is expected to occur in the future, the CBGSA does not see an immediate need for the installation of additional subsidence monitoring stations.
- Vertical gradients in the majority of the Basin are not understood due to the lack of wells with completions of different depths ~~near~~ located near each other-.
 - Salinity in groundwater in the BasinAs described in Section 2.2.3, DWR installed multi-completion (or nested) wells at three locations and the CBGSA has installed multi-completion wells at six additional locations throughout the Basin. These nested wells are completed at different depths to evaluate vertical gradients. Some of the USGS wells have been equipped with pressure transducers to automatically record groundwater levels on a programmed time interval. Readings are downloaded quarterly. The CBGSA also plans to equip the new multi-completion wells that have been drilled with grant funding from DWR with transducers. Other wells are monitored manually at a quarterly frequency. These wells allow the CBGSA to document and monitor changes in vertical gradients at multiple locations.
- Groundwater salinity in the Basin has a number of natural sources, but these sources are not discretely identified.
 - The CCSD has installed a new well that monitors TDS quarterly and the CBGSA has measured TDS in a number of wells as part of its fault investigation, as described in Section 2.1.5. Natural sources of TDS are still not discretely identified throughout the Basin, but additional work has been done to monitor salinity in groundwater. While additional data may be helpful, the CBGSA has determined through its data analysis during GSP implementation that regulating TDS and setting thresholds for TDS falls outside of the GSA's authority.
- GDEs could be evaluated in greater detail.
 - Section 2.2.9 describes the groundwater dependent ecosystem studies that were completed historically utilizing the NCCAG database. Since that time, the CBGSA has installed three new wells (piezometers) and monitored an additional seven groundwater level representative wells at locations identified as at or near groundwater dependent ecosystems. These 10 wells



help the CBGSA understand groundwater levels near the identified potential GDEs throughout the Basin and their potential impact on GDEs.

- Faults are not well understood with regard to the degree they represent a barrier to flow and at what depth below the surface.
 - The CBGSA completed an investigation of the Russell and Santa Barbara Canyon Faults/fault zones as described in Sections 2.1.5. These are the two major faults identified by USGS as impacting groundwater flow. The Santa Barbara Canyon Fault zone includes an unnamed thrust fault and together they juxtapose formations with different water-bearing capacity that results in a significant difference in groundwater elevation across the fault zone. The fault zone is thought to restrict groundwater flow but is not literally a barrier to groundwater flow. Groundwater quality to the south and north of the fault zone is very similar. The Russell Fault zone does not appear to restrict groundwater flow. Depth to groundwater is consistent to the east and west of the fault zone. While the impact on groundwater flow is not fully understood for the Santa Barbara Canyon fault zone in particular, a significant investigation was completed to better understand impacts of both faults. The CBGSA may consider an additional investigation in the future. .
- The size of the Basin regarding groundwater in storage is not well understood.
 - The CBGSA has undertaken a complete update of the water resources model, which uses groundwater levels to predict storage. Significant progress has been made in identifying the storage capacity of each layer and calibrating it to current groundwater level trends. This analysis has been addressed to the extent possible, given the data available in the Basin.
- Information about many of the wells in the Basin is incomplete, and additional information is needed regarding well depths, perforation intervals and current status.

~~As the CBGSA develops its monitoring networks and implements the GSP, these data gaps will be revisited and re-evaluated for importance during the five-year update of the GSP.~~

- Several data collection efforts by the CBGSA have yielded additional information about wells within the Basin. The CBGSA conducted a well survey in 2021 on its groundwater level representative network yielding more accurate and updated construction and survey data such as ground surface elevations and reference point elevations. Additionally, the CBGSA has sent out surveys and worked with Basin stakeholders and landowners to get as much construction information as possible and categorize all wells in the Basin as either inactive or active to use in all future analyses. This information has been updated in the CBGSA's online Opti DMS.



2.22.3 Basin Settings: Water Budget

This section describes the historical, current and projected water budgets for the Basin. As defined by SGMA regulations, this section quantifies the following:

- Total surface water entering and leaving a basin by water source type
- Inflow to the groundwater system by water source type
- Outflows from the groundwater system by water use sector
- The change in the annual volume of groundwater in storage between seasonal high conditions
- If overdraft conditions occur, a quantification of overdraft over a period of years during which water year and water supply conditions approximate average conditions
- The water year type associated with the annual supply, demand, and change in groundwater stored
- An estimate of sustainable yield for the Basin

2.2.12.3.1 Useful Terms

This section of Chapter 2 describe components of water budgets in the Basin. The terms listed here are intended as a guide for readers, and are not a definitive definition of any term.

- **Precipitation** – Precipitation is the volume of rainfall that travels from the soil zone to the unsaturated (vadose) zone of the groundwater aquifer.
- **Applied Water** – Applied water is the volume of water that is applied by an irrigation system to assist crop and pasture growth.
- **Evapotranspiration** – Evapotranspiration is the volume of water entering the atmospheric system through the combined process of evaporation from soil and plant surfaces and transpiration from plants.
- **Domestic Water Use** – Domestic water use is the volume of water used for indoor household purposes, including potable and non-potable water provided to households by a public water supplier (domestic deliveries) and self-supplied water.
- **Deep Percolation** – Deep percolation is the volume of applied water and precipitation that travels from the soil zone to the unsaturated (vadose) zone of the groundwater aquifer.
- **Runoff** – Runoff is the volume of water flowing into the surface water system in a water budget zone from precipitation over the land surface.
- **Stream Seepage** – Stream seepage is the volume of water entering the groundwater system from rivers and streams.

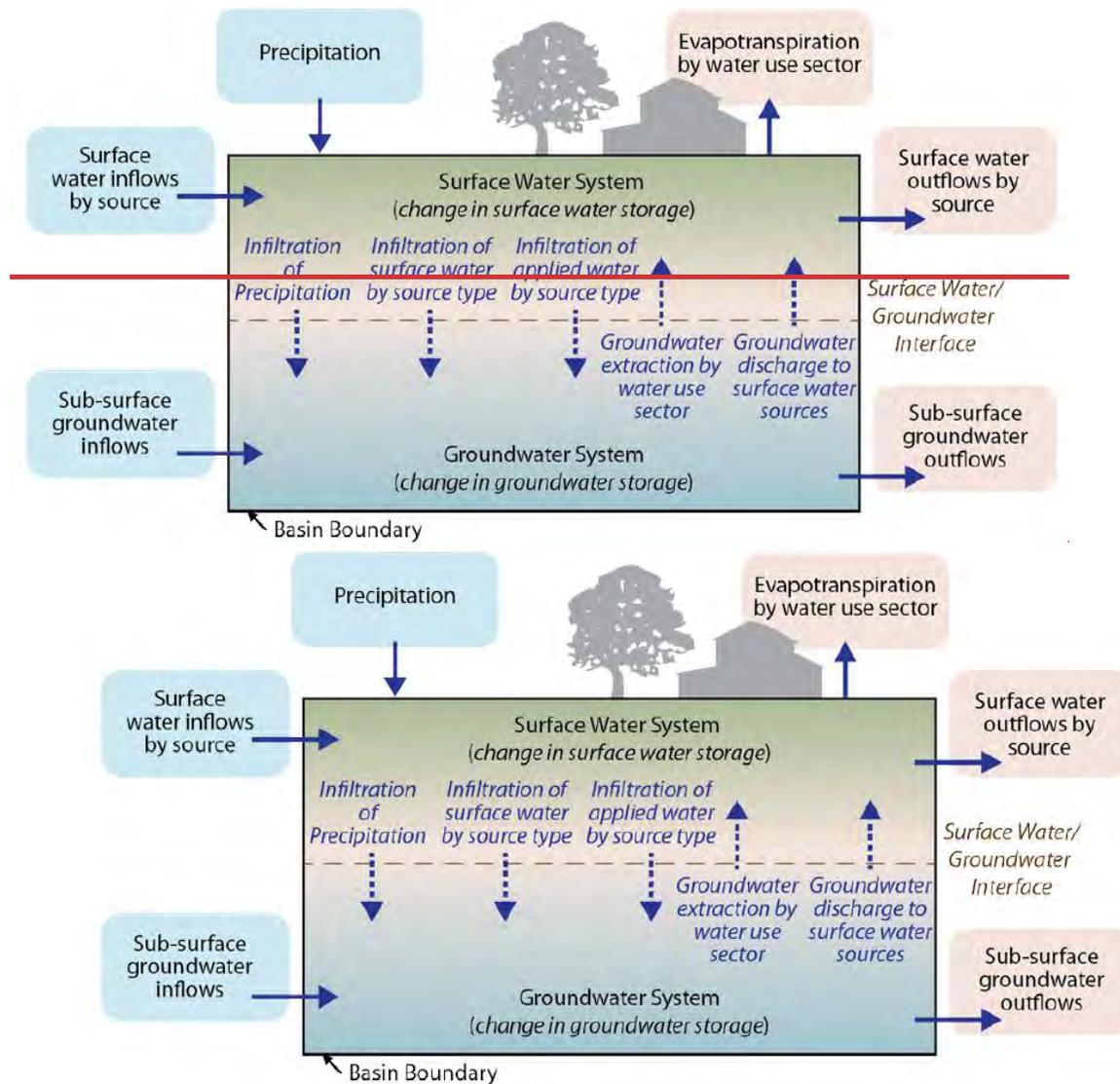


- **Subsurface Inflow** – Subsurface inflow is the volume of water entering as groundwater into the groundwater system through its subsurface boundaries.
- **Change in Storage** – Change in storage is the net change in the volume of groundwater stored in the underlying aquifer.
- **Overdraft** – Overdraft is the long-term negative net change in volume of groundwater stored in the underlying aquifer.
- **Sustainable Yield** – Sustainable yield is the average annual groundwater pumping that can be sustained without any long-term negative net change in groundwater storage.

2.2.22.3.2 Water Budget Information

This water budget was developed to provide a quantitative accounting of water entering and leaving the Basin. Water entering the Basin includes water entering at the surface and entering through the subsurface. Similarly, water leaving the Basin leaves at the surface and through the subsurface. Water enters and leaves naturally, such as through precipitation and streamflow, and through human activities, such as pumping and recharge from irrigation. Figure 2-88 presents a vertical slice through the land surface and aquifer to summarize the water balance components used during analysis.

The values presented in the water budget provide information about historical, current, and projected conditions as they relate to hydrology, water demand, water supply, land use, population, climate change, sea-level rise (which is not applicable in the Basin), groundwater and surface water interaction, and subsurface groundwater flow. This information can help manage groundwater on the Basin by identifying the scale of different uses, highlighting potential risks, and identifying potential opportunities to improve water supply conditions, among other elements.



(Source: DWR)

Figure 2-88: Generalized Water Budget Diagram

Water budgets can be developed on different spatial scales. In agricultural use, water budgets may be limited to the root zone in soil, improving irrigation techniques by estimating the inflows and outflows of water from the upper portion of the soil accessible to plants through their roots. In a strictly groundwater study, water budgets may be limited to water flow in the subsurface, helping analysts understand how water flows beneath the surface. Global climate models simulate water budgets that incorporate atmospheric water, allowing for simulation of climate change conditions. In this document, consistent



with the SGMA regulations, water budgets investigate the combined surface water and groundwater system in the Basin.

Water budgets can also be developed at different temporal scales. Daily water budgets may be used to demonstrate how evaporation and transpiration increase during the day and decrease at night. Monthly water budgets may be used to demonstrate how groundwater pumping increases in the dry, hot summer months and decreases in the cool, wet winter months. In this section, and consistent with SGMA regulations, this water budget focuses on the full water year (i.e., the 12 months spanning from October of the previous year to September of the current year), with some consideration to monthly variability.

The SGMA regulations require that annual water budgets are based on three different conditions: historical, current, and projected. Water budgets are developed to capture typical conditions during these time periods. Typical conditions are developed through averaging over hydrologic conditions that incorporate droughts, wet periods, and normal periods. By incorporating these varied conditions in the budgets, an analysis of the water system under certain hydrologic conditions such as drought can be performed along with an analysis of long-term average conditions. Information is provided below about the hydrology dataset used to identify time periods for budget analysis, the use of the CBWRM and associated data in water budget development, and about budget estimates.

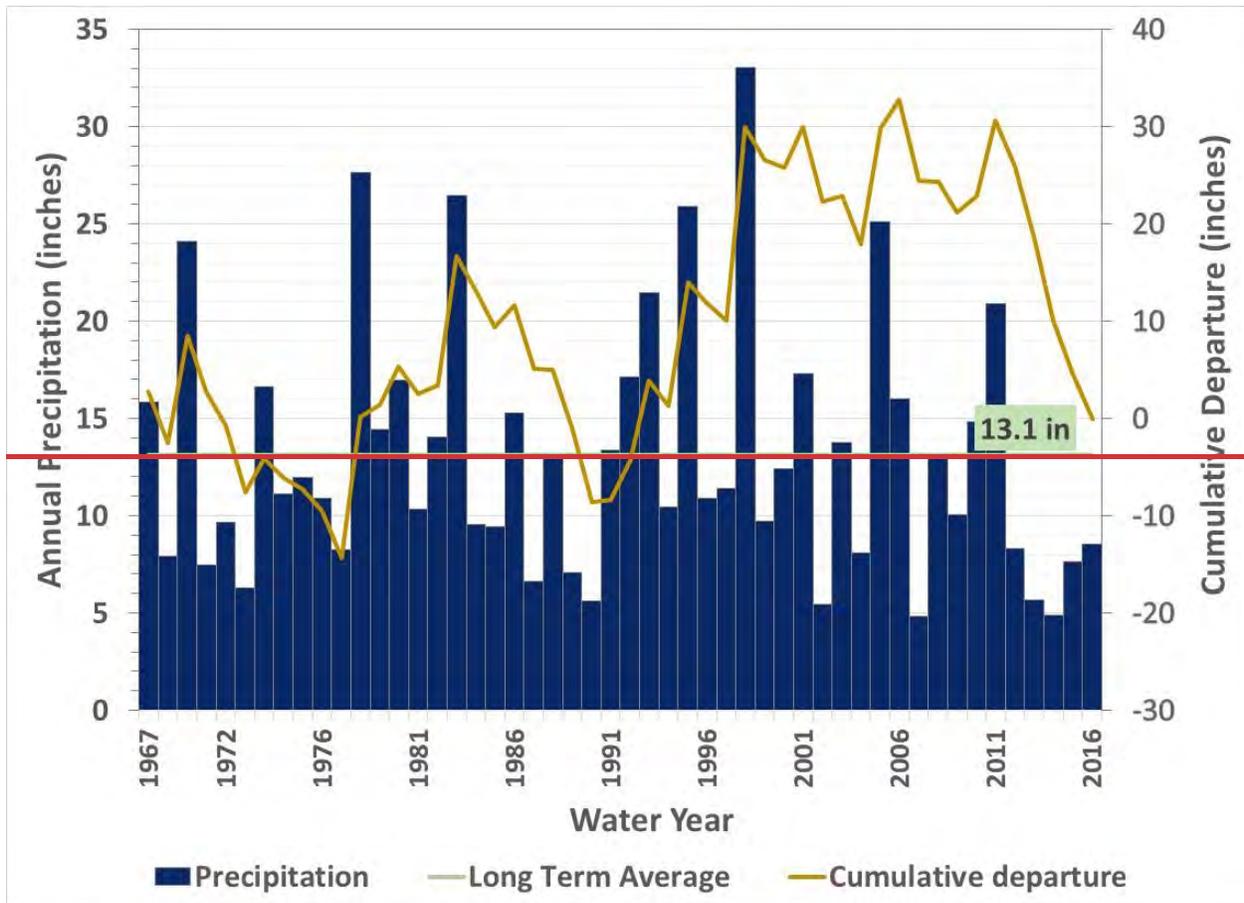
2.2.32.3 Identification of Hydrologic Periods

Hydrologic periods were selected to meet the needs of developing historical, current, and projected water budgets. The SGMA regulations require that the projected water budget reflect 50 years of historical hydrology to reflect long-term average hydrologic conditions. Historical precipitation data for the Basin was used to identify hydrologic periods that would provide a representation of wet and dry periods and long-term average conditions needed for budget analyses. Analysis of a long-term historical period time provides information that is expected to be representative of long-term future conditions.

Figure 2-89 shows annual precipitation in the Basin for water years 1968 to 2017~~23~~. The chart includes bars displaying annual precipitation for each water year and a horizontal line representing the mean precipitation of 13.40 inches. Rainfall data for the Basin are derived from the Parameter-Elevation Regressions on Independent Slopes Model (PRISM) dataset of DWR's California Simulation of Evapotranspiration of Applied Water (CALSIMETAW) model. Analysts identified periods with a balance of wet and dry periods using the cumulative departure from mean precipitation method. Under this method, the long-term average precipitation is subtracted from annual precipitation in each water year to develop the departure from mean precipitation for each water year. Wet years have a positive departure and dry years have a negative departure; a year with exactly average precipitation would have zero departure. Starting at the first year analyzed, departures are added cumulatively for each year. So, if the departure for Year 1 is 5 inches and the departure for Year 2 is -2 inches, the cumulative departure would be 5 inches for Year 1 and 3 inches (i.e., 5 plus -2) for Year 2.



The cumulative departure of the spatially averaged rainfall in the Basin is shown on Figure 2-89. The cumulative departure from mean precipitation is based on ~~these data sets~~ the PRISM dataset, and is displayed as a line that starts at zero and highlights wet periods with upward slopes and dry periods with downward slopes. More severe events are shown by steeper slopes and greater changes. The period from 2013 to 2014 illustrates a short period with dramatically dry conditions (i.e., a 16-inch decline in cumulative departure over ~~two years~~ four years). The decline in cumulative departure continued in the later years including 2022. The wet period in 2023 brings the cumulative departure back to the zero line.



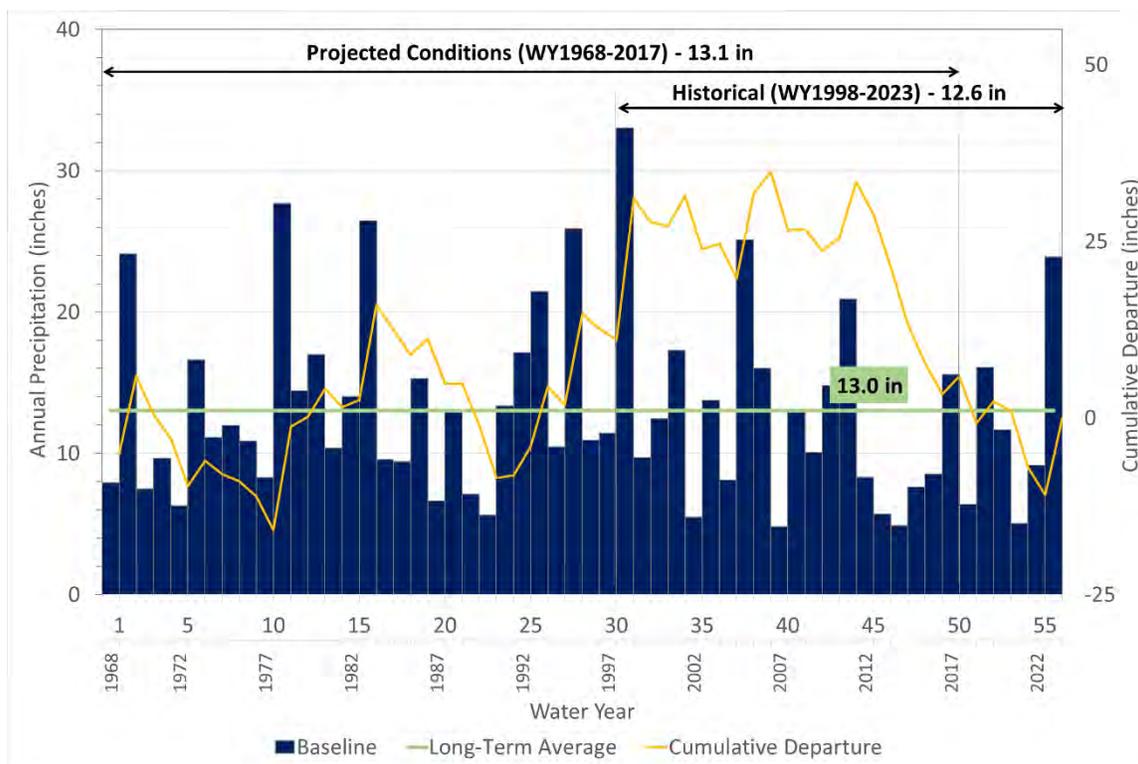


Figure 2-89: 50-Year Historical Precipitation and Cumulative Departure from Mean Precipitation

2.2.42.3.4 CBWRM Model Use and Associated Data for Water Budget Development

Water budgets were developed using the CBWRM model, which is a fully integrated surface and groundwater flow model covering the Basin. The CBWRM was developed in consultation with members of the Technical Forum, which includes technical staff and consultants representing a range of public and private entities in the Basin. Participants on the Technical Forum are shown in Chapter 1 Section 1.3. The Technical Forum held 14 monthly conference calls over the course of model development- [for the 2020 GSP. Additional Technical Forum calls have occurred as the model has been updated for the 2025 GSP Update.](#) These calls provided opportunities for Technical Forum members to review and comment on all major aspects of model development.

The CBWRM integrates the groundwater aquifer with the surface hydrologic system and land surface processes and operations. The CBWRM was calibrated for the hydrologic period of October 1995 to September 2015~~23~~ by comparing simulated evapotranspiration, groundwater levels, and streamflow records with historical observed records. Development of the model involved study and analysis of



hydrogeologic conditions, agricultural and urban water demands, agricultural and urban water supplies, and an evaluation of regional water quality conditions.

The ~~model~~updated model used for the 2025 GSP Update was developed based on the best available data and information as of ~~June 2018~~September 2023. This version of the model includes substantial data changes compared to the version that was released in 2020, reflecting additional data and information that was not available at that time. The data changes include the following:

- Updated geologic representation developed using:
 - The results of a fault investigation conducted by the CBGSA for the Santa Barbara Canyon and Russell faults
 - Airborne Electromagnetic (AEM) survey data collected by the California Department of Water Resources
 - Well log data from new monitoring wells installed in the Basin
- Updated pumping well locations using data provided by landowner surveys
- Updated land use using data and designations of non-irrigated land areas based on information provided by landowners
- Updated evapotranspiration estimates calibrated to better match metered reporting data provided by landowners for 2022 and 2023
- Calibration period extended to incorporate groundwater level measurements taken by the GSA's monitoring program up through WY 2023

It is expected that the model will continue to be refined in the future as improved and updated monitoring information becomes available for the Basin. These refinements may result in changes in the estimated water budgets described in this section.

Additional information on the development and calibration of the CBWRM is included in Appendix C.

CBWRM simulations were developed to allow for the estimation of water budgets. Model simulations were used to develop the water budgets for historical, current, and projected conditions, which are discussed in detail below:

- The **historical water budget** was based on a simulation of historical conditions in the Basin.
- The **current water budget** was based on a simulation of current (~~2017~~2023) land and water use over historical hydrologic conditions, assuming no other changes in population, water demands, land use, or other conditions.



- The **projected water budget** was based on a simulation of future land and water use over the historical hydrologic conditions. Since future land and water use in the Cuyama Basin is assumed to be the same as current conditions, the projected water budget is the same as the current water budget.

Water Budget Definitions and Assumptions

Definitions and assumptions for the historical, current, and projected water budgets are provided below.

~~Table 2-2~~ Table 2-3 summarizes these assumptions.

Historical Water Budget

The historical water budget is intended to evaluate availability and reliability of past surface water supply deliveries, aquifer response to water supply, and demand trends relative to water year type. The hydrologic period of 1998 through 20~~17~~23 was selected for the historical water budget to provide a period of representative hydrology while capturing recent Basin operations. The period 1998 through 20~~17~~23 has an average annual precipitation of 12.~~26~~26 inches, ~~nearly the same as~~0.4 inches less than the long-term average of 13.~~40~~40 inches and includes the ~~recent~~ 2012 to 2017 drought, the wet years of 1998, 2005, and 20~~05~~23, and periods of normal precipitation.

Current and Projected Water Budget

While a budget indicative of current conditions could be developed using the historical calibration model, like the historical water budget, such an analysis would be difficult to interpret due to the extreme weather conditions of the past several years and its effect on local agricultural operations. Instead, to analyze the effects of current land and water use on groundwater conditions, and to accurately estimate current inflows and outflows for the Basin, a current and projected conditions baseline scenario was developed using the IWFEM. This baseline uses current land and water use conditions approximating year 20~~17~~23 conditions with a historical precipitation sequence and a year-to-year variance in cropping patterns that matches the historical variability. Because there is no basis to assume any changes in Basin population or land use in the future as compared to current conditions (in the absence of projects or actions), a single baseline has been developed that reflects both current and projected conditions.

The current and projected conditions baseline includes the following conditions:

- Hydrologic period:
 - Water years 1968 to 2017 (i.e., a 50-year hydrology)
- Precipitation is based on:
 - PRISM dataset for the period from 1968 to 2017
- Land use is based on:



- ~~Land use estimates developed by DWR and the CBGSA using remote sensing data~~
- Land use information for historical years was developed from private landowner provided by private landowners data, and the remote sensing data provided by DWR and the CBGSA.
- Permanent crop acreage from 2023 was maintained, while the annual crop pattern was varied from year-to-year similar to the historical data.

- Domestic water use is based on:
 - Current population estimates
 - Cuyama Community Services District delivery records
- Agricultural water demand is based on:
 - The IWFDM Demand Calculator in conjunction with historical remote sensing technology, Mapping Evapotranspiration at High Resolution and Internalized Calibration (METRIC)

Table 2-3: Summary of Groundwater Budget Assumptions

Water Budget Criteria	Historical	Current and Projected
Scenario	Historical simulation	Current and projected conditions baseline
Hydrologic Years	Water years 1998 to 2017	Water years 1968 to 2017
Development	Historical	Current
Agricultural Demand	Historical land use	Current conditions
Domestic Use	Historical records	Current conditions

Projected Water Budget with Climate Change

A second projected level water budget has been developed that incorporates the projected effects of climate change. The projected conditions with climate change baseline are the same as the current and projected conditions baseline, except that adjustments have been made to estimated precipitation and agricultural and native vegetation evapotranspiration during the 50-year hydrologic period. The estimated precipitation and evapotranspiration from 1968 to 2017 were adjusted using perturbation factors developed from the Central Tendency climate scenario data provided by DWR. On average, the perturbation factors for this scenario result in an increase in precipitation of about 1.4 percent and in an increase in crop evapotranspiration of about 5.4 percent. Additional information about how precipitation and evapotranspiration were adjusted for climate change can be found in the IWFDM documentation in Appendix C.



Water Budget Estimates

Land surface and groundwater budgets are reported for the historical period, for current and projected conditions, and for projected conditions with climate change.

The following components are included in the land surface water budget:

- Inflows:
 - Precipitation
 - Applied Water
- Outflows:
 - Evapotranspiration
 - Agriculture
 - Native vegetation
 - Domestic water use
 - Deep percolation
 - From precipitation
 - From applied water
 - Runoff
 - Stream seepage to groundwater
 - Flow out of Basin

The following components are included in the groundwater budget:

- Inflows:
 - Deep percolation
 - Stream seepage
 - Subsurface inflow
- Outflows:
 - Groundwater pumping
- Change in storage (where negative values reflect overdraft conditions)

The estimated average annual water budgets are provided in Tables 2-4 and 2-5 for the historical period and for current and projected conditions. The following sections provide additional information regarding each water budget.



Table 2-4: Average Annual Land Surface Water Budget

Component	Historical Water Volume ^a (AFY)	Current and Projected Water Volume ^b (AFY)	Projected Water Volume With Climate Change ^b (AFY)
Inflows			
Precipitation	226,000 <u>223,600</u>	230,000 <u>231,100</u>	233,000 <u>236,400</u>
Applied water	58,000 <u>41,600</u>	59,000 <u>38,500</u>	63,000 <u>41,800</u>
Total Inflow	285,000 <u>265,200</u>	289,000 <u>269,600</u>	296,000 <u>278,200</u>
Outflows			
Evapotranspiration			
___ Agriculture	58,000 <u>45,700</u>	63,000 <u>47,900</u>	66,000 <u>51,100</u>
___ Native vegetation	167,000 <u>169,700</u>	174,000 <u>178,200</u>	174,000 <u>180,200</u>
Domestic water use	3 <u>400</u>	400	400
Deep Percolation			
Precipitation	18,000 <u>4,500</u>	15,000 <u>5,300</u>	155,000
Applied water	40,000 <u>13,600</u>	41,000 <u>10,800</u>	11,100 <u>0</u>
Runoff	32,000 <u>31,500</u>	26,900 <u>0</u>	29,000 <u>30,200</u>
Total Outflow	285,000 <u>265,400</u>	289,000 <u>269,500</u>	296 <u>278,000</u>
Notes:			
AFY = acre-feet per year			
^a From water years 1998 to 20 <u>17</u> 23			
^b Based on 50-year hydrology			



Table 2-5: Average Annual Groundwater Budget

Component	Historical Water Volume ^a (AFY)	Current and Projected Water Volume ^b (AFY)	Projected Water Volume with Climate Change ^b (AFY)
Inflows			
Deep percolation	28,000 <u>18,100</u>	25,000 <u>16,100</u>	26,000 <u>16,100</u>
Stream seepage	3,900 <u>0</u>	5,400 <u>0</u>	6,000 <u>5,900</u>
Subsurface inflow	5,000 <u>2,800</u>	5,000 <u>2,800</u>	5,000 <u>3,200</u>
Total Inflow	36,000 <u>24,800</u>	35,000 <u>24,300</u>	37,000 <u>25,200</u>
Outflows			
Groundwater pumping	59,000 <u>41,700</u>	60,000 <u>38,500</u>	64,000 <u>41,800</u>
Total Outflow	59,000 <u>41,700</u>	60,000 <u>38,500</u>	64,000 <u>41,800</u>
Change in Storage	(23,000) <u>16,900</u>	(25,000) <u>13,800</u>	(27,000) <u>15,900</u>
Notes: AFY = acre-feet per year ^a From water years 1998 to 20 <u>17</u> 23 ^b Based on 50-year hydrology			

2.2.52.3.5 Historical Water Budget

The historical water budget is a quantitative evaluation of the historical surface and groundwater supply covering the ~~2026~~-year period from 1998 to 2017~~23~~. This period was selected as the representative hydrologic period to calibrate and reduce the uncertainty of the IWFM. Proper analysis and calibration of water budgets within IWFM ensures the hydrologic characteristics of the groundwater basin are accurately represented. The goal of the water budget analysis is to characterize the supply and demand, while summarizing the hydrologic flow within the Basin, including the movement of all primary sources of water such as rainfall, irrigation, streamflow, and subsurface flows.

Figure 2-67 Figure 2-90 summarizes the average annual historical land surface inflows and outflows in the Basin. Figure 2-91 shows the annual time series of historical land surface inflows and outflows.

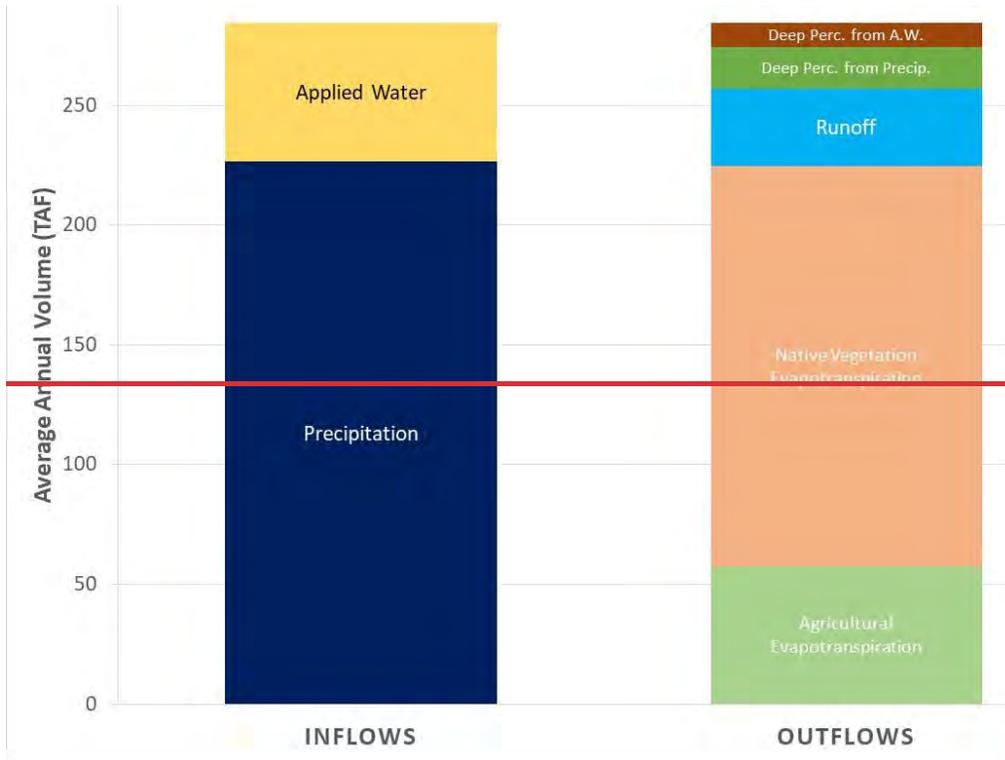
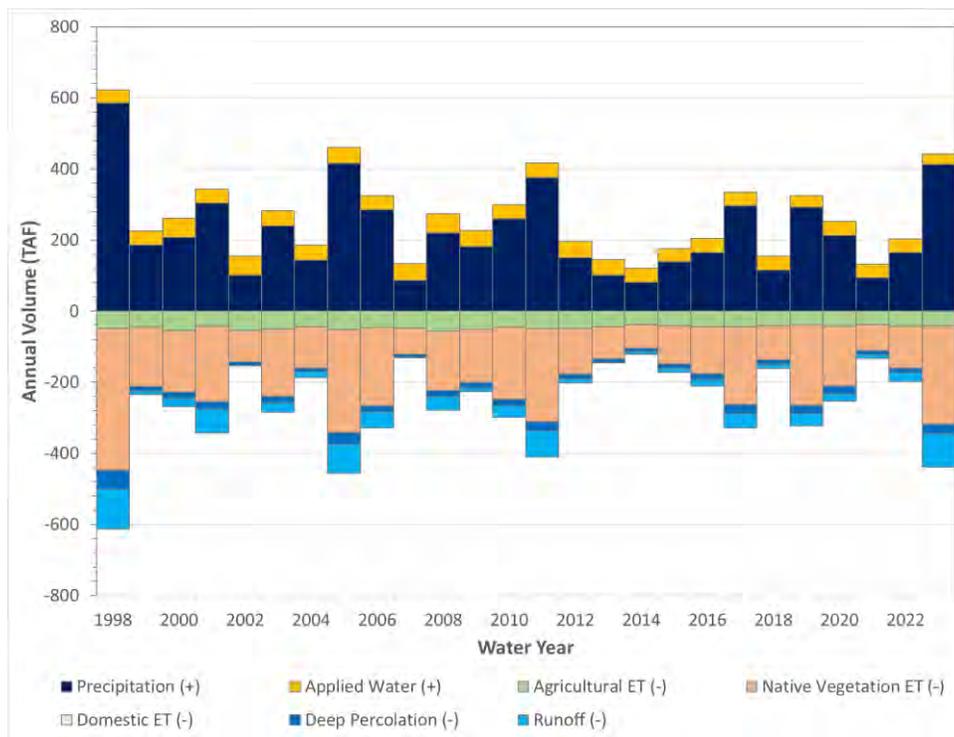




Figure 2-90: Historical Average Annual Land Surface Water Budget



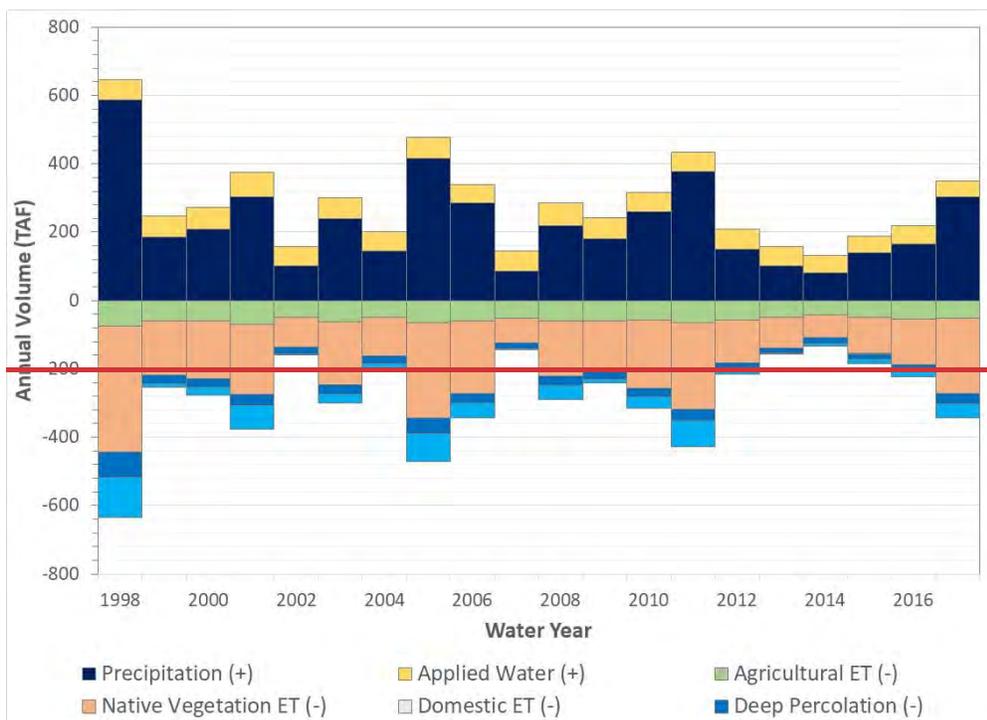


Figure 2-91: Historical Land Surface Water Budget Annual Time Series

The Basin experiences about 286,500 AF of land surface inflows each year, of which 226,300 AF is from precipitation and the remainder is from applied water. About 225,216,000 acre-feet per year (AFY) is consumed as evapotranspiration or domestic use, with the remainder either recharging the groundwater aquifer as deep percolation or stream seepage or leaving the Basin as river flow.

The annual time series shows large year-to-year variability in the availability of water, with land surface inflows ranging from a low of about 1320,000 AF to a high of 645,622,000 AF. These year-to-year changes in inflows result in corresponding differences in outflows, with total annual agricultural, native vegetation and domestic evapotranspiration ranging from 1084,000 to 444,342,000 AF.

~~Figure 2-69~~ Figure 2-92 summarizes the average annual historical groundwater inflows and outflows in the Basin. ~~Figure 2-70~~ Figure 2-93 shows the annual time series of historical groundwater inflows and outflows. The Basin average annual historical groundwater budget has greater outflows than inflows, leading to a projected average annual decrease in groundwater storage (i.e., overdraft) of 23,000 ~~AF~~-17,000 AF. Note that with metered pumping data now available to calibrate the CBWRM the estimated pumping and reduction in storage are both now lower than what was estimated by the CBWRM in the 2020 GSP. Accounting for potential uncertainties in numerical model parameters (as described in Appendix C), the projected average annual overdraft could range from 215,000 to 2619,000 AF. The



groundwater storage decreases consistently over time, despite year-to-year variability in groundwater inflows.



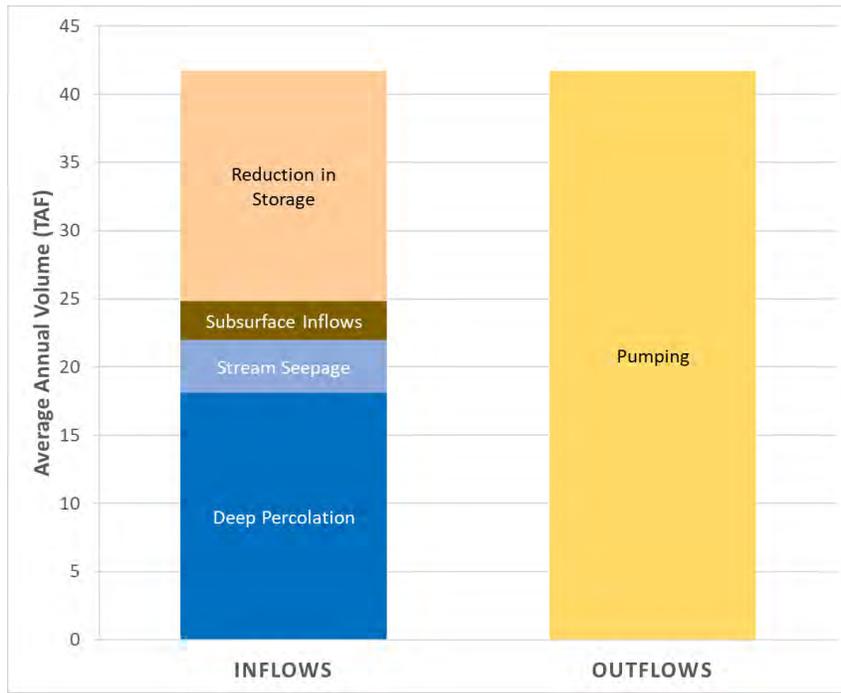
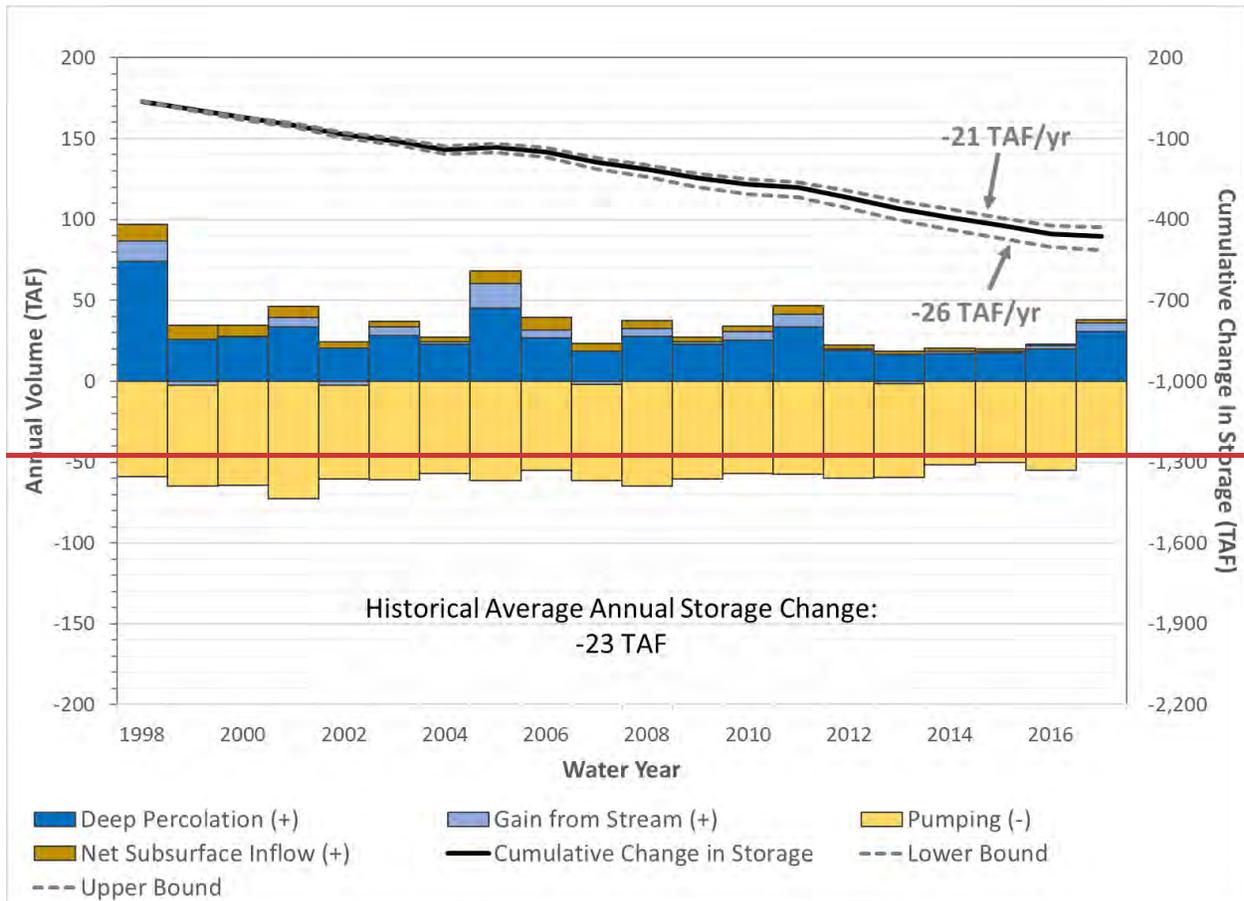


Figure 2-92: Historical Average Annual Groundwater Budget



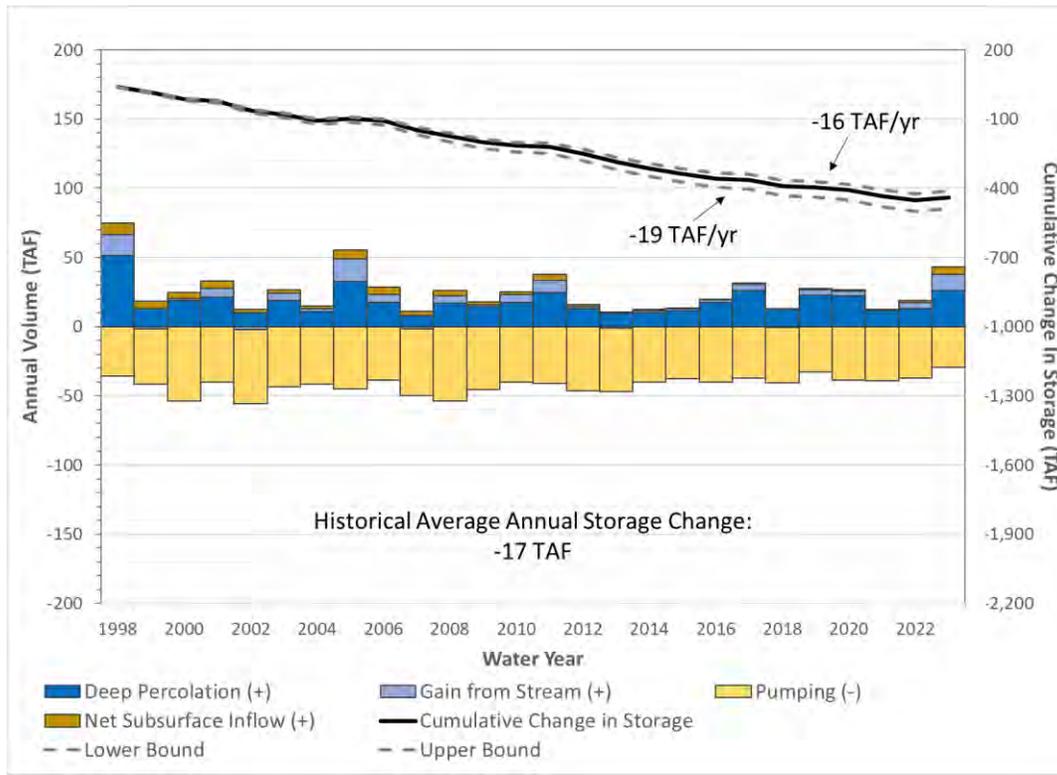


Figure 2-93: Historical Groundwater Budget Annual Time Series

2.2.62.3.6 Current and Projected Water Budget

The current and projected water budget quantifies inflows to and outflows from the Basin using 50 years of hydrology in conjunction with 201720 population, water use, and land use information.

Figure 2-71 Figure 2-94 summarizes the average annual current and projected land surface inflows and outflows in the Basin. Figure 2-72 Figure 2-95 shows the annual time series of current and projected land surface inflows and outflows.

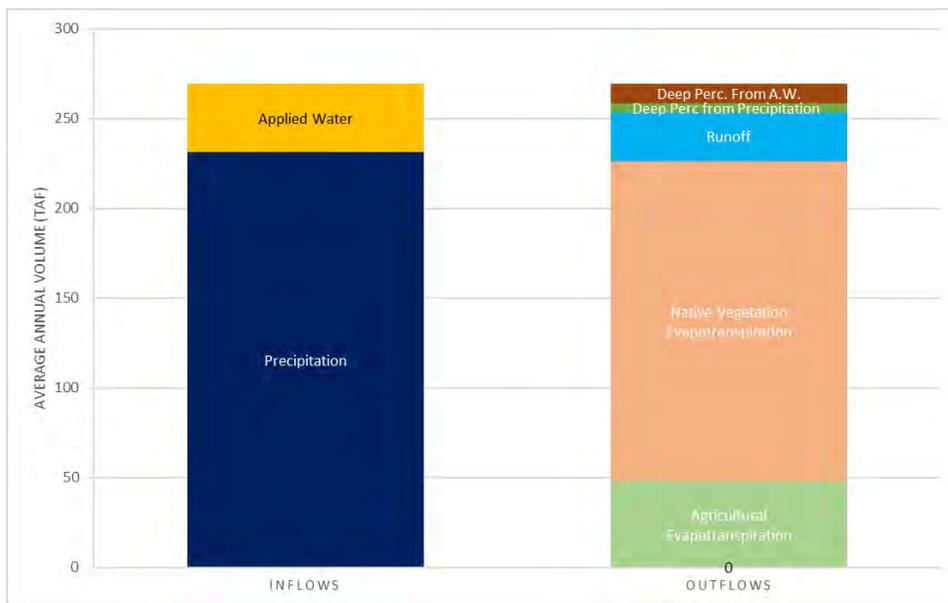
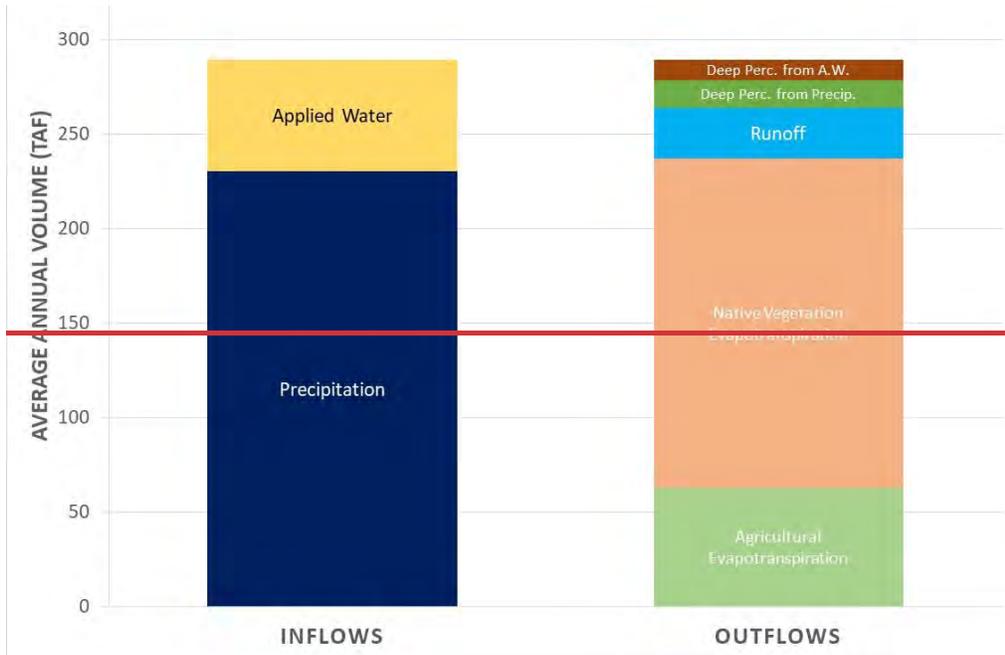


Figure 2-94: Current and Projected Average Annual Land Surface Water Budget

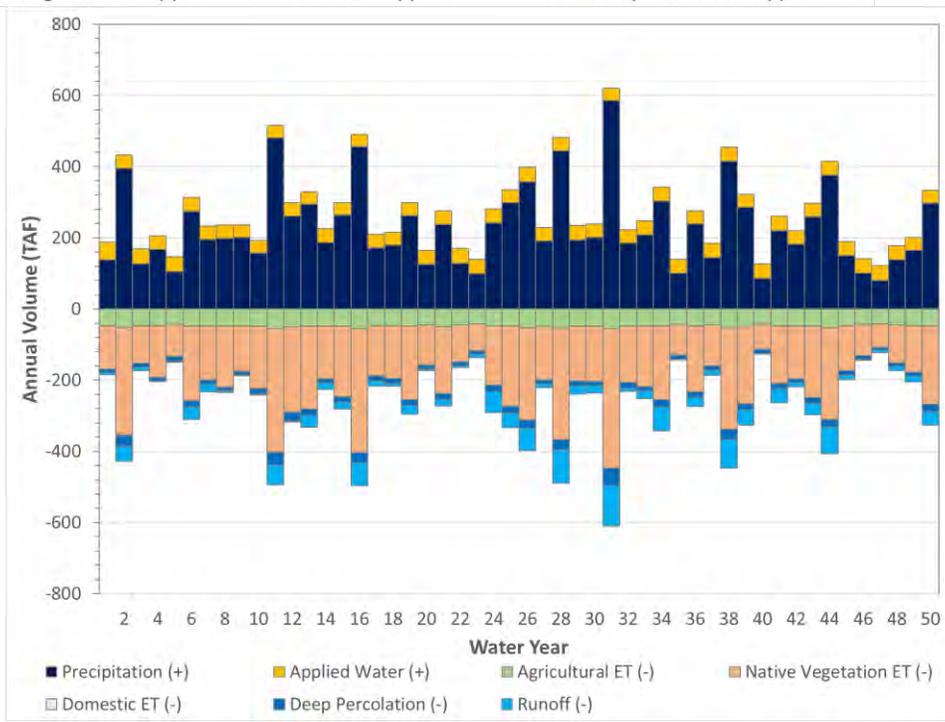
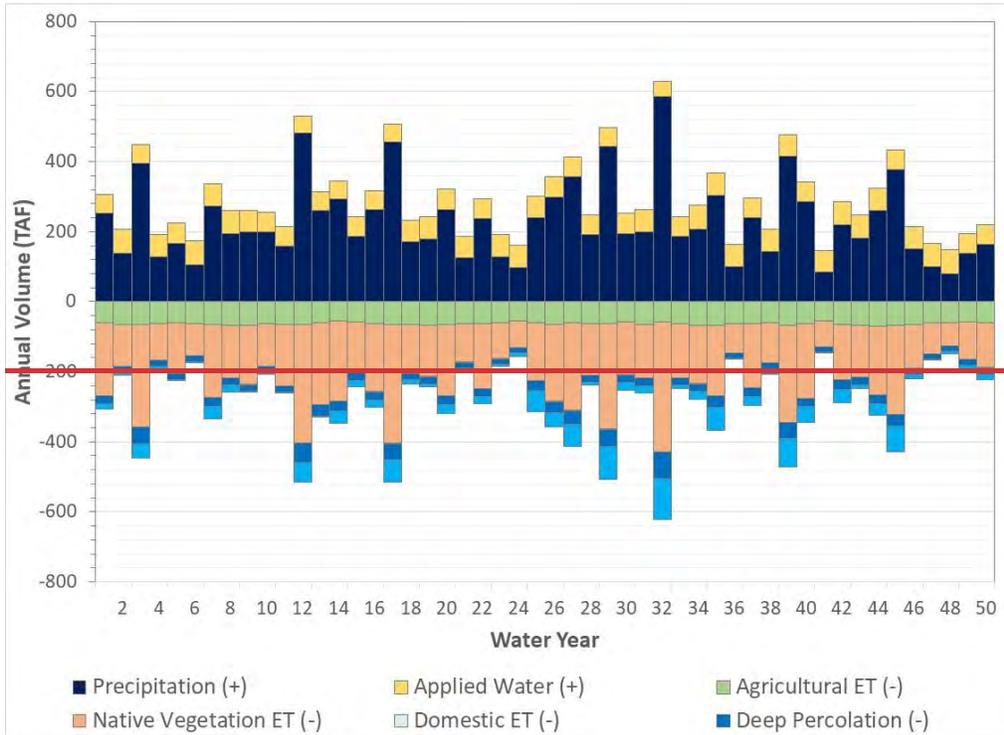




Figure 2-95: Current and Projected Land Surface Water Budget Annual Time Series



Under current and projected conditions, the Basin experiences about 2690,000 AF of land surface inflows each year, of which 2301,000 AF is from precipitation and the remainder is from applied water. ~~About 238,000 AFY is consumed as evapotranspiration or domestic use, with the remainder either recharging the groundwater aquifer as deep percolation or stream seepage or leaving the Basin as river flow.~~

~~The annual time series shows the year to year variability in the availability of water, with land surface inflows ranging from a low of about 147,000 AF to a high of 628,000 AF. These year to year changes in inflows result in corresponding differences in outflows, with total annual agricultural, native vegetation and domestic evapotranspiration ranging from 127,000 to 429,000 AF.~~

~~Figure 2-73 summarizes the average annual current and projected groundwater inflows and outflows in the Basin. Figure 2-74 shows the annual time series of current and projected groundwater inflows and outflows. The Basin average annual current and projected groundwater budget has greater outflows than inflows, leading to an average annual decrease in groundwater storage (i.e. overdraft) of 25,000 AF. Accounting for potential uncertainties in numerical model parameters (as described in Appendix C), the projected average annual overdraft could range from 23,000 to 27,000 AF. As with the historical conditions, the groundwater storage decreases consistently over time, despite year to year variability in groundwater inflows.~~



Figure 2-73: Current and Projected Average Annual Groundwater Budget

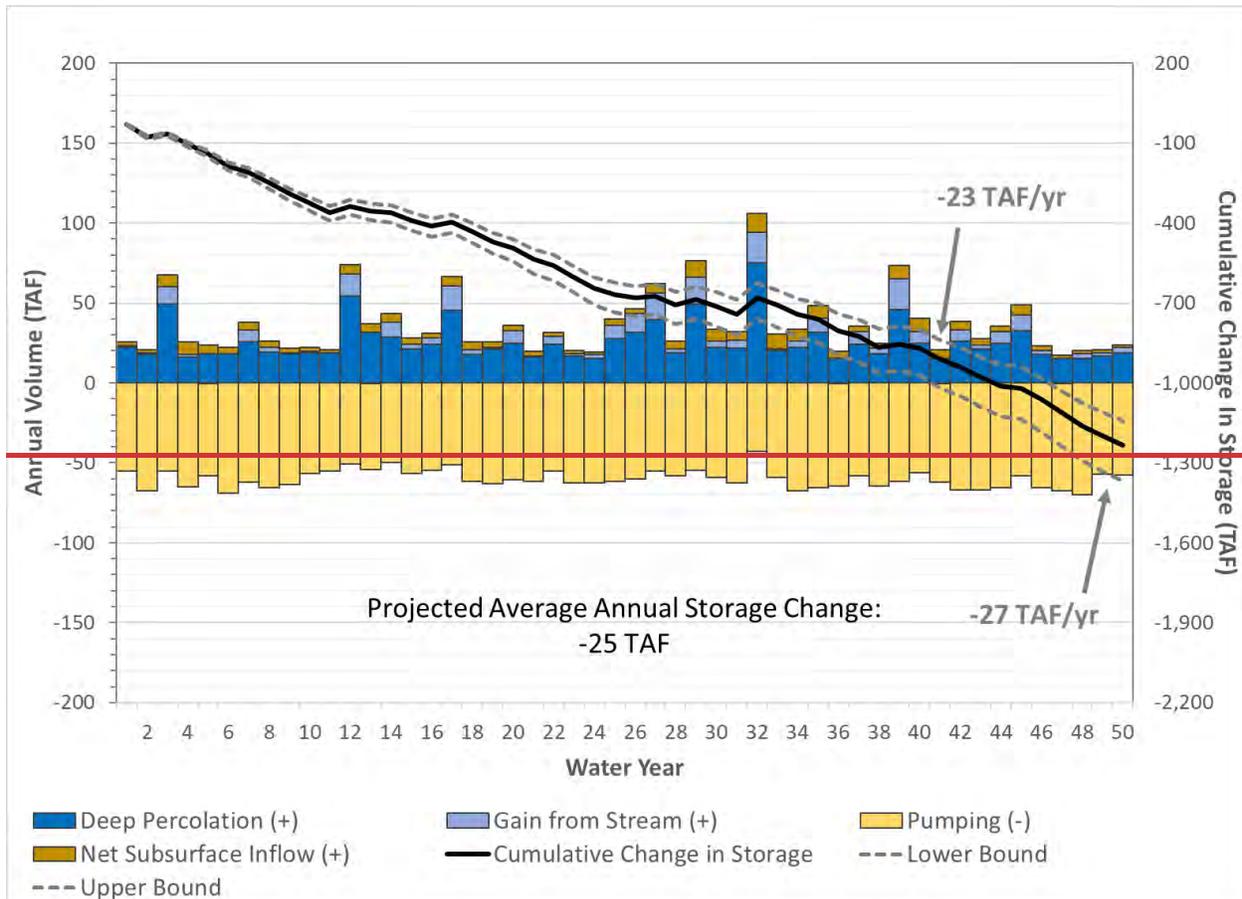


Figure 2-74: Current and Projected Groundwater Budget Annual Time Series

The current and projected water demand, water supply, and change in groundwater storage vary by water year type⁷, as shown in Table 2-6. In wet years, precipitation meets a relative high proportion of the water demand, which reduces the need for groundwater. By contrast, in drier years more groundwater pumping is required to meet the agricultural demand not met by precipitation. This leads to an increase in groundwater storage in wet years and a decrease in the other year types.

⁷Water year types are customized for the Basin watershed based on annual precipitation as follows:

- Wet year = more than 19.6 inches
- Above normal year = 13.1 to 19.6 inches
- Below normal year = 9.85 to 13.1 inches
- Dry year = 6.6 to 9.85 inches
- Critical year = less than 6.6 inches





Table 2-6: Current and Projected Average Annual Supply, Demand, and Change in Groundwater Storage by Water Year Type

Component	Water Year Type				
	Wet	Above Normal	Below Normal	Dry	Critical
Water Demand					
-Agricultural Evapotranspiration (AFY)	64,000	63,000	64,000	63,000	60,000
-Domestic Use (AFY)	500	400	400	300	200
Total Demand	64,000	63,000	64,000	63,000	60,000
Water Supply					
-Groundwater Pumping (AFY)	54,000	59,000	62,000	61,000	66,000
Total Supply	54,000	59,000	62,000	61,000	66,000
Change in Storage	18,000	(21,000)	(34,000)	(37,000)	(46,000)

2.2.72.1.1 Projected Water Budget with Climate Change

The projected water budget with climate change quantifies inflows to and outflows from the Basin using 50 years of hydrology in conjunction with 2017 population, water use, and land use information, with historical precipitation and evapotranspiration values modified for climate change.

Figure 2-75 summarizes the average annual current and projected land surface inflows and outflows in the Basin. Figure 2-76 shows the annual time series of current and projected land surface inflows and outflows.

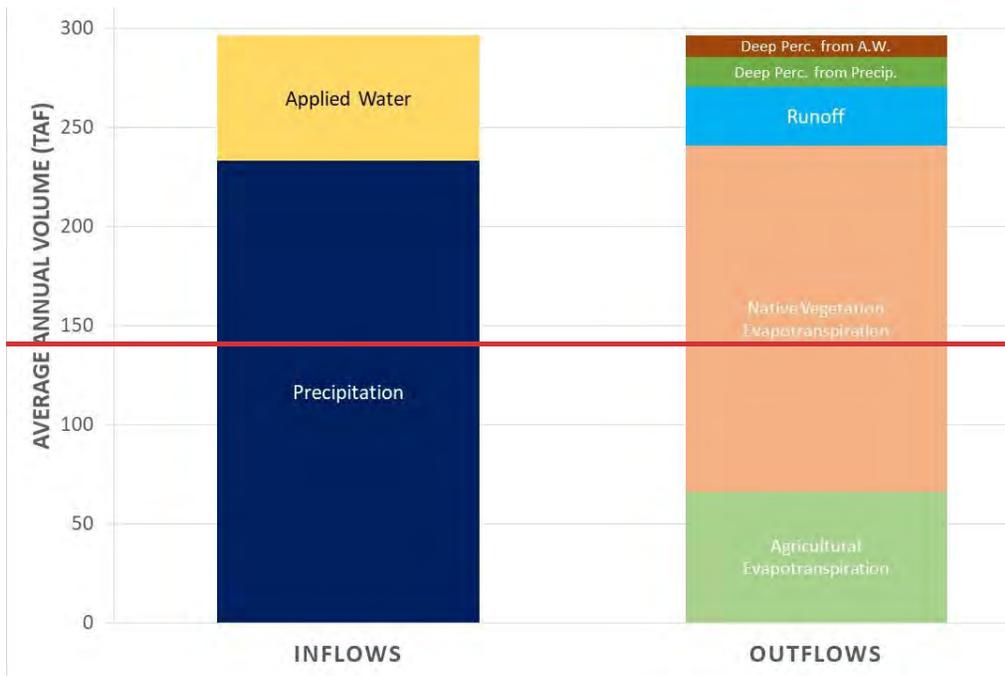


Figure 2-75: Projected Average Annual Land Surface Water Budget with Climate Change

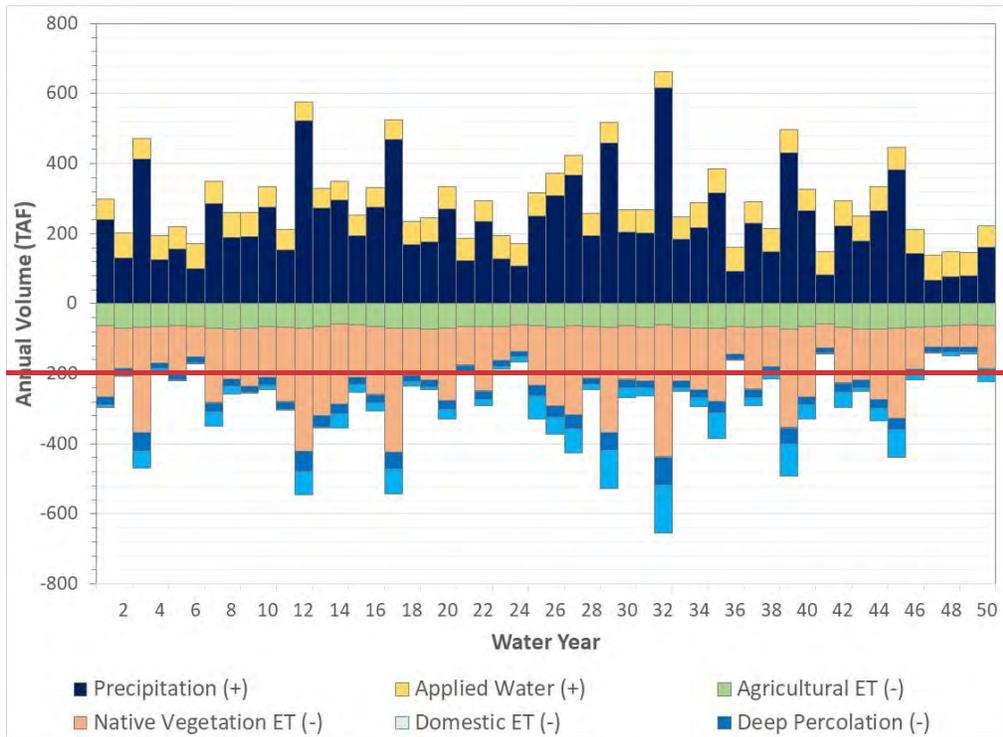


Figure 2-76: Projected Land Surface Water Budget with Climate Change Annual Time Series

Under projected conditions with climate change, the Basin experiences about 296,000 AF of land surface inflows each year, of which 233,000 AF is from precipitation and the remainder is from applied water. About 244 Table 2-4. About 227,000 AFY is consumed as evapotranspiration or domestic use, with the remainder either recharging the groundwater aquifer as deep percolation or stream seepage or leaving the Basin as river flow.

The annual time series shows the year-to-year variability in the availability of water, with land surface inflows ranging from a low of about 138,122,000 AF to a high of 663,621,000 AF. These year-to-year changes in inflows result in corresponding differences in outflows, with total annual agricultural, native vegetation and domestic evapotranspiration ranging from 123,108,000 AF to 438,447,000 AF.

Figure 2-77 Figure 2-96296 summarizes the average annual current and projected groundwater inflows and outflows in the Basin. Figure 2-97297 shows the annual time series of current and projected groundwater inflows and outflows. The Basin average annual current and projected groundwater budget has greater outflows than inflows, leading to an average annual decrease in groundwater storage (i.e. overdraft) of 14,000 AF. Similar to the historical water budget, the estimated pumping and reduction in storage are both now lower than what was estimated by the CBWRM in the 2020 GSP. Accounting for potential uncertainties in numerical model parameters (as described in Appendix C), the projected average annual overdraft could range from 12,000 to 16,000 AF. As with the historical conditions, the



groundwater storage decreases consistently over time, despite year-to-year variability in groundwater inflows.

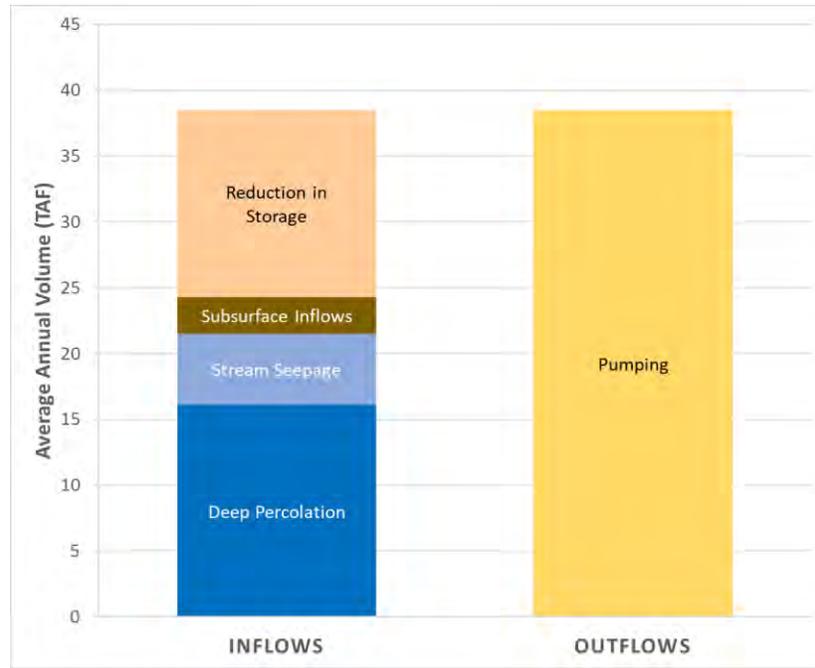


Figure 2-96: Current and Projected Average Annual Groundwater Budget

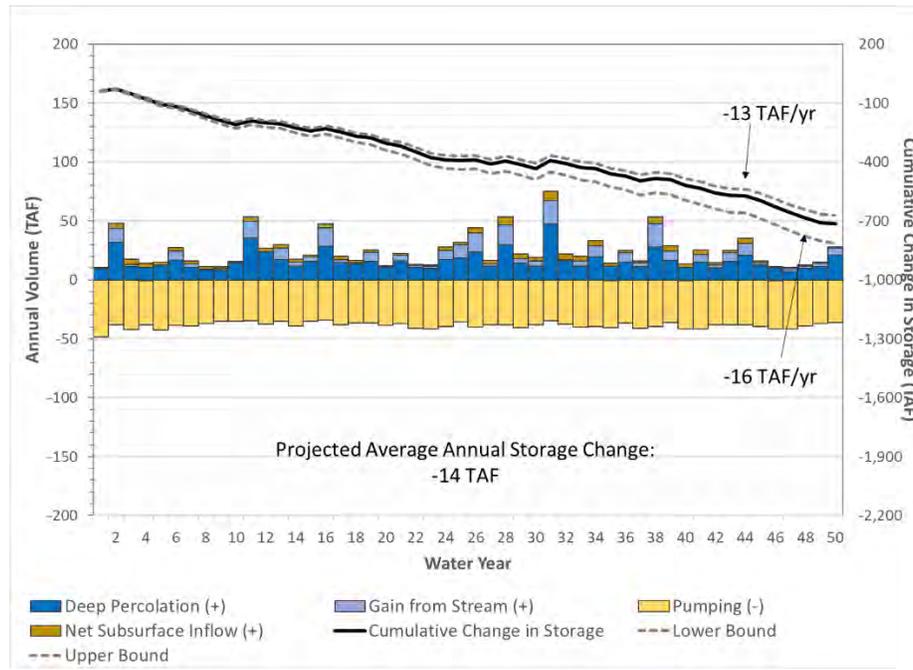


Figure 2-97: Current and Projected Groundwater Budget Annual Time Series

The current and projected water demand, water supply, and change in groundwater storage vary by water year type⁸, as shown in Table 2-626. In wet years, precipitation meets a relatively high proportion of the water demand, which reduces the need for groundwater. By contrast, in drier years more groundwater pumping is required to meet the agricultural demand not met by precipitation. This leads to an increase in groundwater storage in wet years and a decrease in all other year types.

⁸ Water year types are customized for the Basin watershed based on annual precipitation as follows:

- Wet year = more than 19.6 inches
- Above normal year = 13.1 to 19.6 inches
- Below normal year = 9.85 to 13.1 inches
- Dry year = 6.6 to 9.85 inches
- Critical year = less than 6.6 inches



Table 2-6: Current and Projected Average Annual Supply, Demand, and Change in Groundwater Storage by Water Year Type

Component	Water Year Type				
	Wet	Above Normal	Below Normal	Dry	Critical
Water Demand					
<u>Agricultural Evapotranspiration (AFY)</u>	<u>53,500</u>	<u>48,000</u>	<u>48,200</u>	<u>46,300</u>	<u>42,800</u>
<u>Domestic Use (AFY)</u>	<u>200</u>	<u>200</u>	<u>200</u>	<u>200</u>	<u>200</u>
<u>Total Demand</u>	<u>53,700</u>	<u>48,200</u>	<u>48,400</u>	<u>46,500</u>	<u>43,000</u>
Water Supply					
<u>Groundwater Pumping (AFY)</u>	<u>37,200</u>	<u>37,100</u>	<u>38,600</u>	<u>39,400</u>	<u>41,200</u>
<u>Total Supply</u>	<u>37,200</u>	<u>37,100</u>	<u>38,600</u>	<u>39,400</u>	<u>41,200</u>
<u>Change in Storage</u>	<u>14,200</u>	<u>(9,600)</u>	<u>(20,900)</u>	<u>(24,000)</u>	<u>(28,700)</u>

2.3.7 Projected Water Budget with Climate Change

The projected water budget with climate change quantifies inflows to and outflows from the Basin using 50-years of hydrology in conjunction with 2017 population, water use, and land use information, with historical precipitation and evapotranspiration values modified for climate change.

Figure 2-98²⁹⁸ summarizes the average annual current and projected land surface inflows and outflows in the Basin. Figure 2-99²⁹⁹ shows the annual time series of current and projected land surface inflows and outflows.



Figure 2-98: Projected Average Annual Land Surface Water Budget with Climate Change

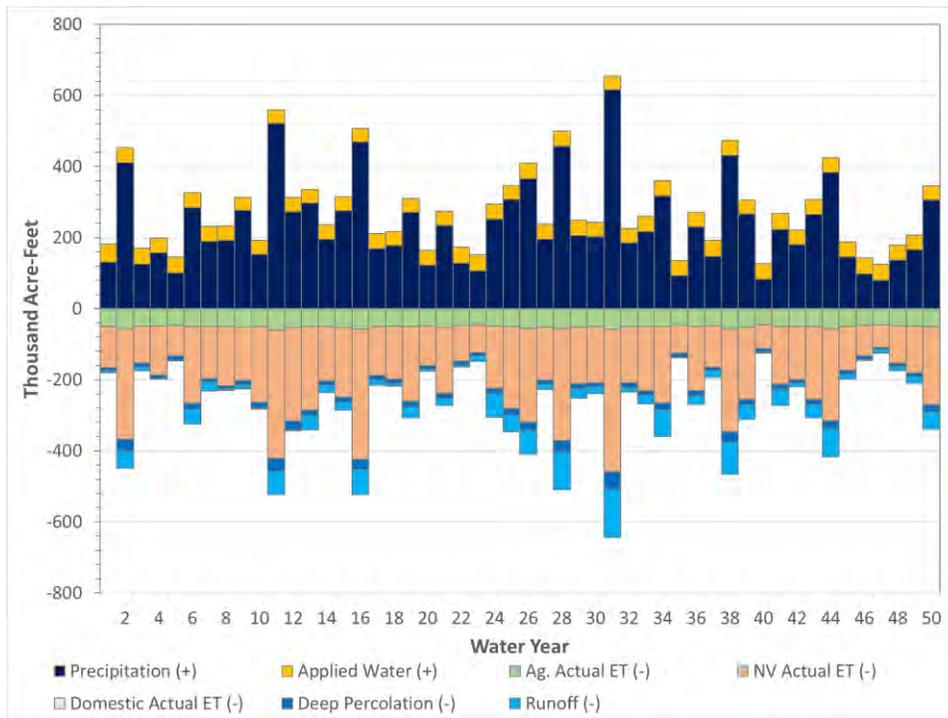




Figure 2-99: Projected Land Surface Water Budget with Climate Change Annual Time Series

Under projected conditions with climate change, the Basin experiences about 278,000 AF of land surface inflows each year, of which 236,000 AF is from precipitation and the remainder is from applied water as shown in Table 2-4. About 232,000 AFY is consumed as evapotranspiration or domestic use, with the remainder either recharging the groundwater aquifer as deep percolation or stream seepage or leaving the Basin as river flow.

The annual time series shows the year-to-year variability in the availability of water, with land surface inflows ranging from a low of about 120,000 AF to a high of 621,000 AF. These year-to-year changes in inflows result in corresponding differences in outflows, with total annual agricultural, native vegetation and domestic evapotranspiration ranging from 104,000 AF to 448,000 AF.

Figure 2-100 summarizes the average annual projected groundwater inflows and outflows with climate change in the Basin. ~~Figure 2-78~~ Figure 2-101 shows the annual time series of projected groundwater inflows and outflows with climate change. The Basin average annual current and projected groundwater budget has greater outflows than inflows, leading to an average annual decrease in groundwater storage (i.e., overdraft) of ~~27,000 AF~~ 16,000 AF. Similar to the historical water budget, the estimated pumping and reduction in storage are both now lower than what was estimated by the CBWRM in the 2020 GSP. As with the historical conditions, the groundwater storage decreases consistently over time, despite year-to-year variability in groundwater inflows.

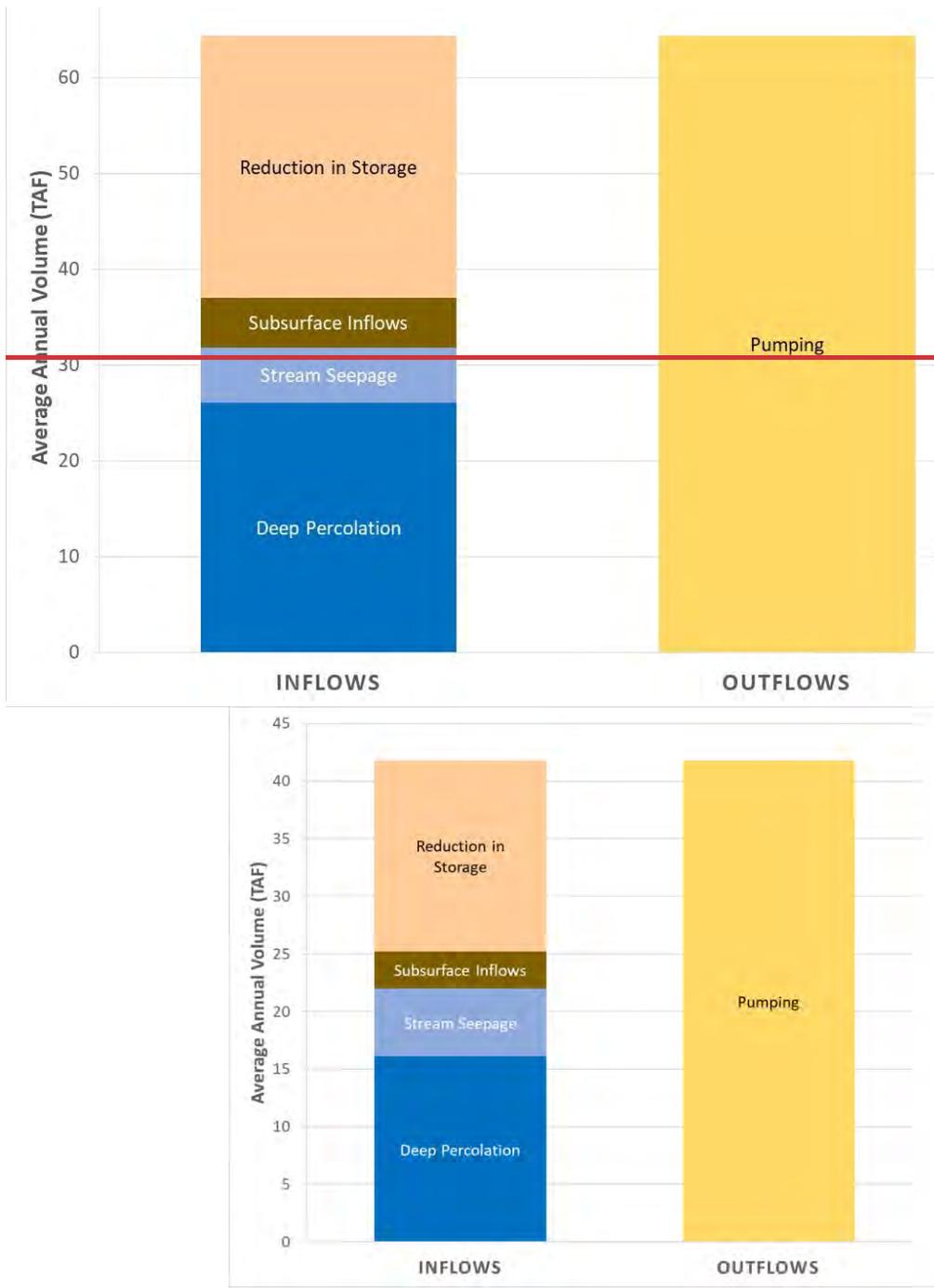
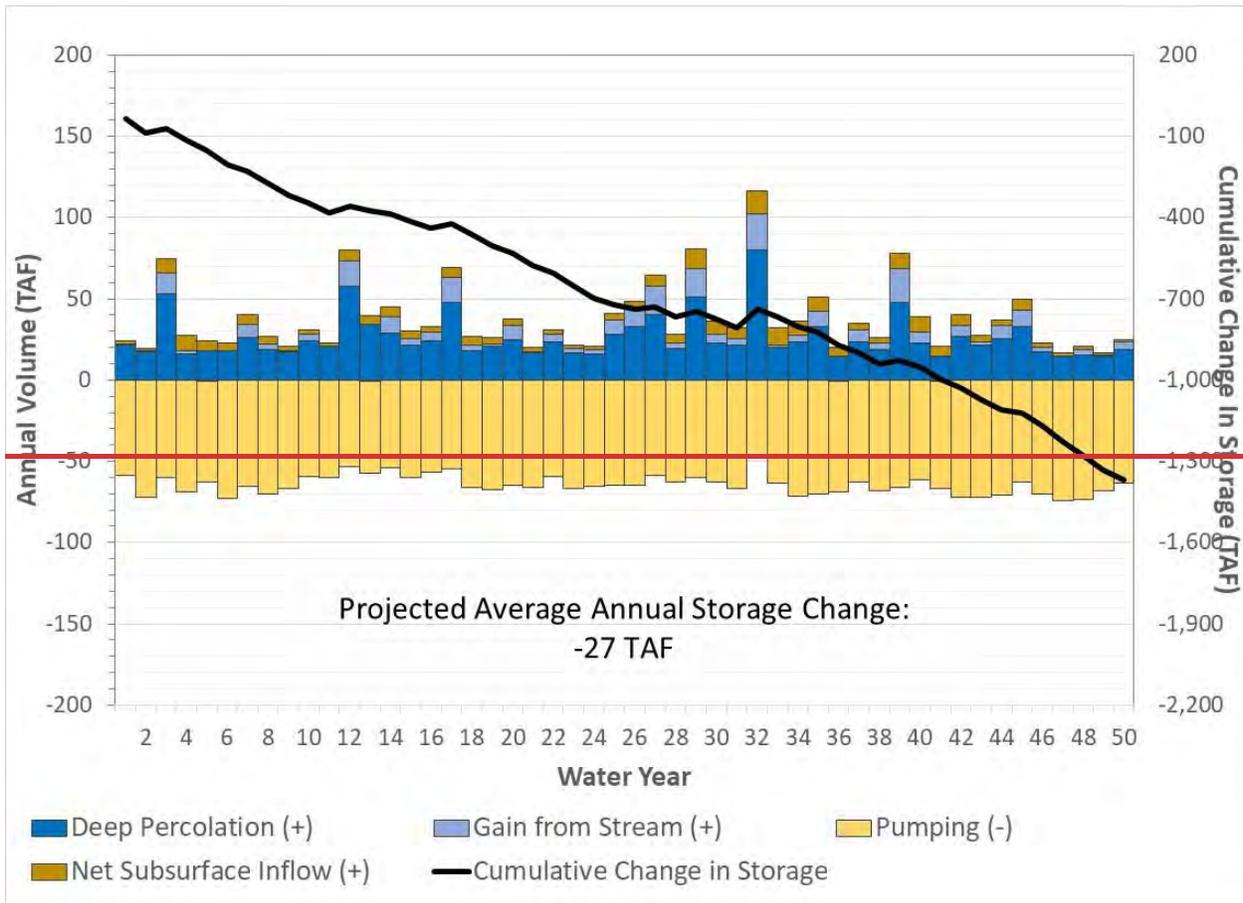


Figure 2-100: ~~Current and~~ Projected Average Annual Groundwater Budget with Climate Change



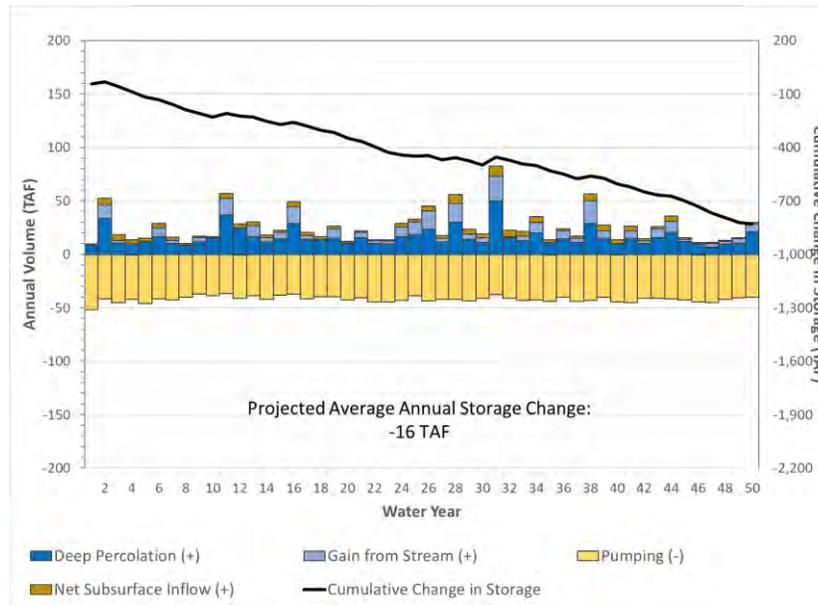


Figure 2-101: ~~Current and~~ Projected Groundwater Budget with Climate Change Annual Time Series

2.2.82.3.8 Sustainable Yield Estimates

Four simulations ~~were~~will be performed with the updated version of the model to estimate the sustainable yield in the Basin as follows:

- Current and projected conditions sustainability with pumping reductions only
- Current and projected conditions sustainability with pumping reductions and water supply projects
- Projected sustainability with climate change with pumping reductions only
- Projected sustainability with climate change with pumping reductions and water supply projects

As of this draft of the document, sustainable yield estimates with climate change and with water supply projects were still under development. These simulations were performed using the current and projected conditions and projected conditions with climate change baselines described above, with projects and pumping reductions implemented so as to achieve an exact balance between supplies and demands in the Basin-wide groundwater budget on average over the 50-year simulation period.



Each simulation incorporating water supply projects was performed using example projects intended to estimate the potential water supply benefits from those projects. It is anticipated that these projects will be further evaluated and refined in the future prior to potential implementation. The analyses included the following water supply projects:

- **Flood and stormwater capture**—it was assumed that facilities would be developed to capture stormwater flows and recharge them into the groundwater aquifer in the central basin area. It was assumed that approximately 2,500 AF per year could be captured and recharged.
- **Precipitation enhancement**—it was assumed that cloud seeding would be performed to increase precipitation in the upper watershed areas. Based on previous studies of potential cloud seeding programs, it was assumed that precipitation would increase by 10% on average.

Chapter 7 of this GSP describes these potential water supply projects in greater detail. Chapter 7 also describes potential mechanisms to reduce groundwater pumping.

As noted above, these simulations were performed using the best available data and information as of June 2018²⁴. It is expected that the model will continue to be refined in the future as improved and updated monitoring information becomes available in the Basin. These refinements will result in changes in the sustainable yield estimates described in this section.

~~Table 2-7~~ Table 2-7 shows the groundwater budget for each sustainability scenario. Because there is no long-term average change in groundwater storage in these scenarios, the groundwater pumping represents the overall estimated sustainable yield in each scenario. The Basin sustainable yield is estimated to be about ~~20,000 to 21,000~~ 17,800 AFY without water supply projects (i.e., a ~~67~~ 54 percent reduction in groundwater pumping compared to baseline) and about 27,000 AFY with water supply projects (i.e., a ~~55 to 63~~ percent reduction in groundwater pumping compared to baseline).



Table 2-7: Average Annual Groundwater Budget for Sustainability Scenarios

Component	Current and Projected Conditions with Pumping Reductions Only (AFY)	Projected Conditions with Climate Change with Pumping Reductions Only (AFY)	Current and Projected Conditions with Pumping Reductions and Water Supply Projects (AFY)	Projected Conditions with Climate Change with Pumping Reductions and Water Supply Projects (AFY)
Inflows				
Deep percolation	12,000 9,600	11,000Under Development	18,000Under Development	18,000Under Development
Stream seepage	4,000 5,400	5,000Under Development	4,000Under Development	4,000Under Development
Subsurface inflowBoundary and Other	4,000 2,800	5,000Under Development	5,000Under Development	5,000Under Development
Total Inflow	20,000 17,800	21,000 Under Development	27,000 Under Development	27,000 Under Development
Outflows				
Groundwater pumping	20,000 17,800	21,000Under Development	27,000Under Development	27,000Under Development
Total Outflow	20,000 17,800	21,000Under Development	27,000Under Development	27,000Under Development
Change in Storage	(0)	(0)Under Development	(0)Under Development	(0)Under Development
Reduction in groundwater pumping relative to Baseline	(40,000) 20,700	(43,000)Under Development	(33,000)Under Development	(37,000)Under Development
Percent reduction	-67 54%	-67%Under Development	-55%Under Development	-63%Under Development
Notes: All sustainability scenarios are simulated using the 1968 to 2017 hydrologic period.				



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3. Undesirable Results

This chapter presents the Undesirable Results statements for the Cuyama Valley Groundwater Basin (Basin). These statements are based on quantitative thresholds on monitoring points described in Chapter 5, which are used here to indicate where Undesirable Results might occur in the monitoring network.

The first section of this chapter is the ~~draft~~ Undesirable Results section. The second section contains guidance from relevant portions of the Sustainable Groundwater Management Act (SGMA) regulations about Undesirable Results, and lists guidance about addressing Undesirable Results from the *Sustainable Management Criteria Best Management Practices* (BMPs) (DWR, 2017).

On June 6, 2018, a public workshop was held where sustainability and undesirable outcomes were discussed with the public. Input from stakeholders at the meeting was tabulated, and stakeholder input was tied to the most relevant GSP component. The sorted results were used to guide creation of the Undesirable Results statements, and are included in Appendix A.

For this 2025 updated GSP, a CBGSA Board meeting was held on January 10th, 2024 where the Board approved retaining the original Undesirable Results definitions included in the original 2020 GSP. This decision was made with review and input from both the Technical Forum and the Standing Advisory Committee.

3.1 Sustainability Goal

Sustainability Goal: To maintain a sustainable groundwater resource for beneficial users of the Basin now and into the future consistent with the California Constitution.

3.2 Undesirable Results Statements

Undesirable Results are defined in SGMA as one or more of the following effects caused by groundwater conditions occurring throughout the Basin:

- Chronic lowering of groundwater levels indicating a significant and unreasonable depletion of supply if continued over the planning and implementation horizon. Overdraft during a period of drought is not sufficient to establish a chronic lowering of groundwater levels if extractions and groundwater recharge are managed as necessary to ensure that reductions in groundwater levels or storage during a period of drought are offset by increases in groundwater levels or storage during other periods.
- Significant and unreasonable reduction of groundwater storage.
- Significant and unreasonable seawater intrusion.
- Significant and unreasonable degraded water quality, including the migration of contaminant plumes that impair water supplies.
- Significant and unreasonable land subsidence that substantially interferes with surface land uses.

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- Depletions of interconnected surface water that have significant and unreasonable adverse impacts on beneficial uses of the surface water.

Undesirable Results related to seawater intrusion are not present in the Basin, and are not likely to occur in the Basin.

The term “significant and unreasonable” is not defined by SGMA regulations. Instead, the conditions leading to this classification are determined by the GSA, beneficial users, and other interested parties in each basin. In the Basin, the identification of URs were developed through an extensive stakeholder-driven process that included:

- Careful consideration of input from local stakeholders and landowners;
- A conceptualization of the hydrogeological conceptual model;
- An assessment of current and historical conditions and best available data; and
- Local knowledge and professional opinion.

The CBGSA recognizes the lack of reliable historical data and acknowledges the limitations and uncertainties it causes (see Data Gaps and Plan to Fill Data Gap subsections of Section 4 – Monitoring Networks and Section 8 – Implementation Plan for addressing those limitations). However, the re-assessment of thresholds and UR statements has been a component of the redevelopment of this updated GSP and have taken recent data, information, stakeholder input, and modeling updates/calibration into consideration.

Information is provided below for each effect as it applies to the Basin. For the sustainability indicators relevant to the Basin, the discussion does the following:

- Describes the Undesirable Result
- Identifies Undesirable Results
- Identifies potential causes of Undesirable Results
- Identifies potential effects of Undesirable Results on beneficial uses

For any indicator not present, a justification for not establishing Undesirable Results is provided. This information was developed based on the California Water Code, SGMA regulations, BMPs, and stakeholder input.

3.2.1 Chronic Lowering of Groundwater Levels

Description of Undesirable Results

The Undesirable Result for the chronic lowering of groundwater levels is a result that causes significant and unreasonable reduction in the long-term viability of domestic, agricultural, municipal, or environmental uses over the planning and implementation horizon of this GSP.



Identification of Undesirable Results

This result is considered to occur during GSP implementation when 30 percent of representative monitoring wells (i.e., 1518 of 4760 wells) fall below their minimum groundwater elevation thresholds for two consecutive years.

The 30 percent of wells exceeding their MT for 24 consecutive months criteria included in the GSP allows the CBGSA the flexibility to identify the cause of MT exceedances and to develop a plan for response (per the Adaptive Management approach described in Section 7.6). Potential causes of MT exceedances could include:

- Prolonged drought;
- Pumping nearby the representative well; and
- Unreliable and non-representative data used to calculate the MT.

Minimum threshold exceedances in multiple wells is considered more indicative of a basin-scale decline in groundwater levels and potential adverse impacts on groundwater infrastructure, as opposed to more localized groundwater level declines, which could be associated with nearby pumping. Furthermore, groundwater levels in areas of the Basin change in response to climatic conditions and therefore sustained exceedances of minimum thresholds are considered to be more significant than short-term exceedances. Setting the Identification of Undesirable Results criteria at 30 percent or more of wells exceeding their MT is intended to reflect undesirable results at the basin-scale and using 24 consecutive months allows the GSA time to address issues, perform investigations, and implement projects and management actions as needed.

Potential Causes of Undesirable Results

Potential causes of Undesirable Results for the chronic lowering of groundwater levels are groundwater pumping that exceeds the average sustainable yield in the Basin, and changes in precipitation in the Cuyama Watershed in the future.

Potential Effects of Undesirable Results

If groundwater levels were to reach Undesirable Results levels, the Undesirable Results could cause potential de-watering of existing groundwater infrastructure, starting with the shallowest wells, could potentially adversely affect groundwater dependent ecosystems, and could potentially cause changes in irrigation practices, crops grown, and adverse effects to property values. Additionally, reaching Undesirable Results for groundwater levels could adversely affect domestic and municipal uses, including uses in disadvantaged communities, which rely on groundwater in the Basin.



3.2.2 Reduction of Groundwater Storage

Description of Undesirable Results

The Undesirable Result for the reduction in groundwater storage is a result that causes significant and unreasonable reduction in the viability of domestic, agricultural, municipal, or environmental uses over the planning and implementation horizon of this GSP.

Justification of Groundwater Elevations as a Proxy

Use of groundwater elevation as a proxy metric for Undesirable Results is appropriate for groundwater storage. The change in storage is directly correlated to changes in groundwater elevation. By setting minimum thresholds for levels, storage is also effectively managed.

Identification of Undesirable Results

This result is considered to occur during GSP implementation when 30 percent of representative monitoring wells (i.e., 1518 of 4760 wells) fall below their minimum groundwater elevation thresholds for two consecutive years.

The 30 percent of wells exceeding their MT for 24 consecutive months criteria included in the GSP allows the CBGSA the flexibility to identify the cause of MT exceedances and to develop a plan for response (per the Adaptive Management approach described in Section 7.6). Potential causes of MT exceedances could include:

- Prolonged drought;
- Pumping nearby the representative well; and
- Unreliable and non-representative data used to calculate the MT.

Minimum threshold exceedances in multiple wells is considered more indicative of a basin-scale decline in groundwater levels and potential adverse impacts on groundwater infrastructure, as opposed to more localized groundwater level declines, which could be associated with nearby pumping. Furthermore, groundwater levels in areas of the Basin change in response to climatic conditions and therefore sustained exceedances of minimum thresholds are considered to be more significant than short-term exceedances. Setting the Identification of Undesirable Results criteria at 30 percent or more of wells exceeding their MT is intended to reflect undesirable results at the basin-scale and using 24 consecutive months allows the GSA time to address issues, perform investigations, and implement projects and management actions as needed.



Potential Causes of Undesirable Results

Potential causes of Undesirable Results for the reduction in groundwater storage are groundwater pumping that exceeds the average sustainable yield in the Basin, and decreases in precipitation in the Cuyama Watershed in the future.

Potential Effects of Undesirable Results

If reduction of groundwater in storage were to reach Undesirable Results levels, the Undesirable Results could cause potential de-watering of existing groundwater infrastructure and springs, starting with the shallowest wells, could potentially adversely affect groundwater dependent ecosystems, and potentially cause changes in irrigation practices, crops grown, and adverse effects to property values. Additionally, reaching Undesirable Results for reduction of groundwater in storage could adversely affect domestic and municipal uses, which rely on groundwater in the subbasin.

3.2.3 Seawater Intrusion

Seawater intrusion is not an applicable sustainability indicator in the Basin, because seawater intrusion is not present and is not likely to occur due to the distance between the Basin and the Pacific Ocean, bays, deltas, or inlets.

3.2.4 Degraded Water Quality

Description of Undesirable Results

The Undesirable Result for degraded water quality is a result stemming from a causal nexus between SGMA-related groundwater quantity management activities and groundwater quality that causes significant and unreasonable reduction in the long-term viability of domestic, agricultural, municipal, or environmental uses over the planning and implementation horizon of this GSP.

Identification of Undesirable Results

This result is considered to occur during GSP implementation when 30 percent of the representative monitoring points (i.e., 929 of 2964 sites) exceed the minimum threshold for a constituent for two consecutive years.

The 30 percent of wells exceeding their MT for 24 consecutive months criteria included in the GSP allows the CBGSA the flexibility to identify the cause of MT exceedances and to develop a plan for response (per the Adaptive Management approach described in Section 7.6). Potential causes of MT exceedances could include:

- Prolonged drought;
- Pumping nearby the representative well; and



- Unreliable and non-representative data used to calculate the MT.

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Minimum threshold exceedances in multiple wells is considered more indicative of a basin-scale decline in groundwater quality and potential adverse impacts on beneficial uses and users of groundwater, as opposed to more localized groundwater quality declines. Setting the Identification of Undesirable Results criteria at 30 percent or more of wells exceeding their MT is intended to reflect undesirable results at the basin-scale and using 24 consecutive months allows the GSA time to address issues, perform investigations, and implement projects and management actions as needed.

Potential Causes of Undesirable Results

Potential causes of Undesirable Results for the degraded water quality are conditions where groundwater pumping degrades the groundwater quality.

Potential Effects of Undesirable Results

If groundwater quality were degraded to reach Undesirable Results levels, the Undesirable Results could potentially cause a shortage in supply to groundwater users, with domestic wells being most vulnerable as treatment costs or access to alternate supplies can be high for small users. Water quality degradation could cause potential changes in irrigation practices, crops grown, and adverse effects to property values. Additionally, reaching Undesirable Results for groundwater quality could adversely affect municipal uses, including disadvantaged communities, which could have to install treatment systems.

3.2.5 Land Subsidence

Description of Undesirable Results

The Undesirable Result for land subsidence is a result that causes significant and unreasonable reduction in the viability of the use of infrastructure over the planning and implementation horizon of this GSP.

Identification of Undesirable Results

This result is detected to occur during GSP implementation when 30 percent of representative subsidence monitoring sites (i.e., 1 of 2 sites) exceed the minimum threshold for subsidence over two years.

The 30 percent of sites exceeding their MT for 24 consecutive months criteria included in the GSP allows the CBGSA the flexibility to identify the cause of MT exceedances and to develop a plan for response (per the Adaptive Management approach described in Section 7.6). Potential causes of MT exceedances could include:

- Prolonged drought;
- Pumping nearby the representative sites; and
- Unreliable and non-representative data used to calculate the MT.

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Potential Causes of Undesirable Results

Potential causes of future Undesirable Results for land subsidence are likely tied to groundwater pumping resulting in dewatering of compressible clays in the subsurface.

Potential Effects of Undesirable Results

If land subsidence conditions were to reach Undesirable Results, the Undesirable Results could potentially cause damage to infrastructure, including water conveyance facilities and flood control facilities roads, utilities, buildings, and pipelines.

3.2.6 Depletions of Interconnected Surface Water

Description of Undesirable Results

The Undesirable Result for depletions of interconnected surface water is a result that causes significant and unreasonable reductions in the viability of agriculture or riparian habitat within the Basin over the planning and implementation horizon of this GSP.

~~Identification of Undesirable Results~~ This will be developed once guidance documents are provided by DWR.

This result is considered to occur during GSP implementation when 30 percent of representative monitoring wells (i.e., 18 of 60 wells) fall below their minimum groundwater elevation thresholds for two consecutive years.

Justification of Groundwater Elevations as a Proxy

Use of groundwater elevation as a proxy metric for Undesirable Results is necessary given the difficulty and cost of direct monitoring of depletions of interconnected surface water. The depletion of interconnected surface water is driven by a gradient between water surface elevation in the surface water body and groundwater elevations in the connected, shallow groundwater system. By setting minimum thresholds on shallow groundwater wells near surface water, the CBGSA can to monitor and manage this gradient, and in turn, manage potential changes in depletions of interconnected surface.

Potential Causes of Undesirable Results

Potential causes of future Undesirable Results for depletions of interconnected surface water are likely tied to groundwater production, which could result in lowering of groundwater elevations in shallow aquifers near surface water courses. This could change the hydraulic gradient between the water surface elevation in the surface water course and the groundwater elevation, resulting in an increase in depletion of surface water to groundwater.



Potential Effects of Undesirable Results

If depletions of interconnected surface water were to reach Undesirable Results, groundwater dependent ecosystems could be affected.

3.3 Evaluation of the Presence of Undesirable Results

DWR developed the *Sustainable Management Criteria* BMP (DWR, 2017) to help GSAs develop their sustainability criteria, and to identify the presence of Undesirable Results. The *Sustainable Management Criteria* BMP states: “Undesirable results will be defined by minimum threshold exceedances.” The *Sustainable Management Criteria* BMP helps GSAs identify the presence of an Undesirable Result by identifying a quantitative number and location of monitoring points that may be below the minimum threshold prior to a GSA identifying conditions as an Undesirable Result.

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This section evaluates current conditions and compares them with the minimum thresholds established in Chapter 5. Using the method identified above for each sustainability indicator, a GSA can identify the presence of Undesirable Results. For the Basin, Undesirable Results are identified at the Basin scale; this scale may be modified by the CBGSA Board if appropriate or necessary in the future.

3.3.1 Chronic Lowering of Groundwater Levels

The Undesirable Result for the chronic lowering of groundwater levels is considered to occur during GSP implementation when 30 percent of representative monitoring wells (i.e., ~~148~~ of ~~4760~~ wells) fall below their minimum groundwater elevation thresholds for two consecutive years (Section 3.2.1).

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Chapter 5 discusses how minimum thresholds were selected. Appendix A of Chapter 5 presents the hydrographs of groundwater levels through ~~2024~~~~2018~~ and the established depth of the minimum threshold for each monitoring site. Of the ~~4760~~ monitoring sites, ~~threenine~~ were below the minimum threshold in the latest measurement in ~~2024~~~~2018~~, which is ~~six~~~~15~~ percent of representative monitoring wells (i.e., ~~39~~ of ~~4760~~), indicating that the Basin does not currently exceed the requirements for an undesirable condition for the chronic lowering of groundwater levels.

3.3.2 Reduction of Groundwater Storage

The Undesirable Result for the reduction of groundwater storage is monitored by proxy using groundwater levels and groundwater level minimum thresholds (Section 3.2.2). Because measurements show that levels are not in an undesirable condition, reduction of groundwater storage is not identified to be in an undesirable condition.

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3.3.3 Seawater Intrusion

Seawater intrusion is not an applicable sustainability indicator, because seawater intrusion is not present and is not likely to occur due to the distance between the Basin and the Pacific Ocean, bays, deltas, or inlets (Section 3.2.4). Therefore, there is no possibility of an undesirable result due to seawater intrusion.

3.3.4 Degraded Water Quality

The Undesirable Result for degraded water quality is considered to occur during GSP implementation when 30 percent of representative monitoring wells (i.e., 920 of 2964 wells) for water quality exceed minimum threshold levels for two consecutive years (Section 3.2.4).

Discussion of how minimum thresholds were selected is presented in Chapter 5. Table 5-2 in Chapter 5 shows the minimum thresholds and the most recent measurement for each monitoring site. Of the 2964 monitoring sites, none were worse than the minimum threshold in the latest measurement in 2023, which is 0 percent of representative monitoring wells (i.e., 0 of 2960), indicating that the Basin does not currently meet the requirements for an undesirable condition for degraded water quality.

3.3.5 Land Subsidence

The Undesirable Result for land subsidence is considered to occur during GSP implementation when 30 percent of representative subsidence monitoring sites (i.e., 1 of 2 sites) exceed the minimum threshold for subsidence over two consecutive years (Section 3.2.5).

Chapter 5 discussed how minimum thresholds were selected. The minimum threshold for subsidence has been set at 2 inches per year.

The rate of subsidence at the Cuyama Valley High School (CVHS) station is measured daily. Subsidence at the CVHS station cycles annually, with elastic rebound occurring in the winter, indicated by an annual high. Recent data available through 2022 (2023 data) shows that during the period of rebound occur between January 1 and March 10 each year. Measurements taken from January 1, 2017 to March 10, 2017 were compared with measurements from January 1, 2018 to March 10, 2018. Each daily measurement was not yet available) compared and the difference between each day was downloaded from UNAVCO¹ and the averaged. The average decline from a day in 2017 during that period and the same day in 2018 during that period was 33 millimeters (1.3 inches).

The rate of subsidence trend for CUHS was recalculated. Subsidence rates during 2021 and 2022 actually reflected a positive change in ground surface elevation, and current on the Ventueopa station was 0 inches over the same period. Because neither station showed a rate of subsidence rates in the central portion of the Basin are 34.02 mm per year or 1.34 over 2 inches per year (for WY 2022). This rate is below the

¹ <https://www.unavco.org/data/web-services/documentation/documentation.html#!/GNSS47GPS/getPositionByStationId>

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minimum threshold, and thus, the Basin does not currently meet the requirements for an undesirable result condition for land subsidence are not occurring in the Basin.

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3.3.6 Depletions of Interconnected Surface Water

This will be developed once guidance documents are provided by DWR.

~~The Undesirable Result for the depletion of interconnected surface water is monitored by proxy using groundwater levels and groundwater level minimum thresholds (Section 3.2.6). Because measurements show that levels do not currently meet the requirements for an undesirable condition, depletion of interconnected surface water is not identified to be in an undesirable condition.~~

3.4 References

California Department of Water Resources (DWR). 2018. *Sustainable Management Criteria Best Management Practice*. Sustainable Groundwater Management Program. November.
<https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Sustainable-Groundwater-Management/Best-Management-Practices-and-Guidance-Documents/Files/BMP-6-Sustainable-Management-Criteria-DRAFT.pdf>. Accessed March 30, 2018.



Chapter 5 Minimum Thresholds, Measurable Objectives, and Interim Milestones

This chapter of the Cuyama Groundwater Basin (Basin) *Groundwater Sustainability Plan* (GSP) defines the sustainability criteria used to avoid undesirable results during GSP implementation. The Sustainable Groundwater Management Act (SGMA) requires the application of minimum thresholds (MTs), measurable objectives (MOs), and interim milestones (IMs) to all representative monitoring sites identified in the GSP. These values, or thresholds, will help the Cuyama Basin Groundwater Sustainability Agency (CBGSA) and other groundwater users in the Basin identify sustainable values for the established SGMA sustainability indicators, and will help identify progress indicators over the 20-year GSP implementation period.

5.1 Useful Terms

There are several terms used in this chapter that describe Basin conditions and the values calculated for the representative sites. These terms are intended as a guide for readers, and are not a definitive definition of any term.

- **Interim Milestones** – IMs are a target value representing measurable conditions, set in increments of five years. They are set by the CBGSA as part of the GSP; IMs will help the Basin reach sustainability by 2040.
- **Measurable Objectives** – MOs are specific, quantifiable goals for maintaining or improving specified groundwater conditions that are included in the adopted GSP to achieve the Basin’s sustainability goal.
- **Minimum Thresholds** – MTs are a numeric value for each sustainability indicator, which are used to define when undesirable results occur if minimum thresholds are exceeded in a percentage of sites in the monitoring network.
- **Sustainability Goals** – Sustainability goals are the culmination of conditions in the absence of undesirable results within 20 years of the applicable statutory deadline.
- **Undesirable Results** – Undesirable results are the significant and unreasonable occurrence of conditions that adversely affect groundwater use in the Basin, as defined in Chapter 3.

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- **Sustainability Indicators** – These indicators refer to any of the effects caused by groundwater conditions occurring throughout the Basin that, when significant and unreasonable, cause undesirable results, as described in Water Code Section 10721(x). These include the following:
 - Lowering groundwater levels
 - Reduction of groundwater storage
 - Seawater intrusion
 - Degraded water quality
 - Land subsidence
 - Depletion of interconnected surface water

Both MOs and MTs are applied to all sustainability indicator representative sites. Sites in the Basin’s monitoring networks that are not classified as representative sites are not required to have MOs or MTs. All of the Basin’s representative sites will also have IMs calculated for 2025, 2030, and 2035 to help guide the CBGSA toward its 2040 sustainability goals. All wells meeting the representative well criteria outlined in this GSP are included in the Basin’s monitoring network, although participation in the SGMA monitoring program is dependent upon agreements between the CBGSA and the well owners.

The following subsections describe the process of establishing MOs, MTs, and IMs for each of the sustainability indicators described above. They also discuss the results of this process.

5.2 Chronic Lowering of Groundwater Levels

The undesirable result for the chronic lowering of groundwater levels is a result that causes significant and unreasonable reduction in the long-term viability of domestic, agricultural, municipal, or environmental uses over the planning and implementation horizon of this GSP.

Groundwater conditions, as discussed in Chapter 2, Section 2.2, vary across the Basin. Groundwater conditions are influenced by geographic attributes, geologic attributes, and overlying land uses in the Basin. Because of the variety of conditions, six threshold regions were established in the Basin so appropriate sustainability criteria could be set more precisely for each region.

5.2.1 Threshold Regions

The ~~previous GSP utilized six~~ threshold regions ~~that~~ were defined to allow areas with similar conditions to be grouped together for calculation of MOs, MTs, and IMs. ~~However, for this GSP Update the CBGSA has utilized new threshold calculations that incorporate historical data, potential impacts to beneficial uses and users of groundwater, and variations in local conditions in a consistent manner across the Basin. Therefore, these~~ threshold regions are ~~no longer being used~~ shown in Figure 5-1. ~~The following subsections discuss threshold region characteristics and boundaries.~~



Southeastern Threshold Region

The Southeastern Threshold Region lies on the southeastern edge of the Basin, and is characterized as having moderate agricultural land use with steep geographic features surrounding the valley. Groundwater is generally high in this area, with recent historical data showing levels around 50 feet or less below ground surface, which indicates that this region is likely currently in a full condition. Groundwater levels in this region are subject to declines during drought periods, but have typically recovered back to previous levels during historically wet periods. The northern boundary of this region is the narrows at the Cuyama River approximately at the boundary with U.S. Forest Service lands, and the eastern boundary is the extent of alluvium. The southern and western extent of this region is defined by the groundwater basin boundary.



Figure 5-4: Threshold Regions

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Eastern Threshold Region

The Eastern Threshold Region lies southeast of the central part of the Basin and encompasses Ventucopa and much of the surrounding agricultural property. This part of the Basin has agricultural pumping. Hydrographs in this region indicate that groundwater levels have historically ranged widely and repeatedly over the last 50 years, and in general, are declining over the past 20 years. However, these levels are generally higher than those in the Central Threshold Region. The northern boundary of this region is the Santa Barbara Canyon Fault, and the southern boundary is where the Cuyama Valley significantly narrows due to geographic changes. The eastern boundary is the extent of the boundary, and the western boundary is defined by the groundwater basin boundary.

Central Threshold Region

The Central Threshold Region incorporates the majority of agricultural land use in the Basin, as well as the towns of Cuyama and New Cuyama. The greatest depths to groundwater are also found in the Central Threshold Region, and groundwater levels have generally been declining in this region since the 1950s. The southeastern boundary is defined by the Santa Barbara Canyon fault, and the western boundary by the Russell Fault. The northern and southern boundary of this region is defined by the Basin boundary.

Western Threshold Region

The Western Threshold Region is characterized by shallow depth to water, and recent historical data and hydrographs in this region indicate that it is likely this portion of the Basin is currently in a full condition. Land uses in this area generally include livestock and small agricultural operations. It lies primarily on the north-facing slope of the lower Cuyama Valley. The eastern boundary is defined by the Russell Fault, and the northern boundary was drawn to differentiate distinct land uses. The southwestern boundary is defined by the groundwater basin boundary.

Northwestern Threshold Region

The Northwestern Threshold Region is the bottom of the Cuyama Basin and has undergone changes in land use from small production agricultural and grazing to irrigated crops over the last four years. Recent historical data and hydrographs in this portion of the Basin indicate that this portion is likely currently in a full condition. The southern border was drawn to differentiate between the land uses of the Western and Northwestern Threshold regions, resulting in different kinds of agricultural practices. The rest of the region is defined by the Basin boundary.



Badlands Threshold Region

The Badlands Threshold Region includes the areas east of the Central, East, and Southeast Threshold regions on the west facing slope of the Cuyama Valley. There are no active wells and there is little groundwater use in this area. There is no monitoring in this region, and no sustainability criteria were developed for this region.

5.2.2 Minimum Thresholds, Measurable Objectives, and Interim Milestones

This section describes how MTs, MOs, and IMs were established for each representative well by threshold region, and explains the rationale behind the each selected methodologies methodology.

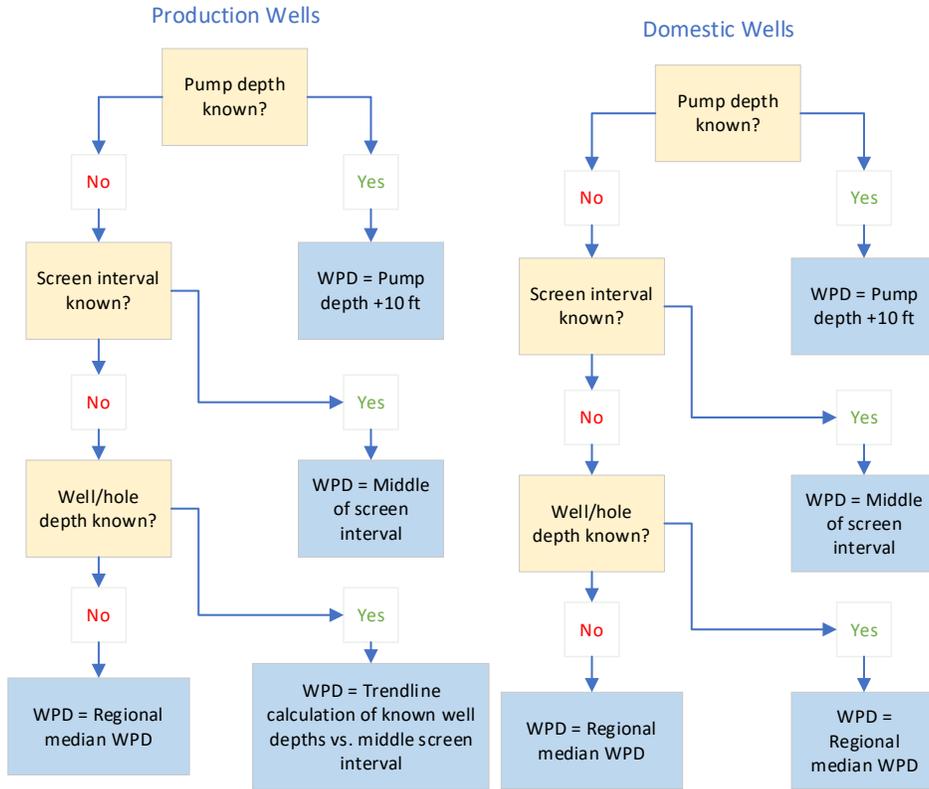
The minimum threshold calculation uses a stepwise function that takes a conservative approach to protect wells (production and domestic) across the Basin while providing flexibility when possible, to accommodate the CBGSA planned pumping allocations and reductions strategy. The stepwise function has four potential calculation outcomes:

1. **Combined Well protection and GDE protection depth:** The well protection depth and GDE protection depth were merged together in a GIS analysis process that interpolated the data into a 3-dimensional coverage across the Basin, in the same process elevation points make a topographic map of the surface elevation. For each RMW's location, the interpolated protection depth was then extracted to get the final Well Protection / GDE protection depth value.
 - a. **Well Protection Depth:** The well protection depth is used to ensure that active production and domestic wells within the Basin are protected from harm to their beneficial uses. The well protection depth is a numerical value representing the approximate depth at which, if exceeded, beneficial uses could be impacted in a well. This value is unique and calculated for each active production and domestic well within the Basin where there is available data. Where data is not available, generalized or regional proxy data is utilized. Some wells are screened from this analysis either because they are too far removed from the representative well network (and therefore conditions at the nearest RWM are not indicative of conditions at the active well because of distance and/or other conditions such as geology or topology) or wells were already dry in 2015. The well protection depth is calculated for each pumping well as a four-part stepwise function, with a slight difference in the fourth step between domestic and production wells (Figure 5-1).
 - b. **GDE Protection Depth:** GDEs are incorporated two ways into the well protection depth GIS analysis. First, RMW wells within 2,000 feet of potential GDEs (with two exceptions due to local topography) were automatically assigned a well protection depth of 30 ft bgs. These RMWs are Opti wells 2, 114, 568, 830, 832, 833, and 836. Second, all potential GDE locations in the Basin were assigned a protection depth of 30 ft bgs via a dense spatial point-cloud within each GDE polygon in GIS. The point-clouds allow GIS to

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utilize the same data type (points instead of polygons) in the processing required for the protection depth calculation.



Southeastern Threshold Region

Monitoring in this threshold region indicates groundwater levels are static except during drought conditions from 2013 to 2018. Static groundwater levels indicate this area of the Basin is generally at capacity; therefore, the MT is protective of domestic, private, public, and environmental uses.

The MO for the Southeastern Threshold Region’s wells was calculated by finding the measurement taken closest to (but not before) January 1, 2015 and not after April 30, 2015. If no measurement was taken during this four-month period, then a linear trendline was applied to the data and the value for January 1, 2015 was extrapolated.



To provide an operational flexibility range, the MT was calculated by subtracting five years of groundwater storage from the MO. Five years of storage was calculated by finding the decline in groundwater levels from 2013 to 2018, which was considered a period of drought. If measurements were insufficient for this time period, a linear trendline was used to extrapolate the value decline value.

IMs were set to equal the MT in 2025, with a projected improvement to one third the distance between the MT and MO in 2030 and half the distance between the MT and MO in 2035. As a result, IMs will a way to measure progress toward sustainability over the GSP's planning horizon.

Groundwater levels will be measured using the protocols documented in Chapter 4's Appendix A.

Eastern Threshold Region

Monitoring in this threshold region indicates a downward trend in groundwater levels. However, much of this downward trend is due to hydrologic variability and may be recovered in the future. Therefore, MTs have been set to allow for greater flexibility as compared to other regions. The MT for wells in this region intends to protect domestic, private, public and environmental uses of the groundwater by allowing for managed extraction in areas that have beneficial uses and protecting those with at risk infrastructure.

Stakeholders reported concern about the dewatering of domestic wells in this region, and groundwater levels have been declining in monitoring wells. Both the MT and MO consider the sustainability of water levels in regard to both domestic and agricultural users.

The MT was calculated by taking the total historical range of recorded groundwater levels and used 35 percent of the range. This 35 percent was then added below the value closest to January 1, 2015 (as described above).

MOs were calculated by subtracting five years of groundwater storage from the MT. Five years of storage was found by calculating the decline in groundwater levels from 2013 to 2018 (a drought period). If measurements were insufficient for this time period, a linear trendline was used to extrapolate the value.

IMs were set to equal the MT in 2025, with a projected improvement to one third the distance between the MT and MO in 2030 and half the distance between the MT and MO in 2035. As a result, IMs will a way to measure progress toward sustainability over the GSP's planning horizon.

Groundwater levels will be measured using the protocols documented in Chapter 4's Appendix A.

Central Threshold Region

Monitoring in this threshold region indicates a decline in groundwater levels, indicating an extraction rate that exceeds recharge rates. The MT for this region is set to allow current beneficial uses of groundwater while reducing extraction rates over the planning horizon to meet sustainable yield. The MO is intended to allow sufficient operational flexibility for future drought conditions.



The MT for representative wells in the Central-Threshold Region was calculated by finding the maximum and minimum groundwater levels for each representative well, and calculating 20 percent of the historical range. This 20 percent was then added to the depth to water measurement closest to, but not before, January 1, 2015, and no later than April 30, 2015. If no measurement was taken during this four-month period, then a linear trendline was applied to the wells data, and the value for January 1, 2015 was extrapolated.

The MO was calculated by subtracting five years of groundwater storage from the MT. Five years of storage was found by calculating the decline in groundwater levels from 2013 to 2018 (a drought period). If measurements were insufficient for this time period, a linear trendline was used to extrapolate the value.

For Opti-Wells 74, 103, 114, 568, 609, and 615, a modified MO calculation was used where the MO used the linear trendline of the full range of measurements to extrapolate a January 1, 2015 value. This modification was made because measurements from 2013 to 2018 in these wells did not provide sufficient data to provide an adequate trendline for calculating the MO.

IMs were set to equal the in 2025, with a projected improvement to one-third the distance between the MT and MO in 2030 and half the distance between the MT and MO in 2035. As a result, IMs will a way to measure progress toward sustainability over the GSP's planning horizon.

Groundwater levels will be measured using the protocols documented in Chapter 4's Appendix A.

Western Threshold Region

Monitoring in this threshold region indicates groundwater levels are stable, and levels varied significantly depending on where representative wells were in the region. The most common use of groundwater in this region is for domestic use. Due to these hydrologic conditions, the MT was set to protect the water levels from declining significantly, while allowing beneficial land surface uses of the groundwater and protection of current well infrastructure. The MT was calculated by taking the difference between the total well depth and the value closest to mid-February, 2018, and calculating 15 percent of that depth. Values from 2018 are used because data collected during this time represent a full basin condition. That value was then subtracted from the mid-February, 2018 measurement to calculate the MT. This allows users in this region to use their groundwater supply without increasing the risk of running a well beyond acceptable limits, and this methodology is responsive to the variety of conditions and well depths in this region.

The MO was then calculated by finding the measurement closest to mid-February, 2018, which monitoring indicates is likely a full condition.

Opti-Well 474 uses a modified MO calculation where the historical high elevation measurement was used as the MO. This was done to allow for a sufficient operational flexibility based on historical data for the well.



IMs were set to equal the in 2025, with a projected improvement to one-third the distance between the MT and MO in 2030 and half the distance between the MT and MO in 2035. As a result, IMs will a way to measure progress toward sustainability over the GSP's planning horizon.

Groundwater levels will be measured using the protocols documented in Chapter 4's Appendix A.

Northwestern Threshold Region

Monitoring in this threshold region indicates levels are stable, with some declines in the area where new agriculture is established. Due to these hydrologic conditions, the MT was set to protect the water levels from declining significantly, while allowing beneficial land surface uses (including domestic and agricultural uses) and using the storage capacity of this region. The MT for the this region was found by determining the region's total average saturated thickness for the primary storage area, and calculating 15 percent of that depth. This value was then set as the MT.

The MO for this region was calculated using 5 years of storage. Because historical data reflecting new operations in this region are limited, 50 feet was used as 5 years of storage based on local landowner input.

There are several representative wells in this region that were reclassified as far-west northwestern wells, and include Opti Wells 830, 831, 832, 833, 834, 835, and 836. These wells have total depths that are shallower, and they use the same strategies as the Western Threshold Region for their MOs and MTs to be more protective of these wells and ensure levels do not drop below the total well depth.

IMs were set to equal the MT in 2025, with a projected improvement to one-third the distance between the MT and MO in 2030 and half the distance between the MT and MO in 2035. As a result, IMs will a way to measure progress toward sustainability over the GSP's planning horizon.

Groundwater levels will be measured using the protocols documented in Chapter 4's Appendix A.

Badlands Threshold Region

This threshold region has no groundwater use or active wells. As a result, no MO, MT, or IM was calculated.

Figure 5-1: Well Protection Depth Stepwise Diagram for Production and Domestic Wells

2. **Recent deepest measurement plus 10 ft or 5% buffer (whichever is greater):** Historical data for the last ten years (2013-2023 based on the timing of the development of this methodology) was analyzed to find the deepest depth to water during that period. A buffer of the greater of either 10 ft or 5% of the depth to water value was then added to the max depth. This methodology



helps utilize, where appropriate, historical and recently collected data that captures both wet and dry periods. This criteria allows for the flexibility for regions of the Basin that experience significant drawdown and recovery during dry and wet hydrologic cycles to manage those variations in groundwater elevation.

3. Projected depth of water in 2040 based on modeled glidepath: The Cuyama Basing Groundwater Model (updated in 2024) was used to project the depth of water in 2040 based on the CBGSA's planned allocation and glidepath pumping reductions. In regions of the Basin where there is significant pumping, this allows for groundwater levels to decline to where the model predicts they will be in 2040 given the anticipated schedule for pumping reductions.

4. Saturated thickness in areas of greater geologic understanding: The calculation for this strategy uses the localized region's total average saturated thickness for the primary storage area and calculating 15 percent of that depth. Because there is an area in the northwestern portion of the Basin with greater geological research and understanding, the saturated thickness provides a measurable and defined direct relationship between available water in the aquifer, storage capacity, and undesirable conditions. As discussed in the following section, additional analysis has also been conducted to ensure that the calculated MTs in this area do not impact beneficial uses or uses at any nearby active wells or potential GDEs.

Using these four options above, the stepwise function to determine the appropriate MT for each RMW is as follows:

1. For RMWs that used the saturated thickness approach in the approved 2020 GSP, utilize that same approach.
2. For RMWs that did not utilize the saturated thickness approach in the approved 2020 GSP,
 - a. First find the deeper of these two values:
 - i. Deepest depth to water (DTW) from 2013-2023 + buffer
 - ii. Cuyama Basin groundwater model projected DTW in 2040
 - b. Then find the shallower value between Step 2a, the WPD and the GDE protection depth

Figure 5-2 shows the groundwater level SMC minimum threshold methodology that resulted from the stepwise function above for all representative wells.

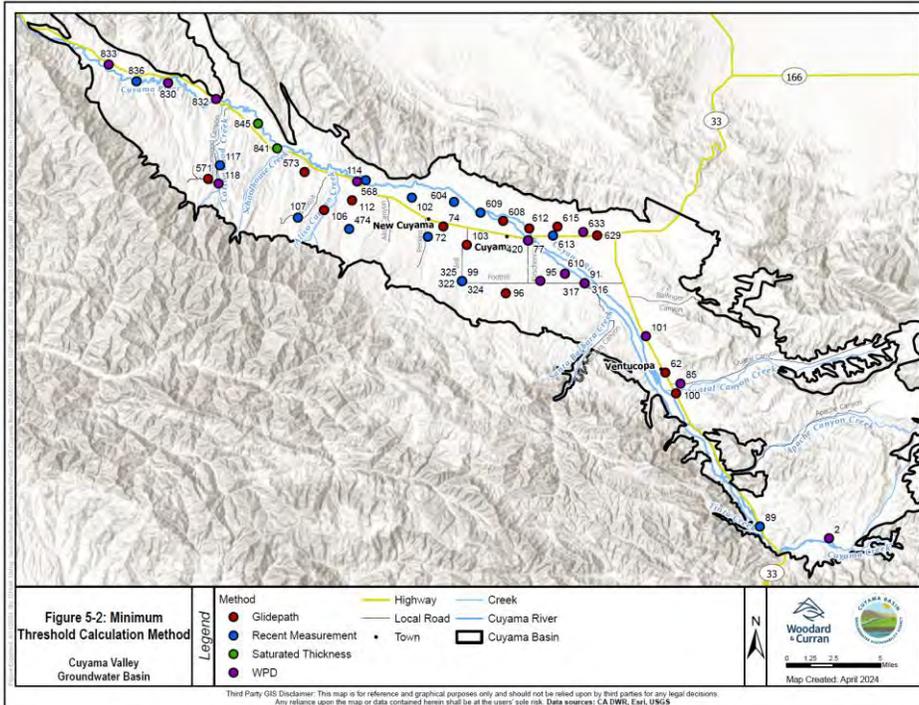
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The CBGSA determined that the same margin of operational flexibility (MoOF) utilized in the 2020 GSP should be used again, unless that margin was less than 10 feet in which the MoOF would be equal to 10 feet.

In summary, this approach achieves the CBGSA's goal of allowing for operational and hydrologic flexibility in all parts of the Basin while also ensuring that groundwater pumping wells and GDEs are protected from negative impacts.



Figure 5-2: Groundwater Level SMC Minimum Threshold Methodology





Analysis of Northwestern Region Minimum Thresholds

DWR's consultation letter expressed concern about whether the thresholds established using the saturated thickness methodology (applied to RMW Opti wells 841 and 845) are protective of nearby beneficial users of water. Specifically, DWR questioned what impact(s) may occur to nearby domestic wells and GDEs if groundwater levels were to reach MTs in representative wells. To address this, the Cuyama Basin Water Resources Model (CBWRM) was used to simulate groundwater level conditions by artificially dropping groundwater levels near Opti Wells 841 and 845 to the set MTs. This was done by assigning specified head boundary conditions at the MT levels for the model nodes near these well locations. The simulation was run for 10 years over the historical period between water years (WY) 2011 to 2020 during which the specified head boundary conditions at the MT levels were continuously active.

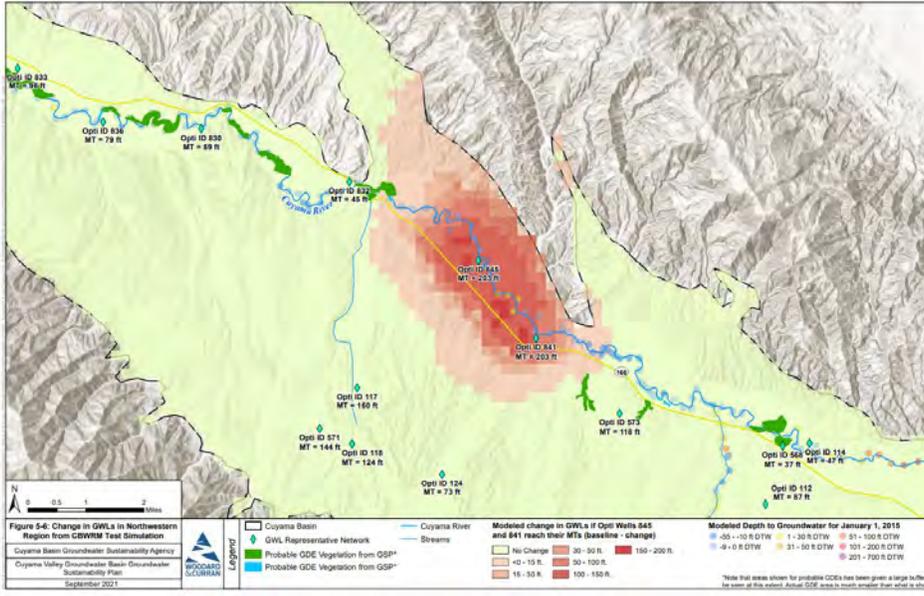
Figure 5-3 shows the modeled change in groundwater elevations resulting from setting groundwater levels at the MTs at wells 841 and 845. Areas shaded in red or tan color on the figure had reduced groundwater elevations as compared to the baseline condition. Areas shaded in lime green were unaffected by the change in groundwater elevations at well 841 and 845 locations. As shown in the figure, there are no active domestic wells within the area affected by the lowered groundwater elevations at wells 841 and 845. The only GDE which may be affected is the GDE located at the confluence of Cottonwood Creek and the Cuyama River, which has an expected impact of less than 5 feet. However, even with this difference, the estimated depth to water at this GDE location would be shallower than 30 feet and therefore should not have a detrimental impact on these potential GDEs. Potential impacts on this GDE location will be monitored at nearby Opti well 832.

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As noted above, the other potential beneficial use that may be affected comes from Cuyama River inflows into Lake Twitchell. The model simulation also showed an increase in stream depletion in the affected portion of the aquifer of about 1,200 acre-feet per year. This represents about 12 percent (out of 10,200 AFY) of the modeled streamflow in the Cuyama River at this location during the WY 2011-2020 model simulation period. However, the actual change in inflows into Lake Twitchell would be less than 1,200 AFY because of stream depletions that would occur between Cottonwood Creek and Lake Twitchell. For comparison, during the same period the USGS gage on the Cuyama River just upstream of Lake Twitchell (11136800) recorded an average annual flow of 7,900 AFY, only a portion of which comes from the Cuyama Basin. Given the lack of data regarding the hydrology and stream seepage between Cottonwood Creek and Lake Twitchell, it is uncertain how much of an impact this would have on the flows that ultimately are stored in Lake Twitchell.



Figure 5-3: Change in Groundwater Levels for Wells that Utilize the Saturated Thickness Methodology for MTs from CBWRM Test Simulation





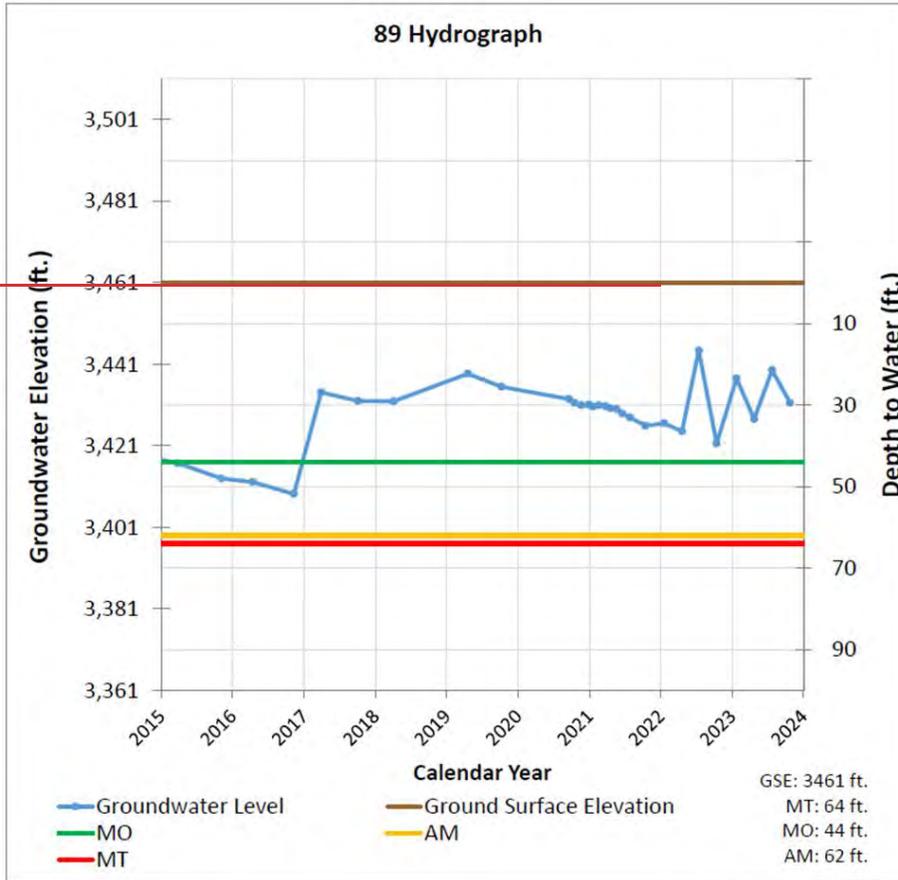
5.2.3 Selected MT, MO, and IM Graphs, Figures, and Tables

Figure 5-4 shows an example hydrograph with indicators for the MT ~~and~~, MO, ~~and~~ IM over the hydrograph. The left axis shows elevation above mean sea level, the right axis shows depth to water below ground surface. The brown line shows the ground surface elevation, and time in years is shown on the bottom axis. Each measurement taken at the monitoring well is shown as a blue dot, with blue lines connecting between the blue dots indicating the interpolated groundwater level between measurements. The MT and IM are shown as a red line, and the MO is shown as a green line. Appendix A includes hydrographs with MT, MO and IM for each representative monitoring well.

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Table 5-1 shows the representative monitoring network and the numerical values for the MT, MO, and IM ~~for each representative well~~.

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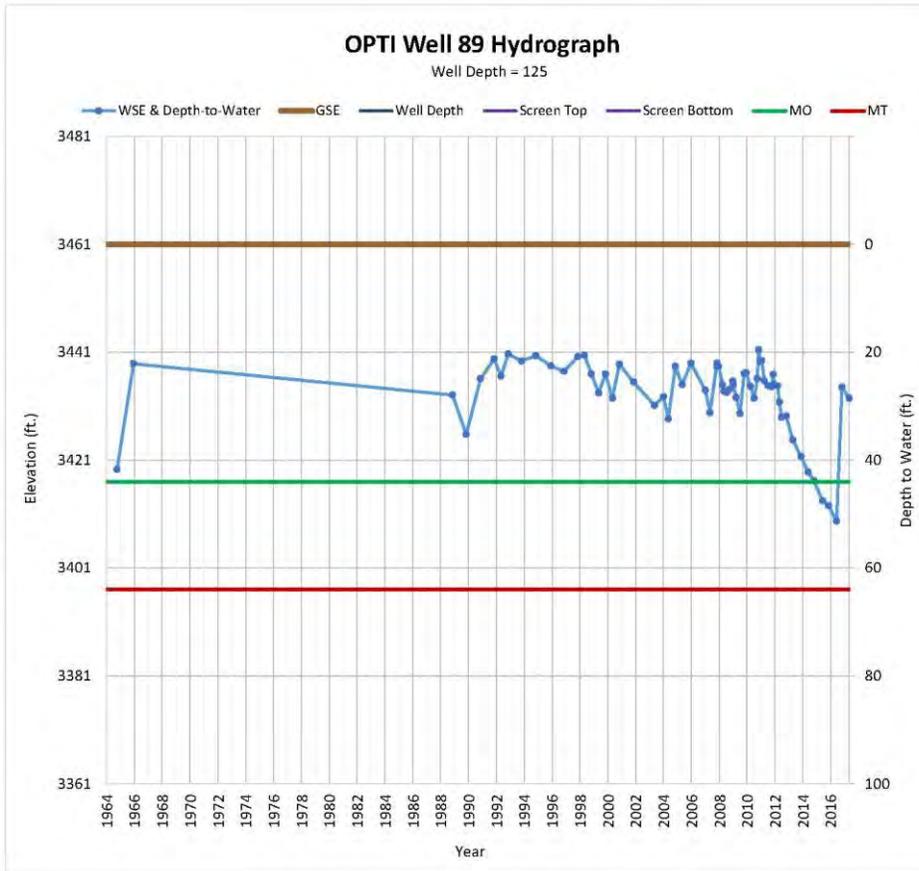


Figure 5-4: Example Hydrograph



Table 5-1: Representative Monitoring Network and Sustainability Criteria

OPTI Well	Region	Final MT	Final MO	2025 IM	2030 IM	2035 IM	Well Depth (feet)	Screen Top (feet)	Screen Bottom (feet)	GSE (feet)	
72	Central		<u>373469</u>	<u>328424</u>	<u>362469</u>	<u>350454</u>	<u>339447</u>	790	340	350	2,171
74	Central		<u>322256</u>	<u>309243</u>	<u>319256</u>	<u>316252</u>	<u>312250</u>	--	--	--	2,193
77	Central		<u>514450</u>	<u>464400</u>	<u>501450</u>	<u>489433</u>	<u>476425</u>	980	960	980	2,286
91	Central		<u>730625</u>	<u>681576</u>	<u>718625</u>	<u>705609</u>	<u>693604</u>	980	960	980	2,474
95	Central		<u>597573</u>	<u>562538</u>	<u>588573</u>	<u>580564</u>	<u>571556</u>	805	--	--	2,449
96	Central		<u>369333</u>	<u>361325</u>	<u>367333</u>	<u>365330</u>	<u>363329</u>	500	--	--	2,606
98	Central		450	430	450	446	445	750	--	--	2,688
99	Central		<u>379344</u>	<u>368300</u>	<u>377344</u>	<u>374307</u>	<u>371306</u>	750	730	750	2,513
102	Central		<u>470235</u>	<u>432497</u>	<u>461235</u>	<u>451222</u>	<u>442246</u>	--	--	--	2,046
103	Central		<u>379290</u>	<u>324235</u>	<u>365290</u>	<u>351272</u>	<u>338263</u>	1,030	--	--	2,289
112	Central		<u>10287</u>	<u>10085</u>	<u>10187</u>	<u>10186</u>	<u>10086</u>	441	--	--	2,139
114	Central		<u>5847</u>	<u>5645</u>	<u>5847</u>	<u>5746</u>	<u>5746</u>	58	--	--	1,925
316	Central		<u>731623</u>	<u>682574</u>	<u>719623</u>	<u>706607</u>	<u>694599</u>	830	--	--	2,474
317	Central		<u>700623</u>	<u>650573</u>	<u>688623</u>	<u>675606</u>	<u>663598</u>	700	--	--	2,474
322	Central		<u>387307</u>	<u>378298</u>	<u>385307</u>	<u>383304</u>	<u>381303</u>	850	--	--	2,513
324	Central		<u>365344</u>	<u>353299</u>	<u>362344</u>	<u>359307</u>	<u>356305</u>	560	--	--	2,513
325	Central		<u>331300</u>	<u>323292</u>	<u>329300</u>	<u>327297</u>	<u>325296</u>	380	--	--	2,513
420	Central		<u>514450</u>	<u>464400</u>	<u>501450</u>	<u>489433</u>	<u>476425</u>	780	--	--	2,286

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Table 5-1: Representative Monitoring Network and Sustainability Criteria

OPTI Well	Region	Final MT	Final MO	2025 IM	2030 IM	2035 IM	Well Depth (feet)	Screen Top (feet)	Screen Bottom (feet)	GSE (feet)	
421	Central		<u>514446</u>	<u>466398</u>	<u>502446</u>	<u>490430</u>	<u>478422</u>	620	--	--	2,286
422	Central		444	397	444	428	421	460	--	--	2,286
474	Central		<u>197488</u>	<u>178460</u>	<u>192488</u>	<u>188482</u>	<u>183470</u>	213	--	--	2,369
568	Central		<u>4737</u>	<u>4636</u>	<u>4737</u>	<u>4737</u>	<u>4637</u>	188	--	--	1,905
604	Central		<u>544526</u>	<u>505487</u>	<u>534526</u>	<u>524543</u>	<u>515507</u>	924	454	924	2,125
608	Central		<u>504436</u>	<u>475407</u>	<u>497436</u>	<u>490426</u>	<u>483422</u>	745	440	745	2,224
609	Central		<u>499458</u>	<u>462424</u>	<u>490458</u>	<u>480446</u>	<u>471440</u>	970	476	970	2,167
610	Central		<u>557624</u>	<u>527504</u>	<u>549624</u>	<u>542644</u>	<u>534606</u>	780	428	780	2,442
612	Central		<u>513463</u>	<u>490440</u>	<u>507463</u>	<u>502455</u>	<u>496452</u>	1,070	657	1070	2,266
613	Central		<u>578503</u>	<u>550475</u>	<u>571503</u>	<u>564404</u>	<u>557480</u>	830	330	830	2,330
615	Central		<u>588500</u>	<u>556468</u>	<u>580500</u>	<u>572480</u>	<u>564484</u>	865	480	865	2,327
620	Central		606	566	606	593	586	4,035	550	4035	2,432
629	Central		<u>613550</u>	<u>581527</u>	<u>605550</u>	<u>597548</u>	<u>589543</u>	1,000	500	1000	2,379
633	Central		<u>605547</u>	<u>551493</u>	<u>591547</u>	<u>578520</u>	<u>564520</u>	1,000	500	1000	2,364
62	Eastern		<u>212482</u>	<u>187457</u>	<u>206482</u>	<u>199460</u>	<u>193470</u>	212	--	--	2,921
85	Eastern		<u>200233</u>	<u>176200</u>	<u>194233</u>	<u>188204</u>	<u>182224</u>	233	--	--	3,047
100	Eastern		<u>186484</u>	<u>157452</u>	<u>179484</u>	<u>172462</u>	<u>164467</u>	284	--	--	3,004
101	Eastern		<u>138444</u>	<u>11588</u>	<u>133444</u>	<u>127404</u>	<u>121400</u>	200	--	--	2,741

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Table 5-1: Representative Monitoring Network and Sustainability Criteria

OPTI Well	Region	Final MT	Final MO	2025 IM	2030 IM	2035 IM	Well Depth (feet)	Screen Top (feet)	Screen Bottom (feet)	GSE (feet)	
840	Northwestern		203	453	203	486	478	900	200	880	4,713
841	Northwestern		203	153	<u>191203</u>	<u>178486</u>	<u>166478</u>	600	170	580	1,761
843	Northwestern		203	453	203	486	478	620	60	600	4,764
845	Northwestern		203	153	<u>191203</u>	<u>178486</u>	<u>166478</u>	380	100	360	1,712
849	Northwestern		203	453	203	486	478	570	450	550	4,713
2	Southeastern		<u>5272</u>	<u>3555</u>	<u>4872</u>	<u>4466</u>	<u>3964</u>	73	--	--	3,720
89	Southeastern		<u>6264</u>	<u>4244</u>	<u>5764</u>	<u>5257</u>	<u>4754</u>	125	--	--	3,461
106	Western		<u>164154</u>	<u>152441.4</u>	<u>161454</u>	<u>158450</u>	<u>155448</u>	227.5	--	--	2,327
107	Western		<u>12294</u>	<u>10372.23</u>	<u>11794</u>	<u>11385</u>	<u>10882</u>	200	--	--	2,482
408	Western		465	435.62	465	455	450	328.75	--	--	2,629
117	Western		<u>163460</u>	<u>154450.82</u>	<u>161460</u>	<u>158457</u>	<u>156455</u>	212	--	--	2,098
118	Western		<u>40424</u>	<u>1057.22</u>	<u>24424</u>	<u>7402</u>	<u>-1094</u>	500	--	--	2,270
423	Western		34	42.50	34	25	22	438	--	--	2,465
424	Western		73	57.12	73	68	65	460.55	--	--	2,287
427	Western		42	34.74	42	39	37	400.25	--	--	2,364
571	Western		<u>142444</u>	<u>118420.5</u>	<u>136444</u>	<u>130436</u>	<u>124432</u>	280	--	--	2,307
573	Western		<u>93448</u>	<u>4267.5</u>	<u>80448</u>	<u>68404</u>	<u>5593</u>	404	--	--	2,084
830	Far-West Northwestern		<u>6350</u>	<u>6056</u>	<u>6250</u>	<u>6258</u>	<u>6158</u>	77.2	--	--	1,571

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Table 5-1: Representative Monitoring Network and Sustainability Criteria

OPTI Well	Region	Final MT	Final MO	2025 IM	2030 IM	2035 IM	Well Depth (feet)	Screen Top (feet)	Screen Bottom (feet)	GSE (feet)
831	Far-West Northwestern	77	52	77	69	65	213.75	-	-	1,557
832	Far-West Northwestern	5045	3530	4645	4340	3938	131.8	--	--	1,630
833	Far-West Northwestern	4896	1024	3096	1272	-660	503.55	--	--	1,457
834	Far-West Northwestern	84	42	84	70	63	320	-	-	1,508
835	Far-West Northwestern	55	36	55	49	46	162.2	-	-	1,555
836	Far-West Northwestern	4979	1036	3879	2865	1758	325	--	--	1,486

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5.3 Reduction of Groundwater Storage

The undesirable result for the reduction in groundwater storage is a result that causes significant and unreasonable reduction in the viability of domestic, agricultural, municipal, or environmental uses over the planning and implementation horizon of this GSP.

Direct measurement of the reduction of groundwater storage in the Basin is not needed because monitoring in several areas of the Basin (i.e., the western, southeastern, and portions of the north facing slope of the Cuyama Valley near the center of the Basin) indicate that those regions are likely near, or at full conditions. Additionally, the Basin's primary aquifer is not confined and storage closely matches groundwater levels.

SGMA regulations define the MT for reduction of groundwater storage as "...the total volume of groundwater that can be withdrawn from the basin without causing conditions that may lead to undesirable results."

Undesirable results for groundwater storage volumes in this GSP will use groundwater levels as a proxy, as the groundwater level sustainability criteria are protective of groundwater in storage.

5.3.1 Threshold Regions

~~Groundwater storage is measured by proxy using groundwater level thresholds, and thus uses the same methodology and threshold regions as groundwater levels.~~

5.3.25.3.1 Proxy Monitoring

Reduction of groundwater storage in the Basin uses groundwater levels as a proxy for determining sustainability, as permitted by Title 23 of the California Code of Regulations in Section 354.26 (d), Chapter 1.5.2.5. Additionally, there are currently no state, federal, or local standards that regulate groundwater storage. As described above, any benefits to groundwater storage are expected to coincide with groundwater level management.

5.4 Seawater Intrusion

Due to the geographic location of the Basin, seawater intrusion is not a concern, and thus is not required to establish criteria for undesirable results for seawater intrusion, as supported by Title 23 of the California Code of Regulations in Section 354.26 (d), Chapter 1.5.2.5.

5.5 Degraded Water Quality

The undesirable result for degraded water quality is a result stemming from a causal nexus between SGMA-related groundwater quantity management activities and groundwater quality that causes significant and unreasonable reduction in the long-term viability of domestic, agricultural, municipal, or environmental uses over the planning and implementation horizon of this GSP.



The SGMA regulations specify that, “minimum thresholds for degraded water quality shall be the degradation of water quality, including the migration of contaminant plumes that impair water supplies or other indicator of water quality as determined by the Agency that may lead to undesirable results.”

Salinity (measured as total dissolved solids [TDS]), arsenic, and nitrates ~~were have all been identified during the development of the 2020 GSP as potential constituents potentially being of concern for water quality in the Basin.~~ However, ~~recent data analysis has led the CBGSA to conclude that thresholds for TDS are warranted and thresholds for as noted in the Groundwater Conditions section, there have only been two nitrate measurements and three arsenic measurements in recent years that exceeded MCLs. In the case of arsenic, all of the high concentration measurements have been taken at groundwater depths of greater than 700 feet, outside of the range of pumping. Furthermore, unlike with salinity, there is no evidence to suggest a causal nexus between potential GSP actions and arsenic or salinity. Therefore, the groundwater quality network has been established to monitor for salinity (measured as TDS) but does not aligned with the CBGSAs role within the Subbasin. include arsenic or nitrates at this time.~~

TDS is being monitored by the GSA for several reasons. Local stakeholders identified TDS as one of the constituents of concerns in the GSP development processes, and TDS has had several exceedance measurements near domestic and public supply wells. Although high TDS concentrations are naturally occurring within the Basin, it is believed that management of groundwater levels may help improve TDS concentration levels towards levels reflective of the natural condition.

5.5.1 – Threshold Regions

~~Groundwater quality monitoring does not use threshold regions, because the same approach is used for all wells in the Basin. Figure 5-3 shows groundwater quality representative well locations in the Basin.~~



~~Figure 5-3-~~ The CBGSA will continue to monitor TDS and utilize the undesirable results statement and UR triggers identified in Section 3.2.4 to determine the appropriate actions and timing of applicable actions to address water quality concerns. As discussed in Section 7.6 Adaptive Management, the CBGSA has also set adaptive management triggers. Adaptive management triggers are thresholds that, if reached, initiate the process for considering implementation of adaptive management actions or projects. During GSP implementation, regular monitoring reports will be prepared for the CBGSA that summarize and provide updates on groundwater conditions, including groundwater quality.

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Nitrates and Arsenic

Nitrates are the result of fertilizer application on agricultural land. The CBGSA does not have the regulatory authority granted through SGMA to regulate the application of fertilizer. This regulatory authority is held by the SWRCB through the Irrigated Lands Regulatory Program (ILRP). The CBGSA can encourage agricultural users in the Basin to use best management practices when using fertilizers but cannot limit their use. Because the CBGSA has no mechanism to directly control nitrate concentrations, the GSA believes that setting thresholds for nitrates is not appropriate. However, it should be noted that GSP implementation will likely have an indirect effect on nitrates in the central portion of the Basin due to the reduction in pumping allocations that were included in the GSP. This will likely reduce the application of fertilizers in the central part of the Basin as agricultural production in the Basin is reduced over time.

Similarly, because arsenic is naturally occurring, the CBGSA does not believe the establishment of thresholds for arsenic is appropriate. As shown in Figure 2-79, wells with high arsenic concentrations are located in a relatively small area of the Basin south of New Cuyama. A review of production well data provided by the counties (discussed in Section 2) indicates that there are no active private domestic wells located in this part of the Basin. The only operational public well that that is located in this part of the Basin serves the Cuyama Community Services District (CCSD). As described in Chapter 7, the CCSD is currently pursuing the drilling of a new production well, which was included as a project in the GSP. Once this well is completed, it is not believed that any domestic water users will be using a well that accesses groundwater with known high arsenic concentrations.

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Monitoring Approach for Nitrates and Arsenic

The CBGSA will continue to coordinate and work with the Regional Water Quality Control Board and other responsible regulatory programs on a regular basis for the successful and sustainable management of water resources that protect against undesirable conditions related to nitrates and arsenic. As discussed in Chapter 4, the CBGSA will take nitrate and arsenic measurements once every five years as part of its monitoring program and will use existing monitoring programs for nitrates and arsenic, in particular ILP for nitrates and USGS for arsenic.

In the event groundwater conditions related to nitrate and arsenic begin to impact the beneficial uses and users of groundwater in the Basin, the CBGSA will notify the appropriate regulatory program and/or agency and initiate more frequent coordination to address those conditions and support their regulatory actions to address those conditions. If undesirable groundwater



conditions for nitrate and arsenic are found to be the result of Basin management by the CBGSA, a process may be developed to help mitigate or assist those uses and users by utilizing adaptive management strategies, including pumping management or well rehabilitation or replacement. At this time, however, the CBGSA will rely on the current processes and programs set forth to manage nitrate and arsenic in a sustainable manner.Groundwater Quality Representative Wells



5-5.25.5.1 Proxy Monitoring

Proxy monitoring is not used for groundwater quality monitoring in the Basin.

5-5.35.5.2 Minimum Thresholds, Measurable Objectives, and Interim Milestones

The CBGSA has decided to address TDS within the Basin by setting MTs, MOs, and IMs as shown in **Table 5-2**. TDS does not have a primary maximum contaminant level (MCL), but does have both a California Division of Drinking Water and U.S. Environmental Protection Agency. Secondary standard of 500 milligrams per liter (mg/L), and a short-term standard of 1,500 mg/L. Current levels in the Basin range from 84 to 4,400 mg/L. This is due to saline conditions in the portions of the watershed where rainfall percolates through marine sediments that contain large amounts of salt.

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Due to this natural condition, additional data **has been and will continue to** be collected during GSP implementation to increase the CBGSA's understanding of TDS sources in the Basin. It should be noted however, that TDS levels in groundwater may not detrimentally impact the agricultural economy of the Basin. Much of the crops grown in the Basin, including carrots, are not significantly affected by the kinds of salts in the Basin.

Due to these factors, the MT for representative well sites was set to be the 20 percent of the total range of each representative monitoring site above the 90th percentile of measurements for each site. For example, Opti Well 72 has a minimum recorded TDS value of 955 mg/L and a maximum of 1,020 mg/L. This is a range of 65 mg/L, and 20 percent of that range is 13 mg/L. The 90th percentile for Opti Well 72 is 1,010 mg/L. The MT is then calculated by taking the 90th percentile of 1,010 mg/L and adding 13mg/L to reach a final MT of 1,023 mg/L.

To provide for an acceptable margin of operational flexibility, the MO for TDS levels in the Basin have been set to the temporary MCL of 1,500 mg/L for each representative well where the latest measurements as of 2018 are greater than 1,500 mg/L. For wells with recent measurements of less than 1,500 mg/L, the MO was set to the most recent measurement as of 2018.

GSP regulations require GSAs to avoid undesirable results by 2040, which means they must meet or exceed the MTs. The CBGSA also recognizes that reaching an MO is a priority, but meeting or exceeding the MT is required by SGMA. For this reason, the IMs for 2025 has been set as the same value as the MT, with a projected improvement to one-third of the distance between the MT and MO in 2030 and one-half of the distance between the MT and MO in 2035.



Table 5-2: MOs, MTs, and Interim Milestones for Groundwater Quality Representative Sites - TDS

Opti Well	Well Depth (feet below GSE)	Screen Interval (feet below GSE)	Well Elevation (feet above MSL)	Most Recent Measurement (feet)	Minimum Value (mg/L)	Maximum Measurement Value (mg/L)	20% of Range (mg/L)	90 th Percentile (mg/L)	MO (mg/L)	MT (mg/L)	2025 I M (mg/L)	2030 I M (mg/L)	2035 IM (mg/L)
61	357	Unkn own	36813 ,684	585	10004 68	896602	793 26.8	68958 8.4	685	645.2	645	605	600
72	790	340 – 350	21712 ,174	900996	11069 55	105540 20	100 343	95240 40	996	4,023	4023	4014	4010
73	880	Unkn own	2,252	805	777	844	43.4	842.5	805	855.9	856	839	830
74	--	Unkn own	21932 ,193	13104,5 50	18724 ,530	17324,8 20	159 158	14514 775	4,500	4,833	4833	4722	4667
76	720	Unkn own	2,277	4,700	1,280	2,400	482	2,124. 9	4,500	2,306. 9	2307	2038	4903
77	980	960 – 980	22862 ,286	1,12052 0	16824 ,520	15424,5 80	140 142	12614 580	4,500	4,592	4592	4564	4546
79	600	Unkn own	23742 ,374	2,140	4,840	2,280	94	2226	1,500	23182, 320	21142 320	19092 047	17054940
84	455	Unkn own	2,698	2,620	2,620	2,760	28	2760	4,500	2,788	2788	2350	2144

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Table 5-2: MOs, MTs, and Interim Milestones for Groundwater Quality Representative Sites - TDS

Opti Well	Well Depth (feet below GSE)	Screen Interval (feet below GSE)	Well Elevation (feet above MSL)	Most Recent Measurement (feet)	Minimum Value (mg/L)	Maximum Measurement Value (mg/L)	20% of Range (mg/L)	90 th Percentile (mg/L)	MO (mg/L)	MT (mg/L)	2025 I M (mg/L)	2030 I M (mg/L)	2035 IM (mg/L)
83	198	Unknown	28582.858	1,120660	18164.660	16421.720	1468.12	12944.714	1,500	1,726	1726	1654	1613
85	233	Unknown	3,047	618	491	1,500	201.8	1,189.4	618	1,391.2	1394	1133	1005
86	230	Unknown	3,144	969	912	969	11.4	963.3	969	974.7	975	973	972
87	232	Unknown	3,546	1,090	891	1,160	53.8	1,114	1,090	1,164.8	1165	1140	1127
88	400	Unknown	35493.549	320302	1000302	830302	6600	490302	302	302	302	302	302
90	800	Unknown	25522.552	1,400530	15964.440	1,580	28	1,565	1,500	1,593	1593	1562	1547
91	980	960 – 980	24742.474	1,020410	15581.410	14241.480	1289.14	11551.473	1,410	1,487	1487	1461	1449
94	550	Unknown	2,456	1,050	1,050	1,230	36	1,209	1,050	1,245	1245	1180	1148
95	805	Unknown	24492.449	13401.740	19501.710	17981.840	1645.26	14931.840	1,500	1,866	1866	1744	1683

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Table 5-2: MOs, MTs, and Interim Milestones for Groundwater Quality Representative Sites - TDS

Opti Well	Well Depth (feet below GSE)	Screen Interval (feet below GSE)	Well Elevation (feet above MSL)	Most Recent Measurement (feet)	Minimum Value (mg/L)	Maximum Measurement Value (mg/L)	20% of Range (mg/L)	90 th Percentile (mg/L)	MO (mg/L)	MT (mg/L)	2025 I M (mg/L)	2030 I M (mg/L)	2035 IM (mg/L)	
96	500	Unknown	26062 26066	11004.5 11009	16764 16500	15324.6 15220	138 824	12444 1608	1,500	1,632	1632	1588	1566	
98	750	Unknown	2,688	2,220	2,220	2,370	30	2,370	1,500	2,400	2400	2100	1950	
99	750	730 – 750	25132 2513	1,14049 11409	16584 16490	15294.5 15295	139 912	12704 1550	1,490	1,562	1562	1538	1526	
101	200	Unknown	27412 2744	12104.5 12105	17354 17550	16044.6 16080	147 326	13414 1667	1,500	1,693	1693	1629	1597	
102	--	Unknown	20462 2046	1,970	1,920	2,290	74	2,277	1,500	25512 354	22882 354	20262 067	17631 026	
130	--	Unknown	3,536	1,800	1,800	1,850	40	1,845	1,500	1,855	1855	1737	1678	
131	--	Unknown	2,990	1,850	1,850	1,970	24	1,958	1,500	1,982	1982	1824	1744	
157	71	Unknown	37553 3755	1,930	1,910	2,320	82	2,278	1,500	12,360	24682 360	21912 073	191419 30	1637
196	741	Unknown	3,117	851	682	868	37.2	866.5	851	903.7	904	886	877	

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Table 5-2: MOs, MTs, and Interim Milestones for Groundwater Quality Representative Sites - TDS

Opti Well	Well Depth (feet below GSE)	Screen Interval (feet below GSE)	Well Elevation (feet above MSL)	Most Recent Measurement (feet)	Minimum Value (mg/L)	Maximum Measurement Value (mg/L)	20% of Range (mg/L)	90 th Percentile (mg/L)	MO (mg/L)	MT (mg/L)	2025 I M (mg/L)	2030 I M (mg/L)	2035 IM (mg/L)
204	--	Unknown	36933 36933,693	380253 380253	1000253 1000253	845266 845266	690 690,26	535266 535266	253	268.6	269	263	261
226	--	Unknown	2,945	1,760	1,760	1,830	44	1,830	1,500	1,844	1844	1720	1672
242 227	155	Unknown	29333 29333,902	1,780	16564 16564,780	14372,2 14372,200	121 121,884	9992,4 9992,446	1,500	2,230	2230	1987	1865
242	155	Unknown	2,933	1,470	1,470	1,510	8	1,510	1,470	1,518	1518	1502	1494
269	--	Unknown	2,756	1,570	1,570	1,690	24	1,678	1,500	1,702	1702	1635	1601
309	1,100	Unknown	2,513	1,410	1,410	1,500	48	1,491	1,410	1,509	1509	1476	1460
316	830	Unknown	24742 24742,474	1,06038 1,060380	15241 15241,380	14081,4 14081,460	129 129,246	11764 11764,452	1,380	1,468	1468	1439	1424
317	700	Unknown	24742 24742,474	6921,26 6921,260	14441 14441,260	12561,3 12561,330	106 106,844	8801,3 8801,323	1,260	1,337	1337	1311	1299
322 318	85061 850610	Unknown	25132 25132,474	1,080	1,080	1,140	1504 1504,42	14134 14134,140	13224 13224,080	12314 12314,152	1152	1128	1116

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Table 5-2: MOs, MTs, and Interim Milestones for Groundwater Quality Representative Sites - TDS

Opti Well	Well Depth (feet below GSE)	Screen Interval (feet below GSE)	Well Elevation (feet above MSL)	Most Recent Measurement (feet)	Minimum Value (mg/L)	Maximum Measurement Value (mg/L)	20% of Range (mg/L)	90 th Percentile (mg/L)	MO (mg/L)	MT (mg/L)	2025 I M (mg/L)	2030 I M (mg/L)	2035 IM (mg/L)
322	850	Unknown	2,513	1,350	1,350	1,380	6	1,380	1,350	1,386	1386	1374	1368
324	560	Unknown	25132,513	740746	1000746	935772	8705.2	805772	746	777.2	777	767	762
325	380	Unknown	25132,513	1,070470	16874,470	15331,560	137848	12244,554	1,470	1,569	1569	1536	1520
400	2,120	Unknown	2,298	918	680	948	53.6	922	918	975.6	976	956	947
420	780	Unknown	22862,286	1,080430	15604,430	14401,480	132040	12004,480	1,430	1,490	1490	1470	1460
421	620	Unknown	22862,286	1,280520	17611,520	16401,600	152046	14004,600	1,500	1,616	1616	1577	1558
422	460	Unknown	2,286	1,810	1,810	1,930	24	1,918	1,500	1,942	1942	1795	1724
424	10004,000	Unknown	22912,294	1,260540	16584,540	1,580	8	1,580	1,500	1,588	1588	1559	14594544, 1360
467	11404,140	Unknown	22242,224	10704,630	18464,530	16521,730	145840	12644,724	1,500	1,764	1764	1676	1632

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Table 5-2: MOs, MTs, and Interim Milestones for Groundwater Quality Representative Sites - TDS

Opti Well	Well Depth (feet below GSE)	Screen Interval (feet below GSE)	Well Elevation (feet above MSL)	Most Recent Measurement (feet)	Minimum Value (mg/L)	Maximum Measurement Value (mg/L)	20% of Range (mg/L)	90 th Percentile (mg/L)	MO (mg/L)	MT (mg/L)	2025 I M (mg/L)	2030 I M (mg/L)	2035 IM (mg/L)
568	188	Unknown	1,905.4	860.874	111.8874	1,054.1480	98.9648	925.429.6	874	1,194.4	1194	1085	1034
702	-	Unknown	3,539	110	48	1,900	370.4	1,704	110	2,074.4	2074	1420	1092
703	-	Unknown	1,613	400	16	4,500	896.8	3,200	400	4,096.8	4097	2865	2248
710	-	Unknown	2,942	1,040	1,040	1,040	0	1,040	1,040	1,040	1040	1040	1040
711	-	Unknown	1,905	928	928	928	0	928	928	928	928	928	928
712	-	Unknown	2,171	977	972	977	4	9,76.5	977	977.5	978	977	977
713	-	Unknown	2,456	1,200	1,200	1,200	0	1,200	1,200	1,200	1200	1200	1200
721	-	Unknown	2,374	2,170	2,170	2,170	0	2,170	1,500	2,170	2170	1947	1835
758	-	Unknown	3,537	900	760	923	32.6	9,21.7	900	954.3	954	936	927



Table 5-2: MOs, MTs, and Interim Milestones for Groundwater Quality Representative Sites - TDS

Opti Well	Well Depth (feet below GSE)	Screen Interval (feet below GSE)	Well Elevation (feet above MSL)	Most Recent Measurement (feet)	Minimum Value (mg/L)	Maximum Measurement Value (mg/L)	20% of Range (mg/L)	90 th Percentile (mg/L)	MO (mg/L)	MT (mg/L)	2025 I M (mg/L)	2030 I M (mg/L)	2035 IM (mg/L)
840	900	200—880	1,713	559	559	559	0	559	559	559	559	559	559
841	600	170—580	17614,764	561	1000564	890564	7810	671564	564	564	564	564	564
842	450	60—430	1,759	547	547	547	0	547	547	547	547	547	547
843	620	60—600	1,764	569	569	569	0	569	569	569	569	569	569
844	730	100—720	1,713	484	484	484	0	484	484	484	484	484	484
845	380	100—360	17124,712	1,250	12504,250	1,250	0	1,250	1,250	1,250	1250	1250	1250
846	610	130—590	1,715	918	918	918	0	918	918	918	918	918	918
847	600	180—580	1,733	480	480	480	0	480	480	480	480	480	480
848	390	110—370	1,694	674	674	674	0	674	674	674	674	674	674

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Table 5-2: MOs, MTs, and Interim Milestones for Groundwater Quality Representative Sites - TDS

Opti Well	Well Depth (feet below GSE)	Screen Interval (feet below GSE)	Well Elevation (feet above MSL)	Most Recent Measurement (feet)	Minimum Value (mg/L)	Maximum Measurement Value (mg/L)	20% of Range (mg/L)	90 th Percentile (mg/L)	MO (mg/L)	MT (mg/L)	2025 I M (mg/L)	2030 I M (mg/L)	2035 IM (mg/L)
849	570	150—550	1,713	1,780	1,780	1,780	0	1,780	1,500	1,780	1780	1687	1640
850	790	180—780	1,759	472	472	472	0	472	472	472	472	472	472



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5.6 Subsidence

The undesirable result for land subsidence is a result that causes significant and unreasonable reduction in the viability of the use of infrastructure over the planning and implementation horizon of this GSP.

5.6.1 Threshold Regions

~~Subsidence monitoring does not use threshold regions, because the same approach is used for all wells in the Basin.~~

~~Figure 5-4 shows representative locations of subsidence in the Basin.~~

5.6.25.6.1 Representative Monitoring

As discussed in ~~Chapter 4~~, Section 4.9, all monitoring network subsidence monitoring stations in the Basin, and three additional sites outside of the Basin are designated as representative monitoring sites. ~~(Figure 5-4)~~. Detrimental impacts of subsidence include groundwater storage reductions and potential damage to infrastructure, such as large pipelines, roads, bridges, and canals. However, the Basin does not currently have infrastructure of this type, and storage losses are small enough they are unlikely to have a meaningful effect on the Basin water budget.

Subsidence in the central portion of the Basin is approximately 0.95 inches per year, as shown in ~~Section Chapter 2, Section 2.2~~. Currently, there are no state, federal, or local standards that regulate subsidence rates.

5.6.35.6.2 Minimum Thresholds, Measurable Objectives, and Interim Milestones

Although several factors may affect subsidence rates, including natural geologic processes, oil pumping, and groundwater pumping, the primary influence within the Basin is due to groundwater pumping. Because current subsidence rates (approximately 0.98 inches per year) are not significant and unreasonable, the MT rate for subsidence was set at 2 inches per year to allow for flexibility as the Basin works toward sustainability in 2040. This rate is applied primarily to the two stations in the Basin (CUHS and VCST), as the other stations in the monitoring network represent ambient changes in vertical displacement, primarily due to geological influences. This level of subsidence is considered unlikely to cause a significant and unreasonable reduction in the viability of the use of infrastructure over the planning and implementation horizon of this GSP.

Subsidence is expected to be influenced through the management of groundwater pumping through the groundwater level MOs, MTs, and IMs. Thus, the MO for subsidence is set for zero lowering of ground surface elevations.



IMs are not needed for the subsidence sustainability indicator because the current rate of subsidence is above the MT.

Subsidence rates will be measured in the frequency of measurement and monitoring protocols documented in Section 4's Appendix A.



Figure 5-4: Subsidence Representative Locations



5.7 Depletions of Interconnected Surface Water

~~This section will be developed once guidance documents are available from DWR. The undesirable result for depletions of interconnected surface water is a result that causes significant and unreasonable reductions in the viability of agriculture or riparian habitat in the Basin over the planning and implementation horizon of this GSP.~~

~~SGMA regulations define the MT for interconnected surface water as “...the rate or volume of surface water depletions caused by groundwater use that has adverse impacts on the beneficial uses of the surface water and may lead to undesirable results.” Under normal surface water conditions in the Basin as of January 1, 2015, surface flows infiltrate into the groundwater system and are used by phreatophytes, except in the most extreme flash flood events, when surface water flows out of the Basin. Historically, these flash flood events flow for less than one week of the year. Conditions have not changed since January 1, 2015, and surface flows continue to infiltrate into the groundwater system for use by local phreatophytes.~~

~~Because current Basin conditions have not varied from January 1, 2015 conditions, the groundwater level thresholds established in Section 5.2 will act to maintain depletions of interconnected surface water at similar levels to those that existed in January 1, 2015. Therefore, groundwater level thresholds are used by proxy to protect the Basin from undesirable results related to depletion of interconnected surface water.~~

5.8 References

California Water Boards Irrigated Land Regulatory Program (ILRP) website.

https://www.waterboards.ca.gov/centralvalley/water_issues/irrigated_lands/. Accessed January 11, 2019.



Chapter 6 Data Management System

This chapter includes an overview of the Cuyama Basin Data Management System (DMS), describes how the DMS works, and details the data used in the DMS. This chapter satisfies Section 352.6 of the Sustainable Groundwater Management Act (SGMA) regulations.

6.1 DMS Overview

The Cuyama Basin DMS uses the Opti platform, which is a flexible and open software platform that uses familiar Google maps and charting tools for analysis and visualization. The DMS serves as a data-sharing portal that enables use of the same data and tools for visualization and analysis. These tools support sustainable groundwater management and create transparent reporting on collected data and analysis results. **Figure 6-1** is a screenshot of the Opti platform.

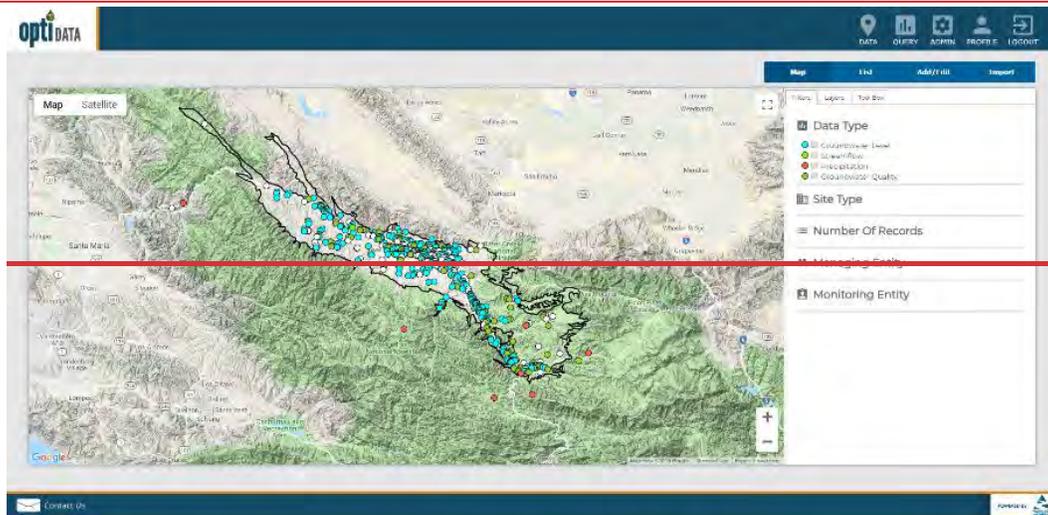
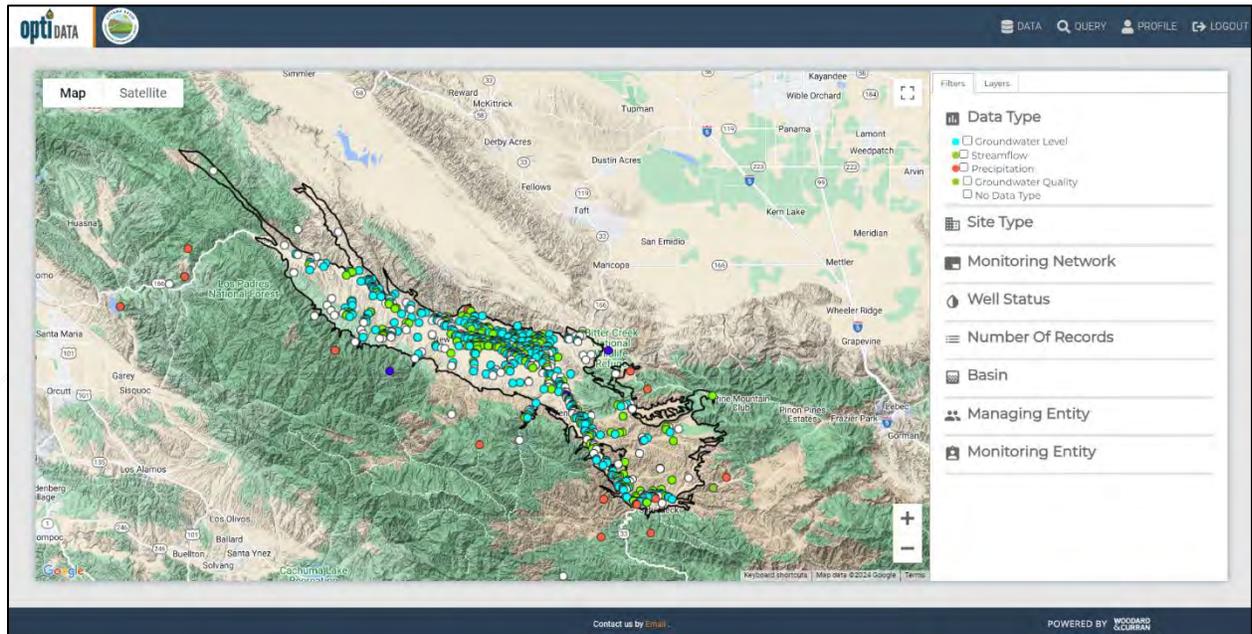


Figure 6-1: Screenshot of Opti Platform

The Cuyama Basin DMS is a web-based publicly accessible portal that may be viewed using common web browsers such as Google Chrome, Firefox, and Microsoft Edge. The DMS utilizes Google maps and other charting tools for analysis and visualization. The site may be accessed at

<http://opti.woodardcurran.com/cuyama>.



6.2 DMS Functionality

The DMS is a modular system that includes numerous tools to support GSP development and ongoing implementation, including the following:

- User and data access permissions
- Data entry and validation
- Visualization and analysis
- Query and reporting

As the needs of the Cuyama Basin Groundwater Sustainability Agency (CBGSA) change over time, the DMS can be configured for additional tools and functionality. The following sections describe the DMS's currently configured tools. For more detailed instructions about how to use the DMS, refer to the Cuyama Basin Data Management System Opti Data Public User Guide (Appendix A).

6.2.1 User and Data Access Permissions

DMS user access permissions are controlled through ~~several~~ user types. These user types have different roles in the DMS as summarized in **Table 6-1** below. These user types are broken into three high-level categories as follows:

- **System Administrator** – System administrators manage information at a system-wide level, with access to all user accounts and entity information. System administrators can set and modify user access permissions when an entity is unable to do so.
- **Managing Entity (Administrator, Power User, User)** – Managing entity users are responsible for managing their entity's site/monitoring data, and can independently control access to these data. Entity users can view and edit their entity's data and view (but not edit) shared or published data supplied by other entities. An entity's site information (i.e., wells, gages, etc.) and associated data may only be edited by system administrators and power users associated with the entity. The CBGSA is currently configured as the managing entity for all datasets in the DMS.
- **Public** – Public users may view data that are published, but may not edit any information. Public users may access the DMS using the guest login feature on the DMS login screen (**Figure 6-2**).



Table 6-1: Data Management System User Types/Access

Modules/ Submodules	System Administrators	Managing Entity			Public
		Admin	Power User	User	
Data: Map	Access to all functionality	Access to all functionality	Access to all functionality	Access to all functionality	Access to partial functionality
Data: List	Access to all functionality	Access to all functionality	Access to all functionality	Access to all functionality	Access to partial functionality
Data: Add/Edit	Access to all functionality	Access to all functionality	Access to all functionality	--	--
Data: Import	Access to all functionality	Access to all functionality	Access to all functionality	--	--
Query	Access to all functionality	Access to all functionality	Access to all functionality	Access to all functionality	Access to partial functionality
Admin	Access to all functionality	--	--	--	--
Profile	Access to all functionality	Access to all functionality	Access to partial functionality	Access to partial functionality	Access to partial functionality

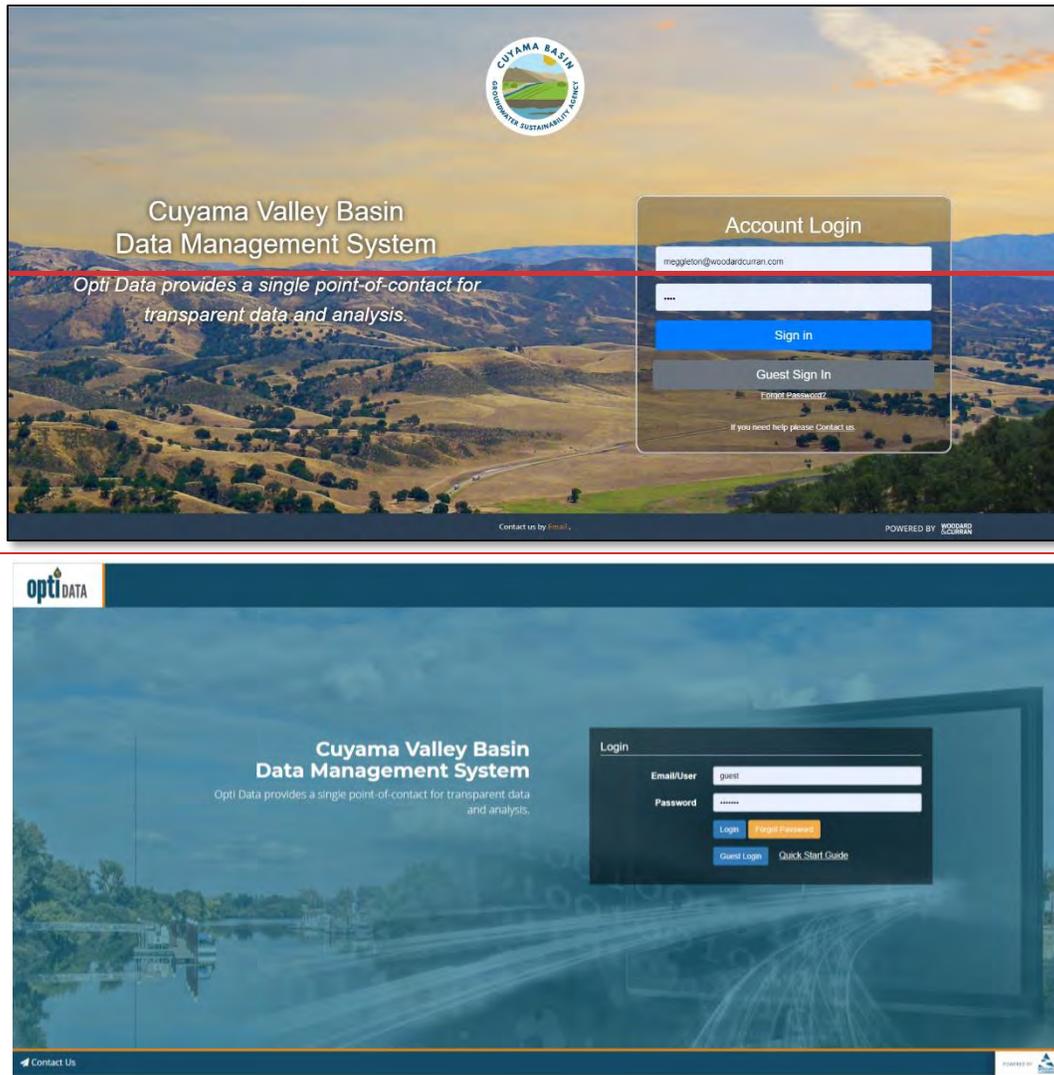


Figure 6-2: Screenshot of Opti Login Screen

Monitoring sites and their associated datasets are added to the DMS by managing entity administrators ~~power users~~. In addition to user permissions, access to the monitoring datasets is controlled through assigning one of three options to the data type as follows:

- **Private data** – Private data are monitoring datasets only available for viewing, depending on user type, by the entity’s associated users in the DMS.
- **Shared data** – Shared data are monitoring datasets available for viewing by all users in the DMS, except for public users.
- **Public data** – Public data are monitoring datasets that are available publicly that can be viewed by all user types in the DMS; public datasets may also be published to other websites or DMSs as needed.



~~Managing entity administrators can set and maintain data access options for each data type associated with their entity.~~

6.2.2 Data Entry and Validation

~~Data~~To encourage agency and user participation in the DMS, data entry and import tools are designed to be easy to use, are accessible over the web, and help maintain data consistency and standardization. The DMS allows entity administrators ~~and power users~~ to enter data either manually via easy-to-use interfaces, or through an import tool using Microsoft Excel templates, so that data may be entered into the DMS as soon as possible after collection. The data records are validated by ~~a managing entity's administrators or power users~~ using a number of quality control checks prior to inclusion in the DMS.

Data Collection Sites

Users can input site information about groundwater wells, stream gages, and precipitation meters manually either through the data entry tool or when prompted in the import tool. Using the data entry tool, new sites may be added by clicking on “New Site.” Existing sites may be updated using the “Edit Site” tool. During data import, the sites associated with imported data are checked by the DMS against an existing site list. If the site is not in the existing site list, the user is prompted to enter the information via the new site tool before the data import can proceed.



Table 6-2 lists the information that is collected for sites. Required information is indicated with an asterisk; all other information is considered optional.

Table 6-2: Data Collection Site Information		
Basic Information	Well Information	Construction Information
Monitoring Network Site Type* Opti Site Name* Local Site Name* State Well ID DWR Site Code Additional Name USGS Code Managing Entity* Monitoring Entity* Monitoring Frequency Latitude/Longitude* Description Coordinates Method County Principal Aquifer County Managing Entity* Monitoring Entity* Type of Monitoring Type of Measurement Monitoring Frequency Principal Aquifer GW Basin Code GW Basin Name Well Location Description	Well Status Well Use Type State Well Completion Type ID MSC (Master State Well Code) USGS Code CASGEM ID Ground Surface Elevation (feet) Reference Point Elevation (feet) Reference Point Location Reference Point Description Well Use Well Status Well Type Aquifers Monitored Groundwater Surface Elevation Basin Name/Code Groundwater Elevation Begin/End Date Groundwater Elevation Measurement Count Water Level Measurement Method Additional Groundwater Quality Begin/End Date Groundwater Quality Measurement Count Comments	Well Completion Report Number Date Constructed Total Well Depth Total Perforation – Interval 1 Borehole Depth Casing Perforations Top/Bottom Perforation – Interval 1 Elevation Casing Material Casing Diameter Date Survey Casing Modifications Well Capacity Well Completion Report Number Comments Construction Documents (att.)
Contacts	Photos	Thresholds
Owner Name Owner Phone Owner Email Owner Address Monitoring Contact Name Monitoring Contact Phone Monitoring Contact Email Monitoring Contact Address	Upload Photos (att.)	MT Elevation MT Depth MO elevation MO Depth TDS MT TDS MO
Notes: ID = identification number MSC = Master State Well Code USGS = United States Geological Survey CASGEM = California Statewide Groundwater Elevation Monitoring Program Att. = attachment (for upload)		



Table 6-2: Data Collection Site Information

Basic Information	Well Information	Construction Information
<p> MT = Minimum Thresholds MO = Measurable Objectives TDS = Total Dissolved Solids * Required information </p>		



Monitoring Data Entry

Monitoring data, including groundwater elevation, groundwater quality, streamflow, and precipitation may be input either manually through the data entry tool or by using templates in the import tool. **Figure 6-3** ~~Figure 6-3~~ is a screenshot of the data entry interface.

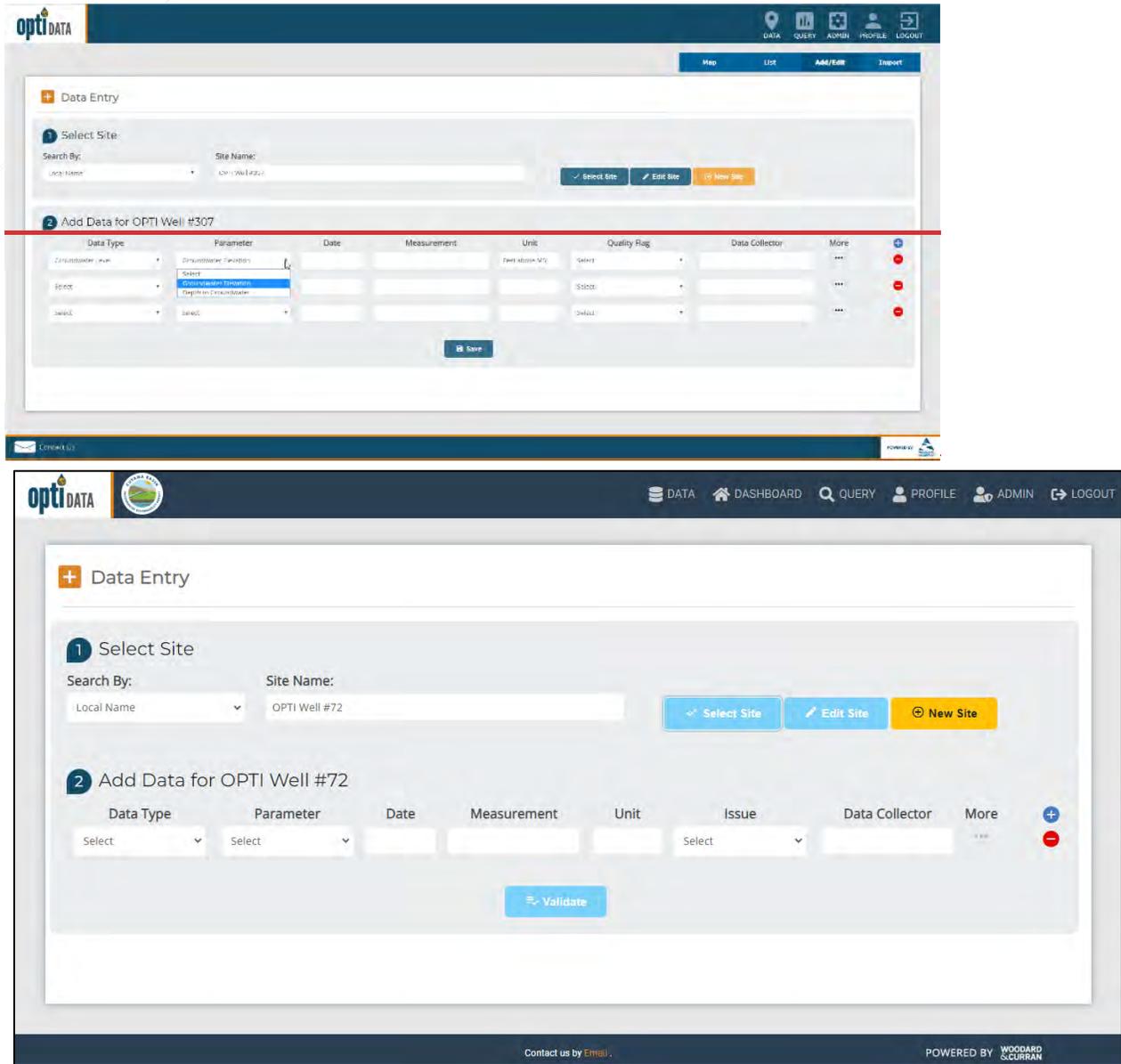


Figure 6-3: Screenshot of Data Entry Tool Interface



The data entry tool allows users to select a site and add data for the site using a web-based form. The following information is collected:

- Data type (e.g. groundwater elevation, groundwater quality, streamflow, or precipitation)
- Parameter for selected data type, units populate based on selection
- Date of measurement
- Measurement value
- Unit of measurement
- Issue/quality ~~Quality~~ flag (i.e., quality assurance description for the measurement such as “Pumping,” “Can’t get tape in casing,” etc. as documented by the data collector)
- Data collector
- Supplemental information based on data type (i.e., reference point elevation, ground surface elevation, etc.)

Data import templates include the same data entry fields and are available for download from the DMS. The Microsoft Excel-based templates contain drop-down options and field validation similar to the data entry interface.

Data Validation

Quality control helps ensure the integrity of the data added to the DMS. The entities that maintain the monitoring data loaded into the DMS may have performed previous validation of that data; no effort was made to check or correct that previous validation, and it was assumed that all data records provided were valid. While it is nearly impossible to determine complete accuracy of the data added to the DMS since the DMS cannot detect incorrect measurements due to human error or mechanical failure, it is possible to verify that the data input into the DMS meets some data quality standards. This helps promote user confidence in the data both stored and published for visualization and analysis.

Upon saving the data via the data entry interface or by importing the data using the Microsoft Excel templates, the following data validation checks are performed by the DMS:

- **Duplicate measurements** – The DMS checks for duplicate entries based on the unique combination of site, data type, date, and measurement value.
- **Inaccurate measurements** – The DMS compares data measurements against historical data for the site and flags entries that are outside the historical minimum and maximum values.
- **Incorrect data entry** – Data field entries are checked for correct data type (e.g., number fields do not include text, date fields contain dates, etc.).

Users are alerted to any validation issues and may either update the data entries or accept the values and continue with the entry/import. Users may access partially completed import validation through the import logs that are saved for each data import. The partially imported datasets are identified in the import



log with an incomplete icon under the status field. This allows a second person to also access the imported data and review prior to inclusion in the DMS.

6.2.3 Visualization and Analysis

Transparent visualization and analysis tools enable use of the same data and methodologies, allowing stakeholders and neighboring GSAs to use the same data and methods for tracking and analysis. In the DMS, data visualization and analysis are performed in both map and list views, as described below.

Map View

The map view displays all sites (i.e., groundwater wells, stream gages, precipitation meters, etc.) in a map-based interface (**Figure 6-4**, ~~Figure 6-4~~). The sites are color-coded based on associated data type and may be filtered by different criteria, such as number of records or monitoring entity. Users may click on a site to view the site detail information and associated data. The monitoring data records are displayed in both chart and table formats. In these views, the user may view different parameters for the data type. The chart and table may be updated to display selected date ranges, and the data may be exported to Microsoft Excel.

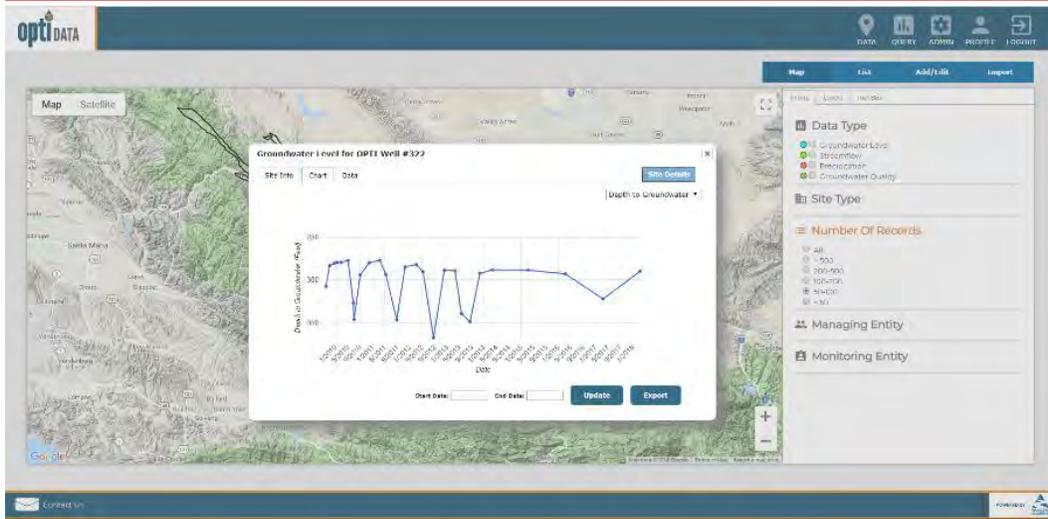


Figure 6-4: DMS Map View

List View

The list view displays all sites (i.e., groundwater wells, stream gages, precipitation meters, etc.) in a tabular interface. The sites are listed according to names and associated entities. The list can be sorted and filtered by different criteria such as number of records or monitoring entity. Similar to the map view, users may click on a site to view the [site's detailed site detail](#) information and associated data. The monitoring data records are displayed in both chart and table formats. In these views, the user may view different parameters for the data type. The chart and table may be updated to display selected date ranges, and the data may be exported to Microsoft Excel.



Analysis Tools

The toolbox is available in the map view and offers administrative ~~and entity users~~ access to the well tiering tool to support monitoring plan development. The DMS' flexible platform allows for the development and addition of future analysis tools, including contouring, total water budget visualization, and management area tracking.

Dashboards

A feature added after the adoption of the GSP is Dashboards within the DMS to assist in the review and assessment of Basin conditions for both groundwater levels and groundwater quality. The dashboards provide a graphical representation of the monitoring sites compared to their thresholds over a user designated period. A color-coded summary table of conditions is also provided relative to each representative sites' minimum threshold. The dashboards may be used by the CBGSA to develop quarter groundwater conditions reports available to the public from the CBGSA website.

6.2.4 Query and Reporting

The DMS has the ability to format and export data and analysis at different levels of aggregation, and in different formats, to support local decision making and for submission to various statewide and local programs (i.e., SGMA, CASGEM Program, Groundwater Ambient Monitoring and Assessment (GAMA) Program, etc.).



Ad Hoc Query

Data in the DMS can be queried and reported using the query tool. The query tool includes the ability to build ad hoc queries using simple options. The data can be queried by the following criteria:

- Monitoring or managing entity
- Site name
- Data type

Once the type of option is selected, the specific criteria may be selected (e.g., groundwater elevation greater than 100 feet). Additionally, users may include time periods as part of the query. The query options can build upon each other to create reports that meet specific needs. Queries may be saved and will display in the saved query drop-down menu for future use.

Query results are displayed in a map format and a list format. In both the map and list views, the user may click on a well to view the associated data. Resulting query data may be exported to Microsoft Excel.

Standard Reports

The DMS can be configured to support wide-ranging reporting needs through the reports tool. Standard report formats may be generated based on a predetermined format and may be created at the click of a button. These report formats may be configured to match state agency requirements for submittals, including annual reporting of monitoring data that must be submitted electronically on forms provided by the California Department of Water Resources (DWR).

6.3 Data Included in the DMS

Because many monitoring programs operate in the Basin at both the local and state/federal levels, -a cross-sectional analysis was conducted during GSP development in the Cuyama Basin to document and assess the availability of water-related data in the Basin. Statewide and federal databases that provide data relevant to Basin were also assessed.



The DMS can be configured to include a wide variety of data types and associated parameters. Based on the analysis of existing datasets from the Basin and GSP needs, **Table 6-3** lists the data that are identified and currently configured in the DMS. The DMS includes 942 monitoring sites~~730 wells~~, of which 511~~488~~ have historical groundwater elevation data and 376~~294~~ have historical groundwater quality measurements.

Table 6-3: Data Types and Their Associated Parameters Configured in the DMS

Data Type	Parameter	Units	Currently Has Data in DMS
Groundwater Elevation	Depth to Groundwater	feet	Yes
	Groundwater Elevation	feet	Yes
Groundwater Quality	Total Dissolved Solids (TDS)	milligrams per liter (mg/L)	Yes
	Nitrate (NO ₃)	mg/L	Yes
	Arsenic	micrograms per liter (µg/L)	Yes
	Benzene	µg/L	No
	Chloride	mg/L	No
	Hexavalent Chromium (Cr(VI))	µg/L	No
	1,2-Dibromo-3-Chloropropane (DBCP)	µg/L	No
	Methyl Tertiary-Butyl Ether (MTBE)	µg/L	No
	Perchlorate	µg/L	No
	Tetrachloroethylene (PCE)	µg/L	No
	Specific Electrical Conductivity (SC)	micromhos per centimeter (µmhos/cm)	No
	1,1,1-Trichloroethane (111-TCA)	µg/L	No
	Trichloroethylene (TCE)	µg/L	No
	1,2,3-Trichloropropane (123-TCP)	µg/L	No
	Chloride (CL)	parts per million (ppm)	No
	Electrical Conductivity (EC)	millimhos (mmhos)	No
Total Dissolved Solids (TDS)	ppm	No	
Streamflow	Streamflow	cubic feet per second (cfs)	Yes
Precipitation	Precipitation	inches	Yes
	Reference Evapotranspiration (ET _o)	--	Yes
	Average Air Temperature	--	No
Subsidence	Subsidence	vertical (in millimeters)	Yes



Additional data types and parameters can be added and modified as the DMS grows over time.

The datasets were collected from a variety of sources, as shown in **Table 6-4**. Each dataset was reviewed for overall quality and consistency prior to consolidation and inclusion in the database. In many cases, there were discrepancies between the ground surface elevation (GSE) of a well from different sources. In these cases of discrepancy, the GSE of the well was updated using the USGS digital elevation model (DEM). The CBGSA did perform a well survey after the adoption of the 2020 GSP, so in some cases, GSEs and RPEs were updated based on the results of that survey.

The groundwater wells shown in the DMS are those that included datasets provided by the monitoring data sources for groundwater elevation and quality. These do not include all wells currently used for production, and may include wells historically used for monitoring that do not currently exist. Care was taken to minimize duplicate well information in the DMS. As datasets were consolidated, sites were evaluated based on different criteria (e.g., naming conventions, location, etc.) to determine if the well was included in a different dataset. Data records for the wells were then associated with the same well, where necessary.

After the datasets were consolidated and reviewed for consistency, they were loaded into the DMS. Using the DMS data viewing capabilities, the datasets were then reviewed for completeness and consistency to ensure imports were successful.

Since the adoption of the 2020 GSP, the CBGSA has continued to collect data, refine its existing dataset, and incorporated new data from other sources as it has become available. Table 6-4 includes the dates of assembled data from the original compilation of the DMS, but has been updated with additional data sources that the CBGSA has utilized.



Table 6-4: Sources of Data Included in the Data Management System

Data Source	Datasets Collected	Date Collected	Activities Performed
US Geological Survey (USGS)	<ul style="list-style-type: none"> • Groundwater • Elevation • Streamflow • Precipitation 	5/4/2018	<ul style="list-style-type: none"> • Removed duplicate records • Recalculated GSE based on DEM on select wells
DWR CASGEM/Water Data Library (WDL)	<ul style="list-style-type: none"> • Groundwater • Elevation 	4/18/2018	<ul style="list-style-type: none"> • Removed duplicate records • Recalculated GSE based on DEM on select wells
San Luis Obispo County	<ul style="list-style-type: none"> • Groundwater • Elevation • Groundwater Quality 	4/2/2018	<ul style="list-style-type: none"> • Removed duplicate records • Recalculated GSE based on DEM on select wells
Santa Barbara County Water Agency	<ul style="list-style-type: none"> • Groundwater • Elevation • Precipitation 	3/27/2018	<ul style="list-style-type: none"> • Removed duplicate records • Recalculated GSE based on DEM on select wells
Ventura County	<ul style="list-style-type: none"> • Groundwater • Elevation • Groundwater Quality • Precipitation 	3/8/2018	<ul style="list-style-type: none"> • Removed duplicate records • Recalculated GSE based on DEM on select wells
DWR Natural Resources Agency	<ul style="list-style-type: none"> • Groundwater Quality 	6/14/2018	<ul style="list-style-type: none"> • Removed duplicate records
GeoTracker	<ul style="list-style-type: none"> • Groundwater Quality 	6/5/2018	<ul style="list-style-type: none"> • Removed duplicate records
California Environmental Data Exchange Network (CEDEN)	<ul style="list-style-type: none"> • Groundwater Quality 	8/29/2018	<ul style="list-style-type: none"> • Removed duplicate records
National Water Quality Monitoring Council	<ul style="list-style-type: none"> • Groundwater Quality 	6/1/2018	<ul style="list-style-type: none"> • Removed duplicate records
UNAVCO	<ul style="list-style-type: none"> • Ground Surface Elevation 	3/12/2018	<ul style="list-style-type: none"> • None
Local Data	<ul style="list-style-type: none"> • Groundwater • Elevation • Groundwater Quality • Other 	Various	<ul style="list-style-type: none"> • Removed duplicate records • Recalculated GSE based on DEM on select wells
<u>CBGSA Monitoring Network Survey</u>		<u>1/29/2021</u>	<ul style="list-style-type: none"> • <u>Survey wells in the GWL Representative network to get updated construction information such as ground surface elevation and reference point elevations.</u>
<u>Domestic Well Survey</u>		<u>2/23/2023</u>	<ul style="list-style-type: none"> • <u>Update current records</u>



Table 6-4: Sources of Data Included in the Data Management System

Data Source	Datasets Collected	Date Collected	Activities Performed
			<ul style="list-style-type: none"> Assist in the development of an "active well" dataset
<u>Active Well Survey</u>		<u>10/1/2022</u>	<ul style="list-style-type: none"> Assist in the development of an "active well" dataset, including production wells
<u>Continued CBGSA Monitoring</u>		<u>Ongoing</u>	<ul style="list-style-type: none"> Continued monitoring



TO: Board of Directors
Agenda Item No. 8i

FROM: Taylor Blakslee / Charles Gardiner

DATE: July 25, 2024

SUBJECT: Discuss and Take Appropriate Action on GSP Amendment Comment Process

Recommended Motion

Approve GSP Update Public Review Process.

Discussion

A brief overview of the public comment process for the Groundwater Sustainability Plan (GSP) amendment is provided in Attachment 1.

Cuyama Basin Groundwater Sustainability Agency

8i. Discuss and Take Appropriate Action on GSP Amendment Comment Process

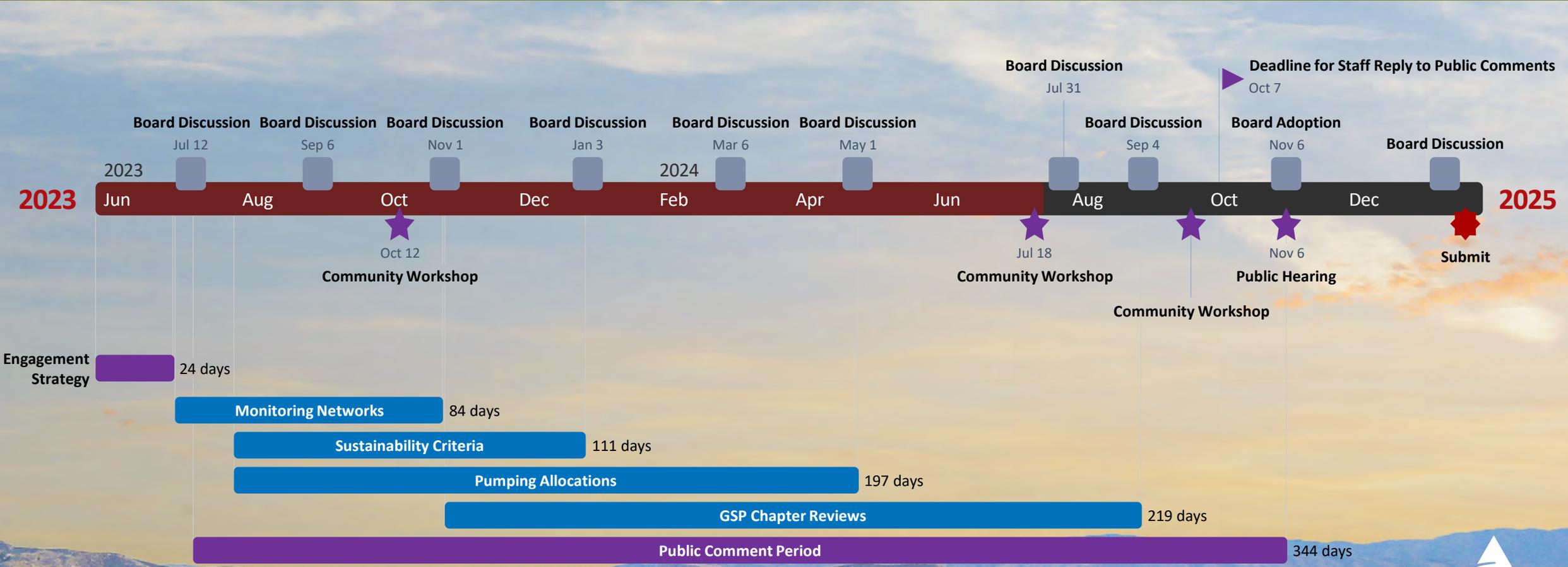
Taylor Blakslee / Charles Gardiner

July 25, 2024

Proposed Public Comment Process

1. Staff to compile stakeholder comments in a matrix and develop draft responses to comments
2. Staff to include matrix in meetings packets for SAC/Board review and direction to staff (September and November)
3. Due to the schedule, comments received after October 7th may not include a staff response, but will be provided for SAC/Board review

GSP Update Timeline



Public Review Next Steps

- **August 29:** SAC meeting
- **September 4:** Board Discussion – Draft GSP Update
- **September 6:** Begin 30-day public review of Draft GSP Update
- **Late September:** Community meeting on Draft GSP Update (date TBD)
- **October 7:** Deadline for staff response to written comments on Draft GSP Update
- **October 31:** SAC meeting
- **November 6:** Public Hearing to receive comments on Final GSP Update
- **November 6:** Board adopts Final GSP
- **January 9, 2025:** SAC Meeting
- **January 15, 2025:** Alternate date for Board adoption of Final GSP Update
- **January 24, 2025:** CBGSA submits Final GSP to DWR

Public Comments on Draft GSP Update

- Public Comments on Final Draft GSP can be provided the following ways:
 - In writing to CBGSA, 4900 California Ave, Tower B, 2nd Floor, Bakersfield, CA 93309
 - Via email to tblakslee@hgcpm.com
 - In-person (orally or written) at SAC, Board, or community meeting

Outreach for Public Comment Period and Public Hearing on Final Draft GSP

- Post card mailing (all parcel owners)
 - Announce public comment opportunity and public hearing date
- Email to CBGSA contact list and post to website
- Flyer for distribution throughout the Cuyama Basin



TO: Standing Advisory Committee
Agenda Item No. 9a

FROM: Brian Van Lienden, Woodard & Curran

DATE: July 25, 2024

SUBJECT: Update on Groundwater Sustainability Plan Activities

Recommended Motion

None – information only.

Discussion

Cuyama Basin Groundwater Sustainability Agency (CBGSA) Groundwater Sustainability Plan (GSP) activities and consultant Woodard & Curran's (W&C) accomplishments are provided as Attachment 1.

Cuyama Basin Groundwater Sustainability Agency

9. Technical Updates

July 25, 2024



May-Jun Accomplishments

- ✓ Performed installation of two multi-completion monitoring wells
- ✓ Performed geophysical surveys at Russell and Santa Barbara Canyon Faults
- ✓ Completed update and re-calibration of the Cuyama Basin groundwater model
- ✓ Developed options for projects and management actions for Board consideration
- ✓ Developed updated draft GSP Chapters 2 and 6 for Board consideration
- ✓ Prepared grant invoice for submittal to DWR



TO: Standing Advisory Committee
Agenda Item No. 9b

FROM: Brian Van Lienden, Woodard & Curran

DATE: July 25, 2024

SUBJECT: Update on Grant-Funded Projects

Recommended Motion

None – information only.

Discussion

An update on Cuyama Basin Groundwater Sustainability Agency (CBGSA) grant-funded projects is provided as Attachment 1.

Cuyama Basin Groundwater Sustainability Agency

9b. Update on Grant Funded Projects

July 25, 2024



Status of Monitoring Well and Piezometer Installation

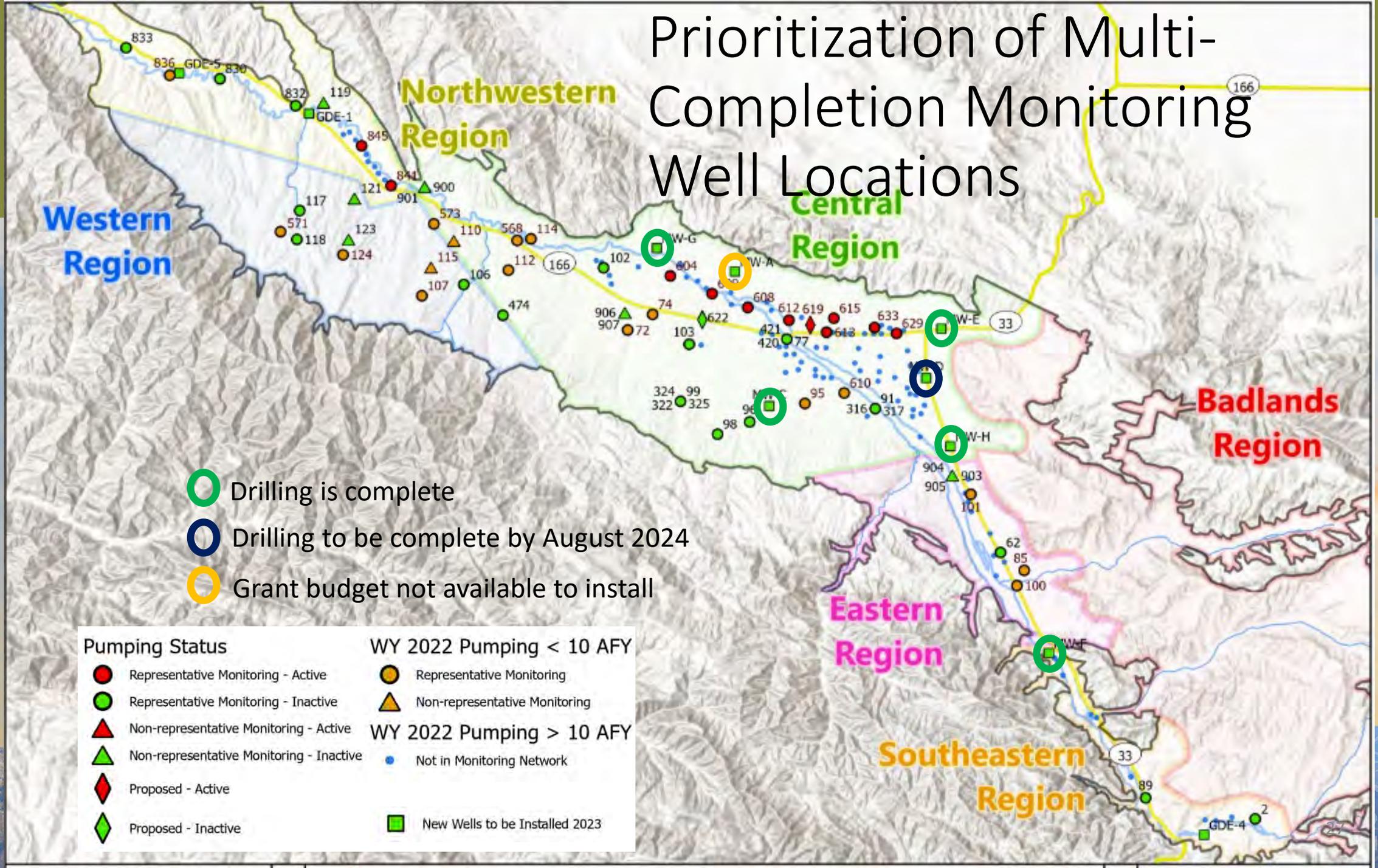
- Piezometer (GDE) Wells:
 - Wells have been constructed at all 3 locations (GDE-1, GDE-4 and GDE-5)
- Multi-Completion Nested Monitoring Wells:
 - MW-F constructed in November 2023. Well screen intervals are 180-200 feet and 350-370 feet.
 - MW-C constructed in February 2024. Well screen interval is 500-520 feet.
 - MW-H constructed in March 2024. Well screen intervals are 660-680 feet and 880-900 feet.
 - MW-E drilling completed in April 2024. Well screen intervals are 610-630 feet and 720-740 feet.
 - MW-G drilling completed in July 2024. Well screen intervals are 280-300 feet and 420-440 feet.
 - MW-D drilling and construction will be complete in August 2024.

Plan and Prioritization for Multi-Completion Monitoring Wells

- Installation of multi-completion wells will be completed at 6 locations with 1 or 2 nested wells at each location

Location	Approximate Depth to Water (Fall 2023)	# of Completions
MW-A	400-500	Removed due to insufficient grant budget
MW-C	480	1
MW-D	600-650	2
MW-E	500-600	2
MW-F	20	2
MW-G	400-500	2
MW-H	610	2

Prioritization of Multi-Completion Monitoring Well Locations



- Drilling is complete
- Drilling to be complete by August 2024
- Grant budget not available to install

Pumping Status		WY 2022 Pumping < 10 AFY	
●	Representative Monitoring - Active	●	Representative Monitoring
●	Representative Monitoring - Inactive	▲	Non-representative Monitoring
▲	Non-representative Monitoring - Active	●	Not in Monitoring Network
▲	Non-representative Monitoring - Inactive	■	New Wells to be Installed 2023
◆	Proposed - Active		
◆	Proposed - Inactive		



TO: Standing Advisory Committee
Agenda Item No. 9c

FROM: Brian Van Lienden, Woodard & Curran

DATE: July 25, 2024

SUBJECT: Update on April 2024 Groundwater Levels Conditions Report

Recommended Motion

None – information only.

Discussion

The quarterly Groundwater Levels Conditions Report for April 2024 is summarized as Attachment 1. The detailed report is provided as Attachment 2.

Cuyama Basin Groundwater Sustainability Agency

9c. Update on Quarterly Groundwater Conditions Report

Brian Van Lienden

July 25, 2024

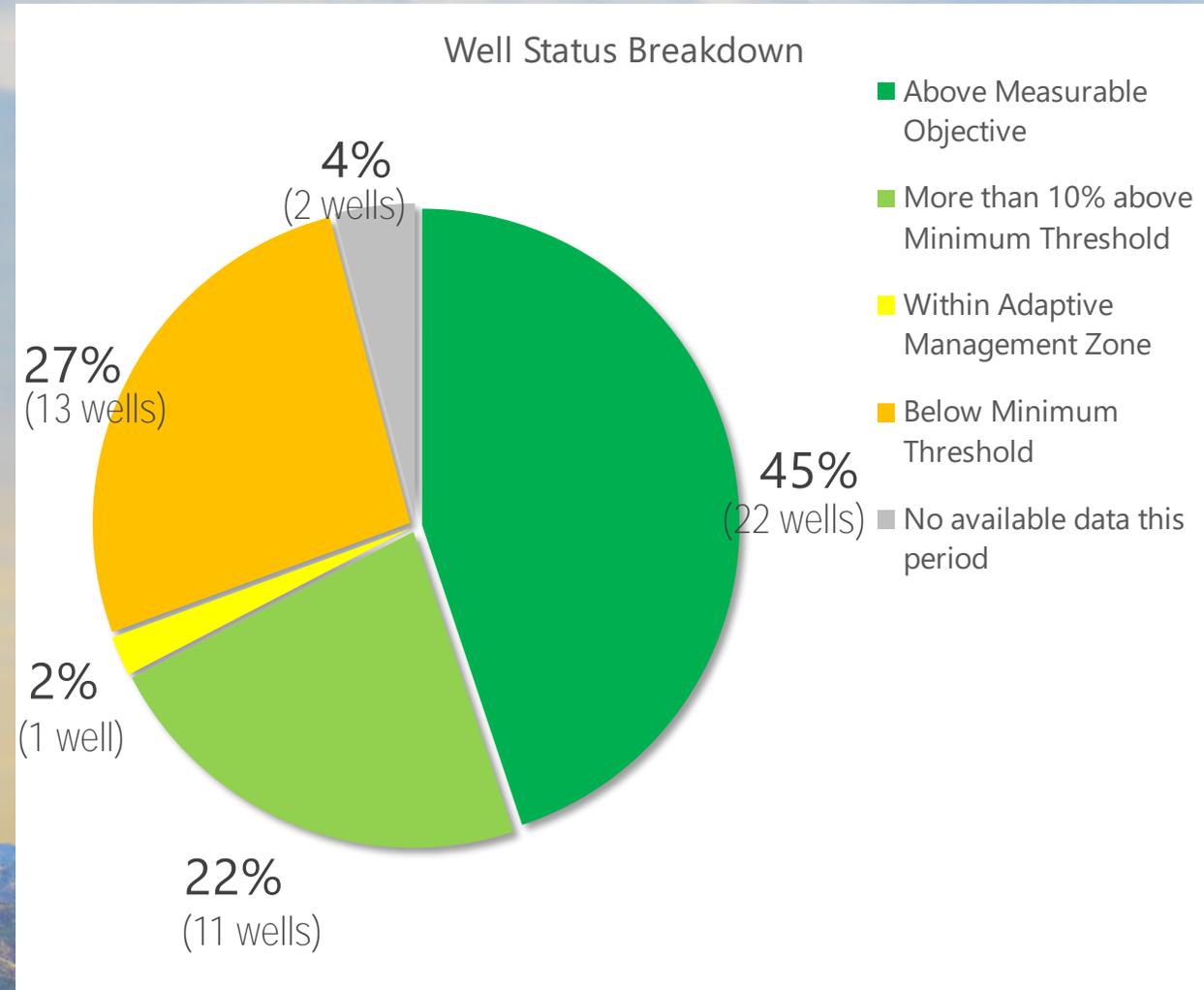
*April 2024
Report*

Groundwater Levels Monitoring Network – Summary of Current Conditions

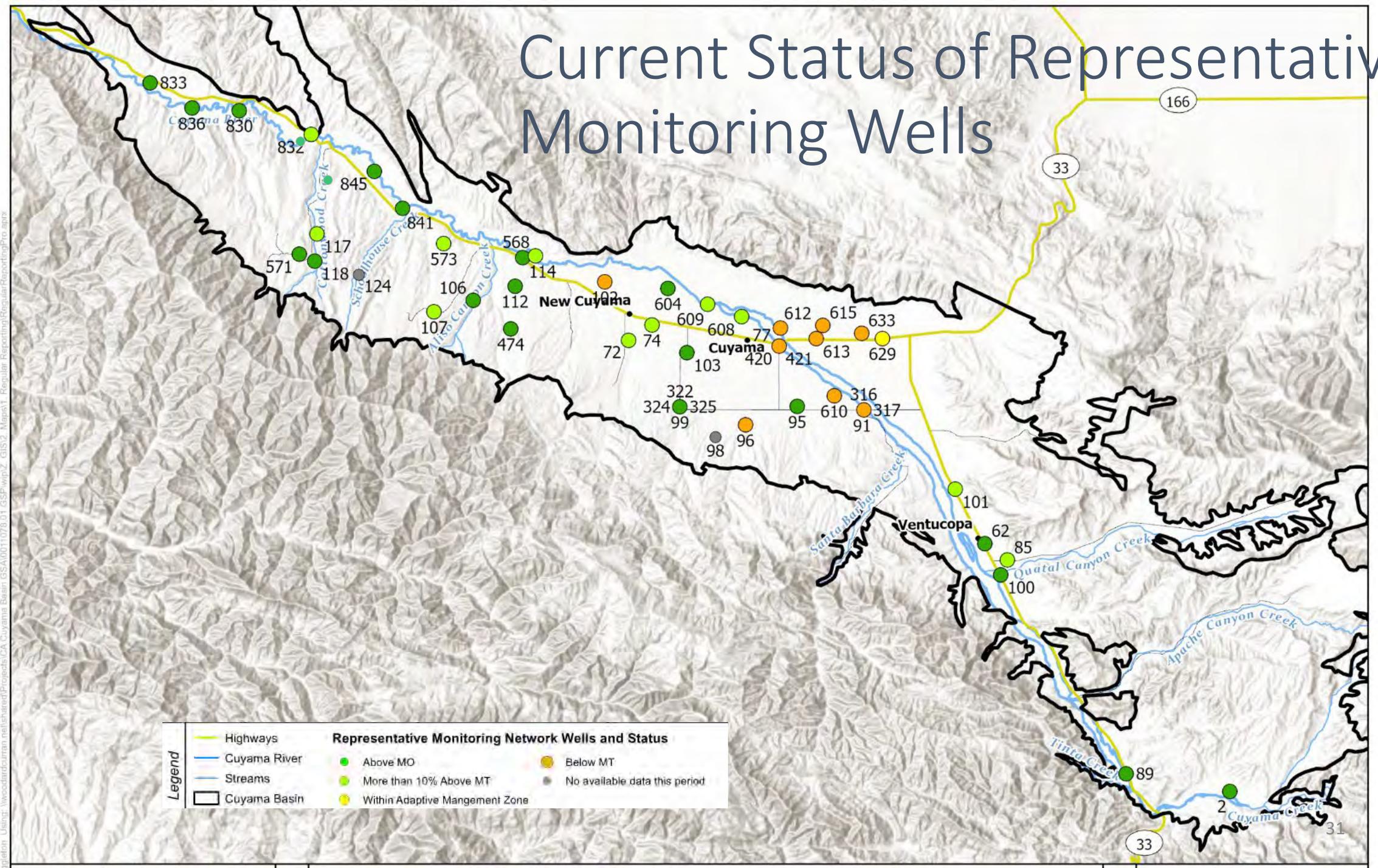
- Monitoring data from October 2023, January 2024 and April 2024 for representative wells is included in the Groundwater Conditions report
- 47 of 49 representative monitoring wells have levels data in at least one out of the previous 12 months
- 13 wells were below the minimum threshold based on latest measurement since October 2023

Summary of Groundwater Well Levels as Compared To Sustainability Criteria

- 13 wells are currently below minimum threshold (MT)
 - 11 wells (22%) have been below the MT for at least 24 months
 - 1 well dropped below the MT this month
 - 2 wells rose above the MT this month



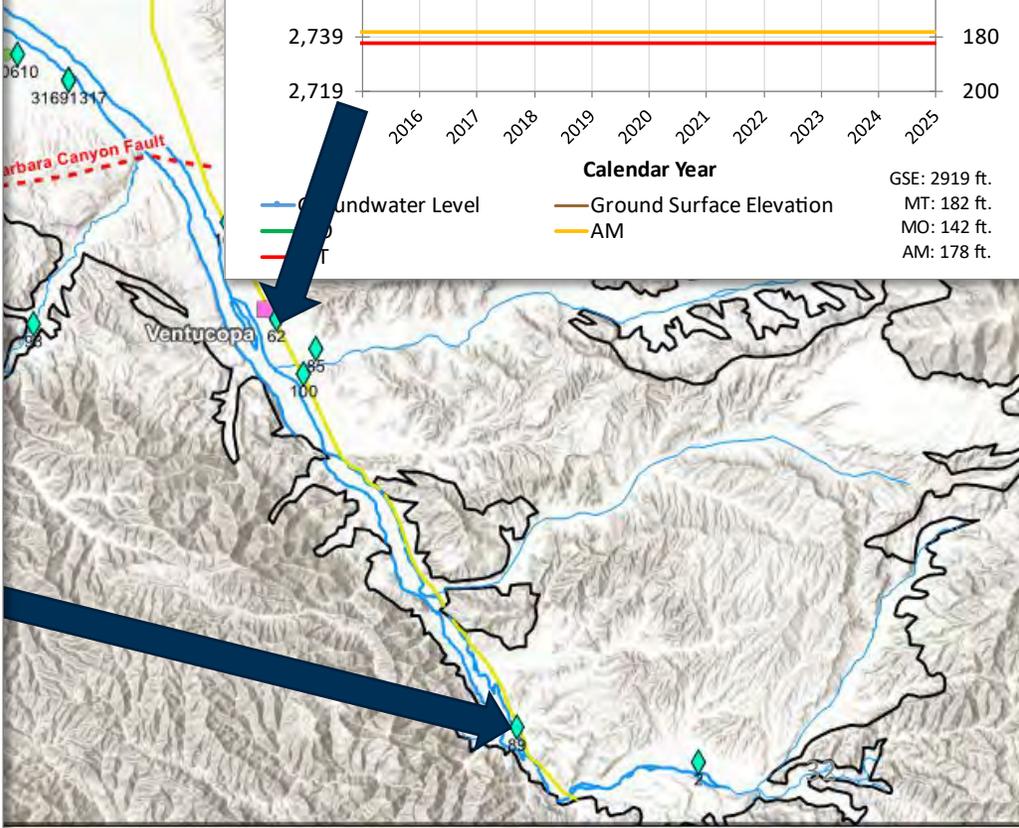
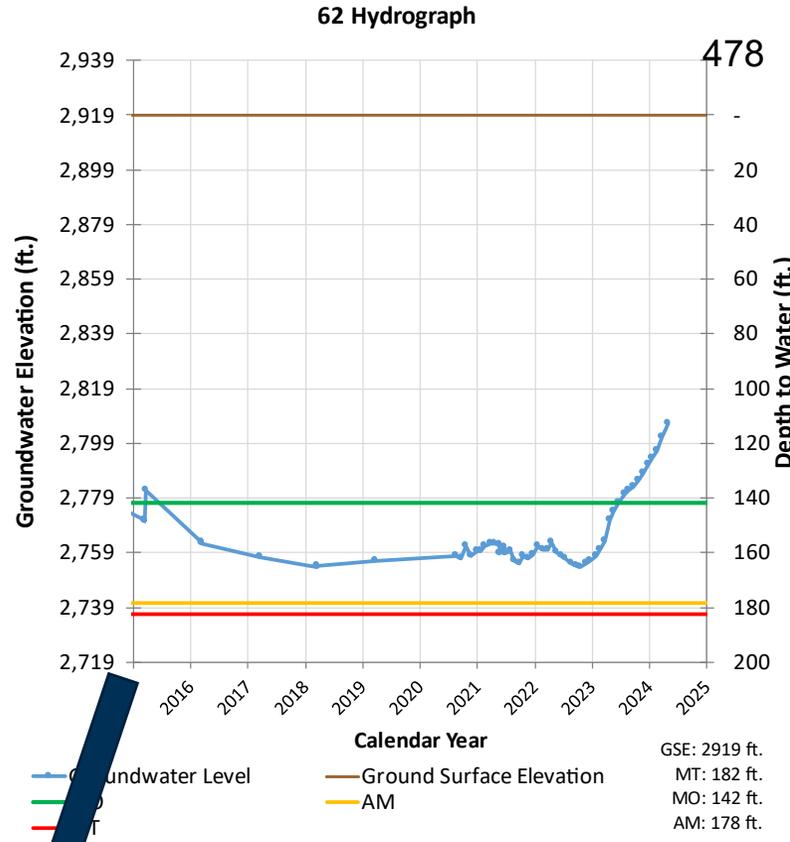
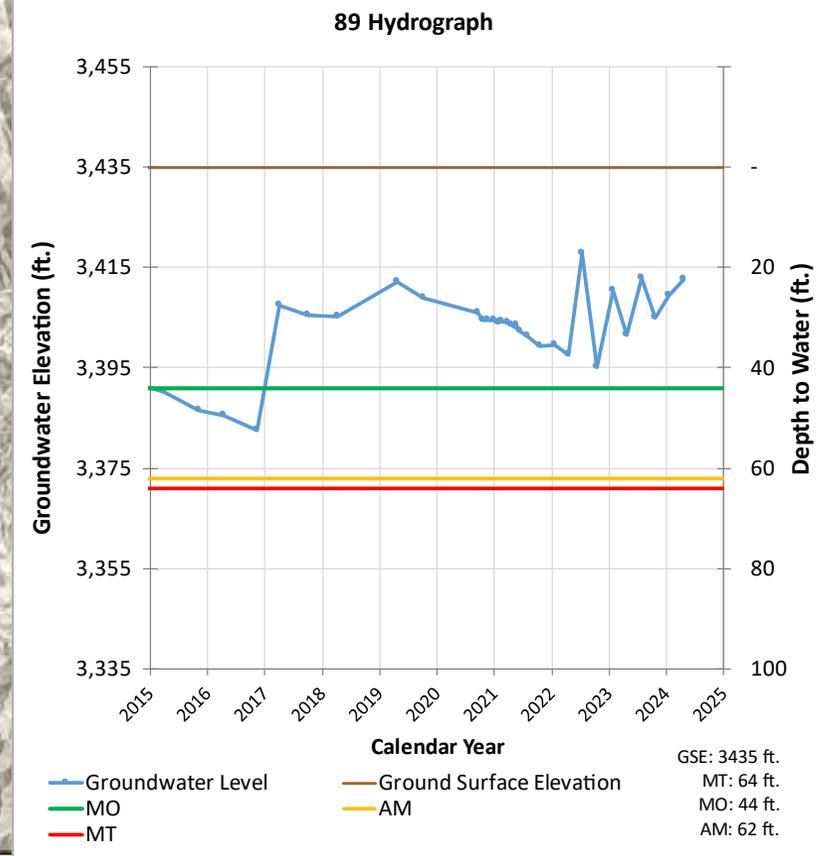
Current Status of Representative Monitoring Wells



Legend		Representative Monitoring Network Wells and Status	
	Highways		Above MO
	Cuyama River		More than 10% Above MT
	Streams		Below MT
	Cuyama Basin		No available data this period
			Within Adaptive Mangement Zone

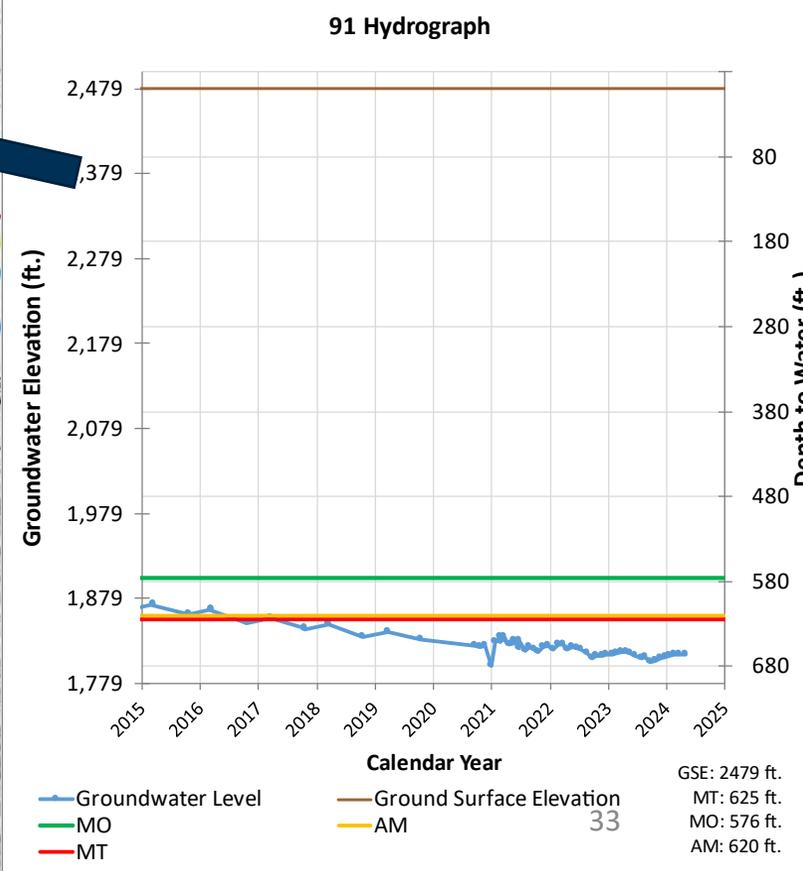
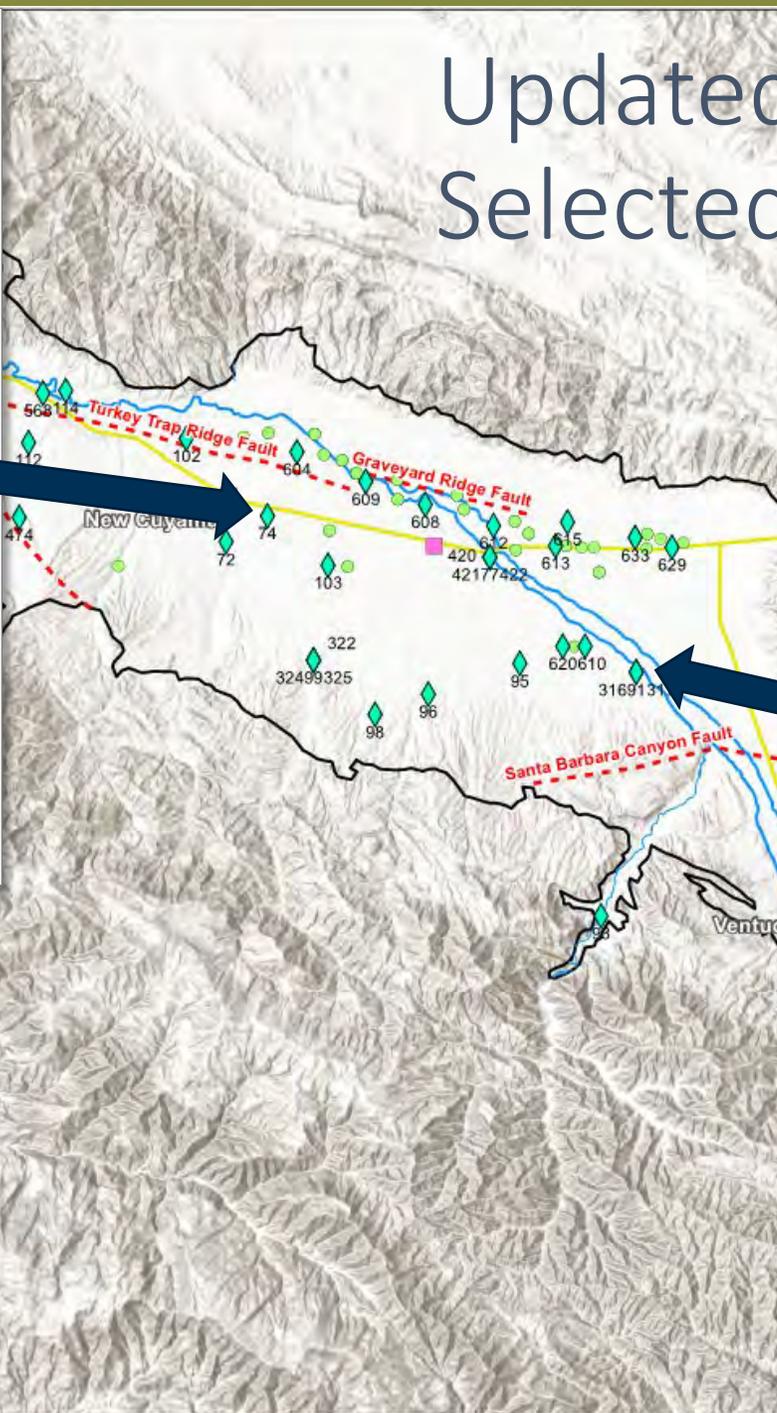
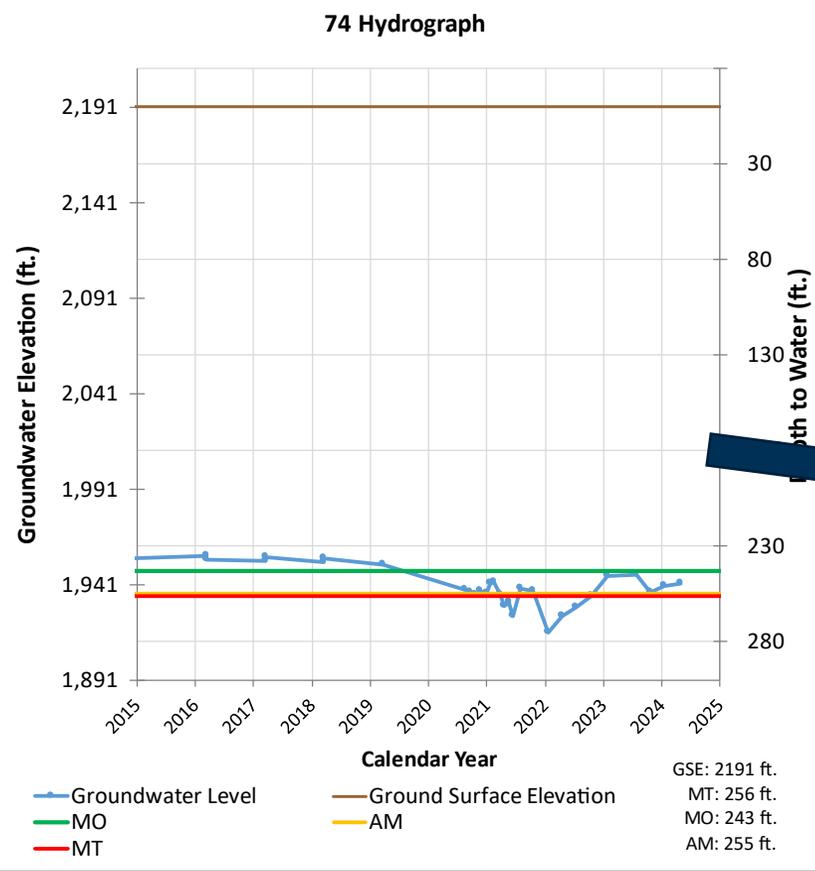
Map created using ArcGIS Pro. Data sources: USGS National Water Research Institute, California Department of Water Resources, and local monitoring agencies. Last updated: 10/2023.

Updated Hydrographs for Selected Monitoring Wells

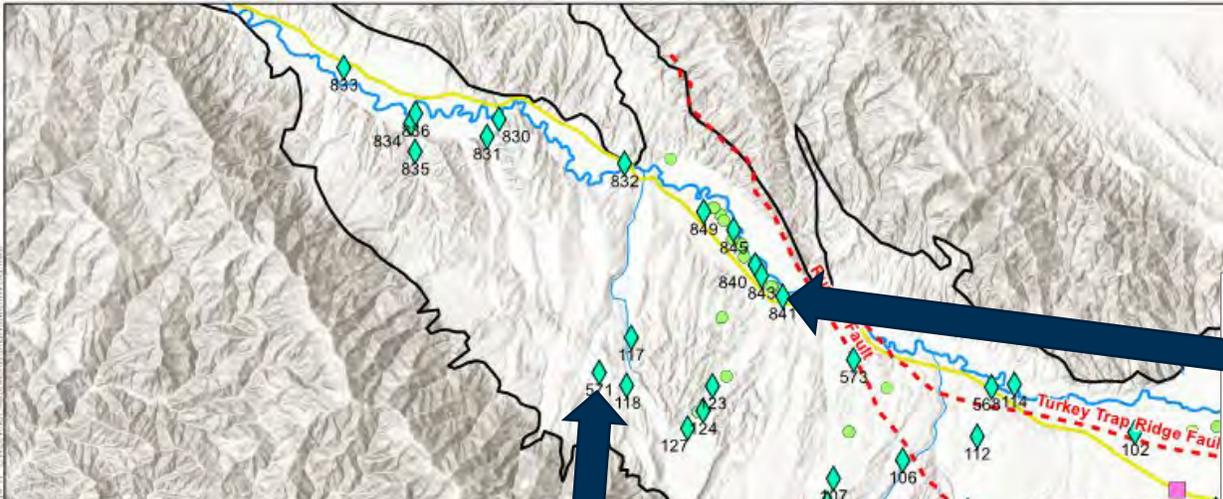


GSE: 2919 ft.
 MT: 182 ft.
 MO: 142 ft.
 AM: 178 ft.

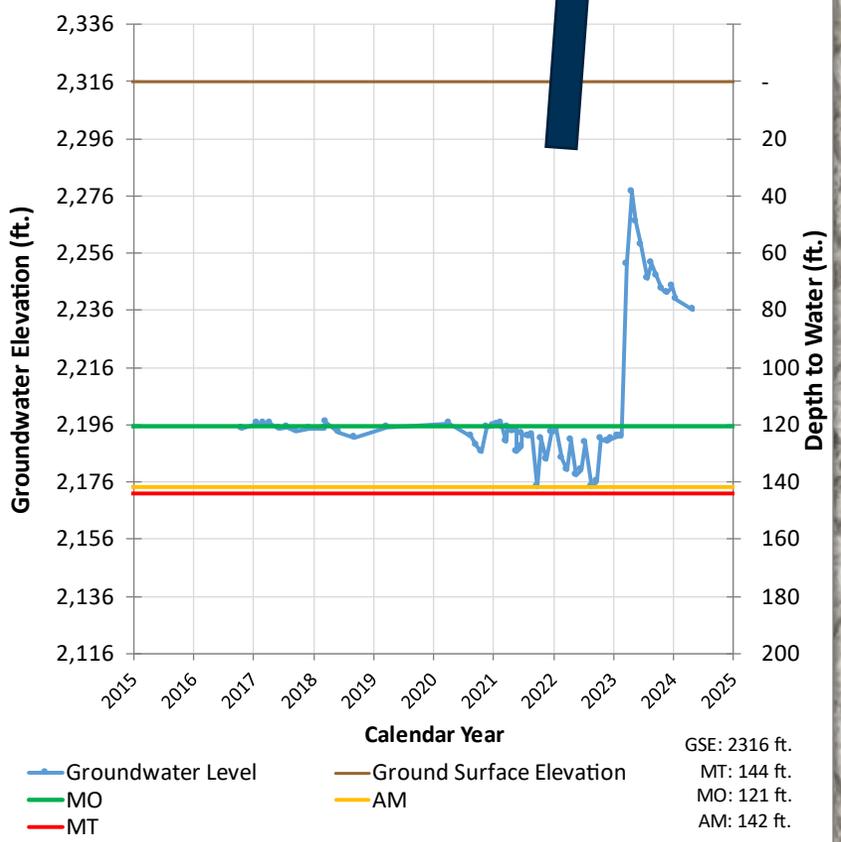
Updated Hydrographs for Selected Monitoring Wells ⁴⁷⁹



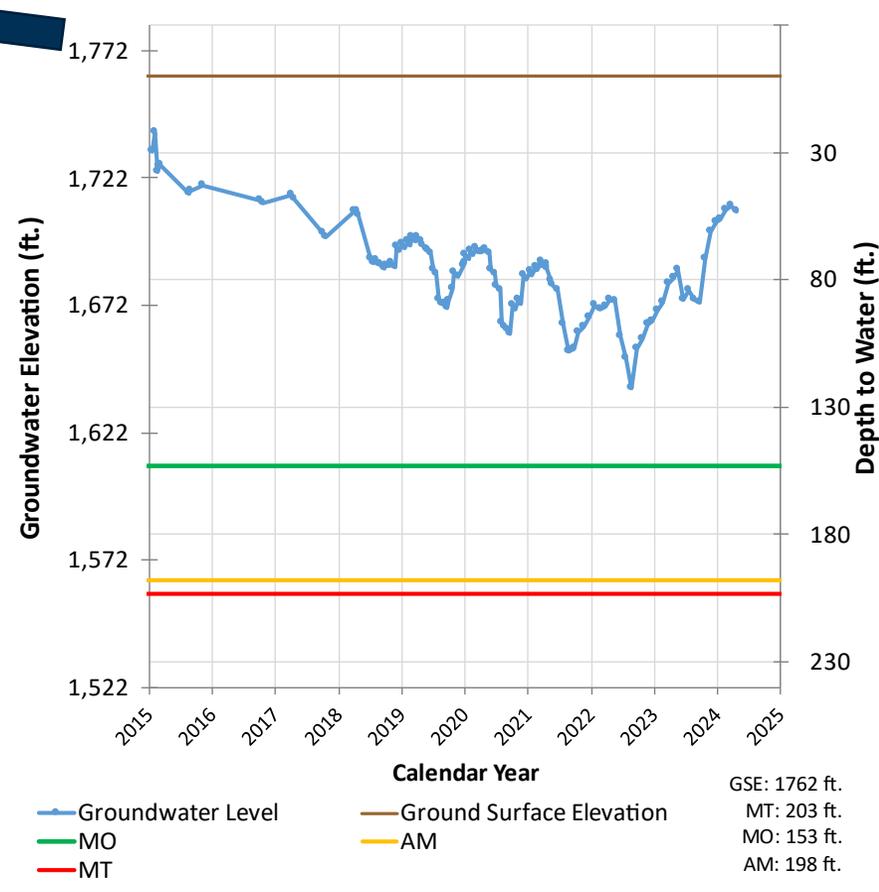
Updated Hydrographs for ⁴⁸⁰ Selected Monitoring Wells



571 Hydrograph



841 Hydrograph





**GROUNDWATER
CONDITIONS
REPORT –
CUYAMA VALLEY
GROUNDWATER
BASIN**

April 2024

801 T Street
Sacramento, CA
916.999.8700

woodardcurran.com

**Cuyama Basin
Groundwater
Sustainability Agency**

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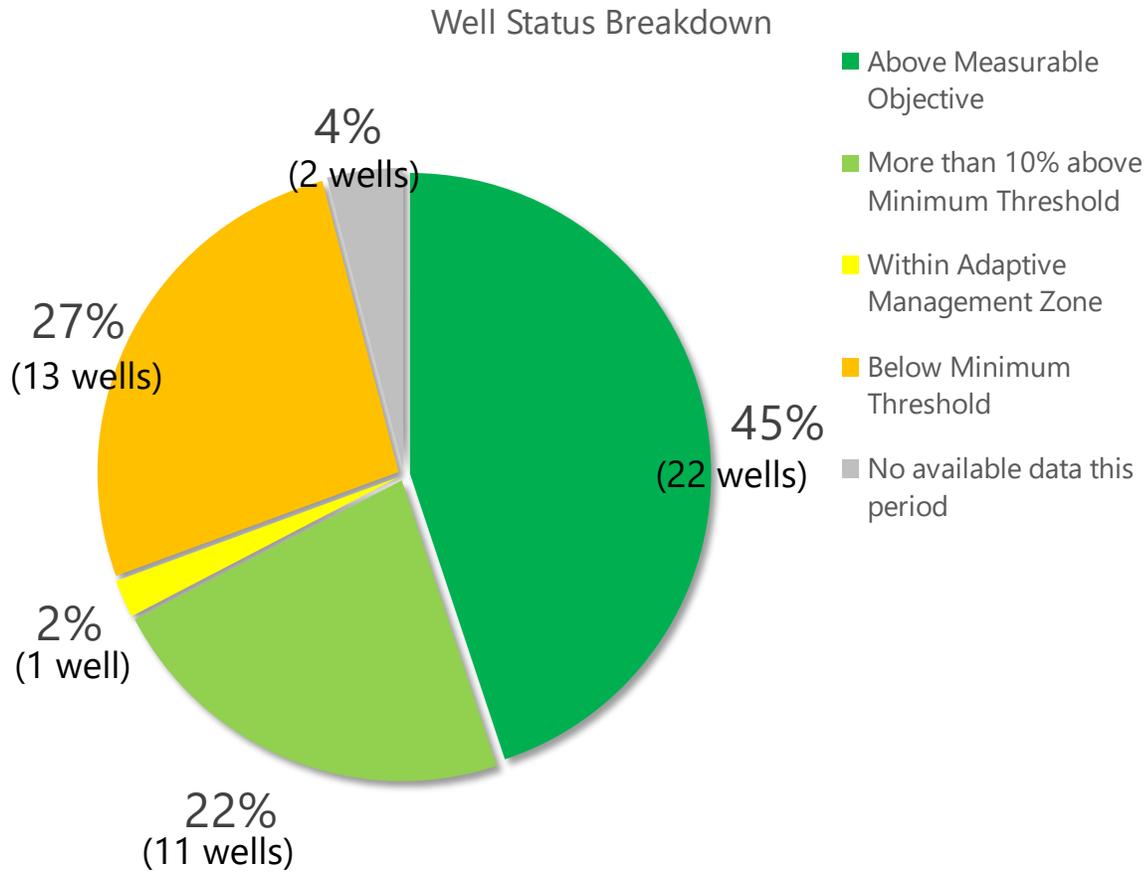
FIGURES

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1. INTRODUCTION

This report is intended to provide an update on the current groundwater level conditions in the Cuyama Valley Groundwater Basin. This work is completed by the Cuyama Basin Groundwater Sustainability Agency (CBGSA), in compliance with the Sustainable Groundwater Management Act (SGMA).

2. SUMMARY STATISTICS



There are currently 13 wells with groundwater levels exceeding minimum thresholds. As outlined in the GSP, undesirable results for the chronic lowering of groundwater levels occurs, “when 30 percent of representative monitoring wells... fall below their minimum groundwater elevation threshold for two consecutive years.” (Cuyama GSP, pg. 3-2). Currently, 22% of representative monitoring wells (i.e. 11 wells) have exceeded the minimum threshold for 24 or more consecutive months.

3. CURRENT CONDITIONS

Table 1 includes the most recent groundwater level measurements taken in the Cuyama Basin from representative wells included in the Cuyama GSP Groundwater Level Monitoring Network, as well as the previous two measurements and the measurement from the same time period in the previous year. Table 2 includes all of the wells and their current status in relation to the thresholds applied to each well. This information is also shown on Figure 1.

All measurements are also incorporated into the Cuyama DMS, which may be accessed at <https://opti.woodardcurran.com/cuyama/login.php>.

Table 1: Recent Groundwater Levels for Representative Monitoring Network

Well	Region	Oct-23	Jan-24	Apr-24	Last Year		Annual Elevation Change (ft)
		GWL (ft. msl)	GWL (ft. msl)	GWL (ft. msl)	GWL (ft. msl)	Month/ Year	
72	Central	2017	2027	2034	2019	Apr-23	15.4
74	Central	1940	1940	1941	-	-	-
77	Central	1793	1804	1795	1798	Apr-23	-2.5
91	Central	1800	1811	1813	1810	Apr-23	3.8
95	Central	1841	1850	2389	-	-	-
96	Central	2270	2273	2269	2275	Apr-23	-6.5
98	Central	-	-	-	-	-	-
99	Central	2223	2216	2218	2223	Apr-23	-5.7
102	Central	1758	-	-	-	-	-
103	Central	2044	2046	2050	2045	Apr-23	5.6
112	Central	2053	2041	2042	2053	Apr-23	-11.7
114	Central	-	1879	1880	-	-	-
316	Central	1799	1810	1812	1808	Apr-23	3.7
317	Central	1801	1811	1814	-	-	-
322	Central	2222	2216	2217	2222	Apr-23	-5
324	Central	2221	2215	2216	2220	Apr-23	-3.8
325	Central	2222	2215	2216	2222	Apr-23	-6.3
420	Central	1792	1803	1794	1795	Apr-23	-1.1
421	Central	1793	1802	1800	1802	Apr-23	-1.8

Well	Region	Oct-23	Jan-24	Apr-24	Last Year		Annual Elevation Change (ft)
		GWL (ft. msl)	GWL (ft. msl)	GWL (ft. msl)	GWL (ft. msl)	Month/ Year	
474	Central	-	2228	2232	2202	Apr-23	29.4
568	Central	1867	1874	1874	1870	Apr-23	4.2
604	Central	1684	1655	1655	1656	Apr-23	-0.7
608*	Central	1790	-	1778*	-	-	-
609	Central	1725	1721	1723	1705	Apr-23	17.7
610	Central	1805	1808	1808	1813	Apr-23	-5.6
612	Central	1788	1797	1796	1801	Apr-23	-4.5
613	Central	1801	1799	1797	1788	Apr-23	8.3
615	Central	1809	1808	1806	1810	Apr-23	-3.8
629	Central	1848	1817	1821	1803	Apr-23	18.1
633	Central	1798	1796	1800	1851	Apr-23	-51.4
62	Eastern	2789	2793	2806	2774	Apr-23	32.1
85	Eastern	2870	2883	2891	2844	Apr-23	46.3
100	Eastern	2909	2911	2939	2901	Apr-23	38
101	Eastern	2635	2653	2658	-	-	-
841	Northwestern	1692	1706	1709	1685	Apr-23	24.4
845	Northwestern	1637	1641	1643	1647	Apr-23	-4.6
2	Southeastern	3698	3697	3706	3704	Apr-23	2.1
89	Southeastern	3432	3390	3413	3428	Apr-23	-15.9
106	Western	2185	2175	2175	2184	Apr-23	-8.9

Well	Region	Oct-23	Jan-24	Apr-24	Last Year		Annual Elevation Change (ft)
		GWL (ft. msl)	GWL (ft. msl)	GWL (ft. msl)	GWL (ft. msl)	Month/Year	
107	Western	-	2422	2419	2390	Apr-23	28.6
117	Western	1946	1947	1947	1950	Apr-23	-3.7
118	Western	2217	2211	2213	2214	Apr-23	-1.8
124	Western	-	-	-	-	-	-
571	Western	2235	2240	2236	2269	Apr-23	-32.6
573	Western	2015	2010	2010	2015	Apr-23	-4.6
830	Far-West Northwestern	1522	1512	1511	1516	Apr-23	-5.3
832	Far-West Northwestern	1595	1604	1604	1596	Apr-23	8.4
833	Far-West Northwestern	1434	1433	1433	1426	Apr-23	7.4
836	Far-West Northwestern	1456	1479	1479	1450	Apr-23	29
<p>*Well 608 is now confirmed to be “destroyed” and is no longer available for monitoring. The landowner and monitoring staff have identified a well within 100 ft that is suitable to continue monitoring in this location, and the groundwater level monitoring network will be modified to remove well 608 and add in this new well. The new well is in the process of being incorporated into Opti and being assigned an ID number.</p>							

Table 2: Well Status Related to Thresholds

Well	Region	Current Month		Minimum Threshold	Within 10% Minimum Threshold	Measurable Objective	Well Depth	Status	GSA Action Required?
		GWL (DTW)	Date						
72	Central	131.30	04-24-2024	169	165	124	790	More than 10% Above Minimum Threshold	No
74	Central	246.06	04-25-2024	256	255	243		More than 10% Above Minimum Threshold	No
77	Central	489.27	04-25-2024	450	445	400	980	Below Minimum Threshold (44 months of exceedance)	No
91	Central	667.34	04-26-2024	625	620	576	980	Below Minimum Threshold (44 months of exceedance)	No
95	Central	67.15	04-25-2024	573	570	538	805	Above Measurable Objective	No
96	Central	337.42	04-25-2024	333	332	325	500	Below Minimum Threshold (1 month of exceedance)	No
98	Central	-	-	450	449	439	750	No available data this period	No
99	Central	287.81	04-24-2024	311	310	300	750	Above Measurable Objective	No
102	Central	-	-	235	231	197		No data available this period (Below MT in Oct 2023, 42 months)	No
103	Central	233.41	04-25-2024	290	285	235	1030	Above Measurable Objective	No
112	Central	84.40	04-24-2024	87	87	85	441	Above Measurable Objective	No
114	Central	45.18	04-24-2024	47	47	45	58	More than 10% Above Minimum Threshold	No
316	Central	668.59	04-26-2024	623	618	574	830	Below Minimum Threshold (44 months of exceedance)	No

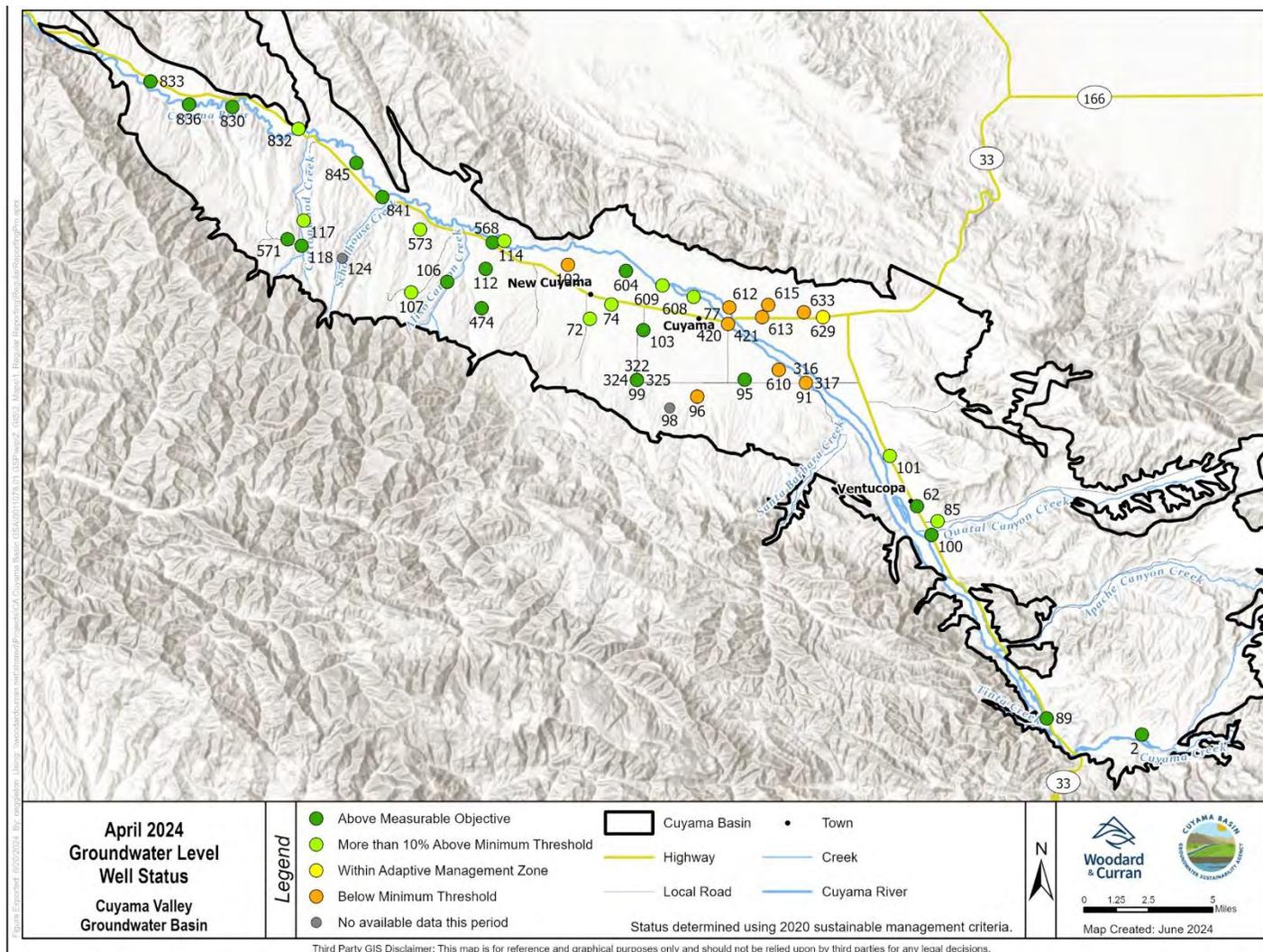
Well	Region	Current Month		Minimum Threshold	Within 10% Minimum Threshold	Measurable Objective	Well Depth	Status	GSA Action Required?
		GWL (DTW)	Date						
317	Central	666.85	04-26-2024	623	618	573	700	Below Minimum Threshold (44 months of exceedance)	No
322	Central	288.31	04-24-2024	307	306	298	850	Above Measurable Objective	No
324	Central	289.52	04-24-2024	311	310	299	560	Above Measurable Objective	No
325	Central	289.59	04-24-2024	300	299	292	380	Above Measurable Objective	No
420	Central	490.46	04-25-2024	450	445	400	780	Below Minimum Threshold (44 months of exceedance)	No
421	Central	484.66	04-25-2024	446	441	398	620	Below Minimum Threshold (44 months of exceedance)	No
474	Central	130.78	04-24-2024	188	186	169	213	Above Measurable Objective	No
568	Central	33.95	04-24-2024	37	37	36	188	Above Measurable Objective	No
604	Central	460.61	04-26-2024	526	522	487	924	Above Measurable Objective	No
608*	Central	431.24	04-25-2024	436	433	407	745	More than 10% Above Minimum Threshold	No
609	Central	435.09	04-26-2024	458	454	421	970	More than 10% Above Minimum Threshold	No
610	Central	629.28	04-25-2024	621	618	591	780	Below Minimum Threshold (37 months of exceedance)	No
612	Central	472.64	04-25-2024	463	461	440	1070	Below Minimum Threshold (28 months of exceedance)	No
613	Central	527.84	04-25-2024	503	500	475	830	Below Minimum Threshold (42 months of exceedance)	No

Well	Region	Current Month		Minimum Threshold	Within 10% Minimum Threshold	Measurable Objective	Well Depth	Status	GSA Action Required?
		GWL (DTW)	Date						
615	Central	514.74	04-25-2024	500	497	468	865	Below Minimum Threshold (41 months of exceedance)	No
629	Central	557.23	04-25-2024	559	556	527	1000	Within Adaptive Management Zone	No
633	Central	563.67	04-25-2024	547	542	493	1000	Below Minimum Threshold (7 months of exceedance)	No
62	Eastern	110.63	04-25-2024	182.45	178	142	212	Above Measurable Objective	No
85	Eastern	156.76	04-25-2024	233.12	225	147	233	More than 10% Above Minimum Threshold	No
100	Eastern	66.88	04-25-2024	181.02	175	125	284	Above Measurable Objective	No
101	Eastern	87.29	04-25-2024	110.55	108	81	200	More than 10% Above Minimum Threshold	No
830	Far-West Northwestern	49.14	04-24-2024	59	59	56	77.2	Above Measurable Objective	No
832	Far-West Northwestern	32.86	04-24-2024	45	44	30	131.8	More than 10% Above Minimum Threshold	No
833	Far-West Northwestern	20.11	04-24-2024	96	89	24	503.55	Above Measurable Objective	No
836	Far-West Northwestern	27.20	04-24-2024	79	75	36	325	Above Measurable Objective	No
841	Northwestern	50.05	04-20-2024	203	198	153	600	Above Measurable Objective	No
845	Northwestern	69.11	04-20-2024	203	198	153	380	Above Measurable Objective	No
2	Southeastern	14.10	04-24-2024	72	70	55	73	Above Measurable Objective	No

Well	Region	Current Month		Minimum Threshold	Within 10% Minimum Threshold	Measurable Objective	Well Depth	Status	GSA Action Required?
		GWL (DTW)	Date						
89	Southeastern	21.11	04-24-2024	64	62	44	125	Above Measurable Objective	No
106	Western	141.36	04-24-2024	154	153	141.4	227.5	Above Measurable Objective	No
107	Western	72.44	04-24-2024	91	89	72.23	200	More than 10% Above Minimum Threshold	No
117	Western	151.4	04-25-2024	160	159	150.82	212	More than 10% Above Minimum Threshold	No
118	Western	49.62	04-25-2024	124	117	57.22	500	Above Measurable Objective	No
124	Western	-	-	73	71	57.12	160.55	No available data this period	No
571	Western	78.29	04-25-2024	144	142	120.5	280	Above Measurable Objective	No
573	Western	67.66	04-24-2024	118	113	67.5	404	More than 10% Above Minimum Threshold	No
<p>*Well 608 is now confirmed to be “destroyed” and is no longer available for monitoring. The landowner and monitoring staff have identified a well within 100 ft that is suitable to continue monitoring in this location, which is where the measurement shown was taken. The groundwater level representative network will be modified to remove well 608 and add in this new well. The new well is in the process of being incorporated into Opti and being assigned an ID number.</p>									

Note: Wells only count towards the identification of undesirable results if the level measurement is below the minimum threshold for 24 consecutive months.

Figure 1: Groundwater Level Representative Wells and Status in April 2024



Third Party GIS Disclaimer: This map is for reference and graphical purposes only and should not be relied upon by third parties for any legal decisions.

4. HYDROGRAPHS

The following hydrographs provide an overview of conditions in each of the six areas threshold regions identified in the GSP.

Figure 2: Southeast Region – Well 89

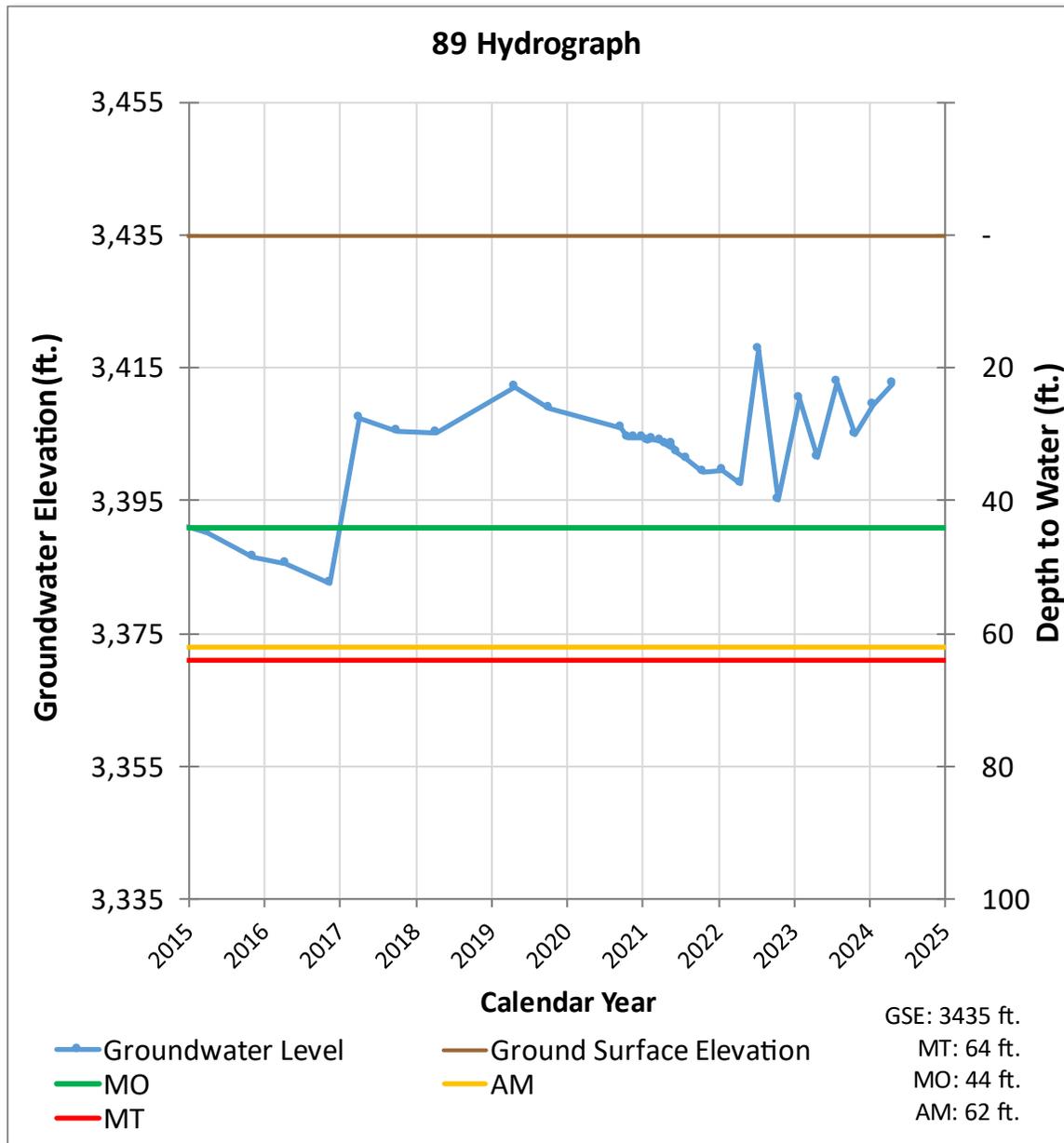


Figure 3: Eastern Region – Well 62

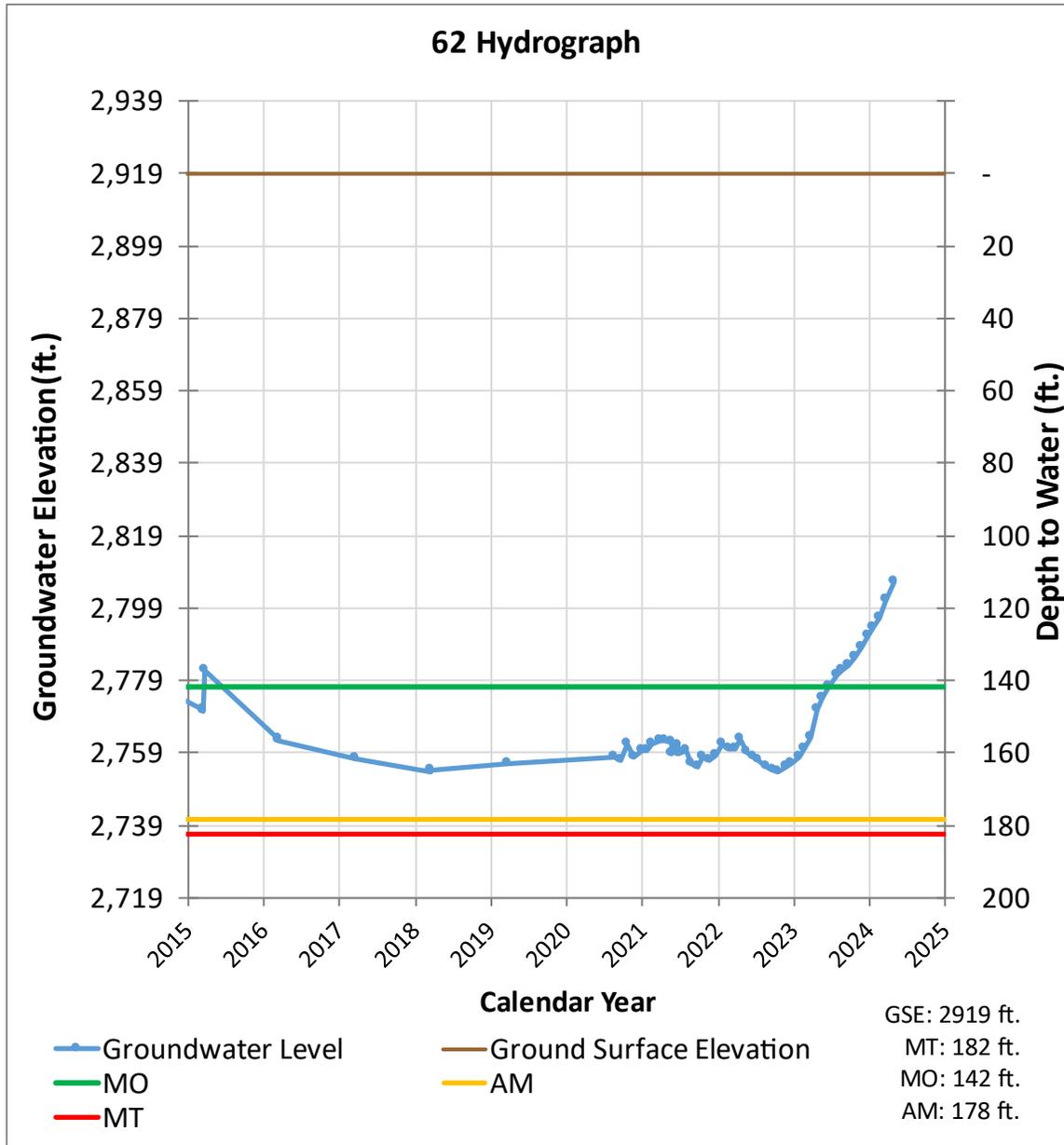




Figure 4: Central Region – Well 91

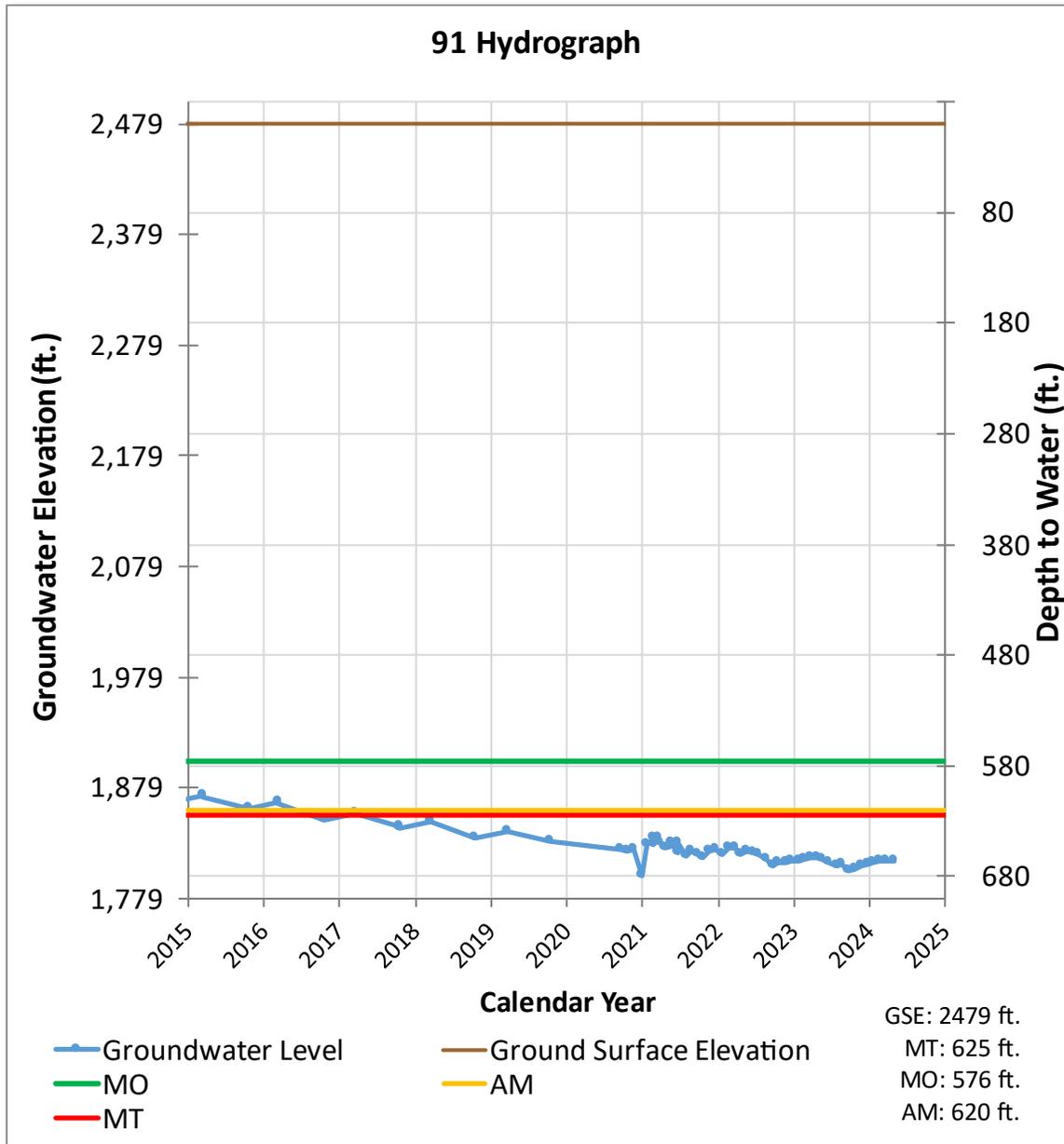


Figure 5: Central Region – Well 74

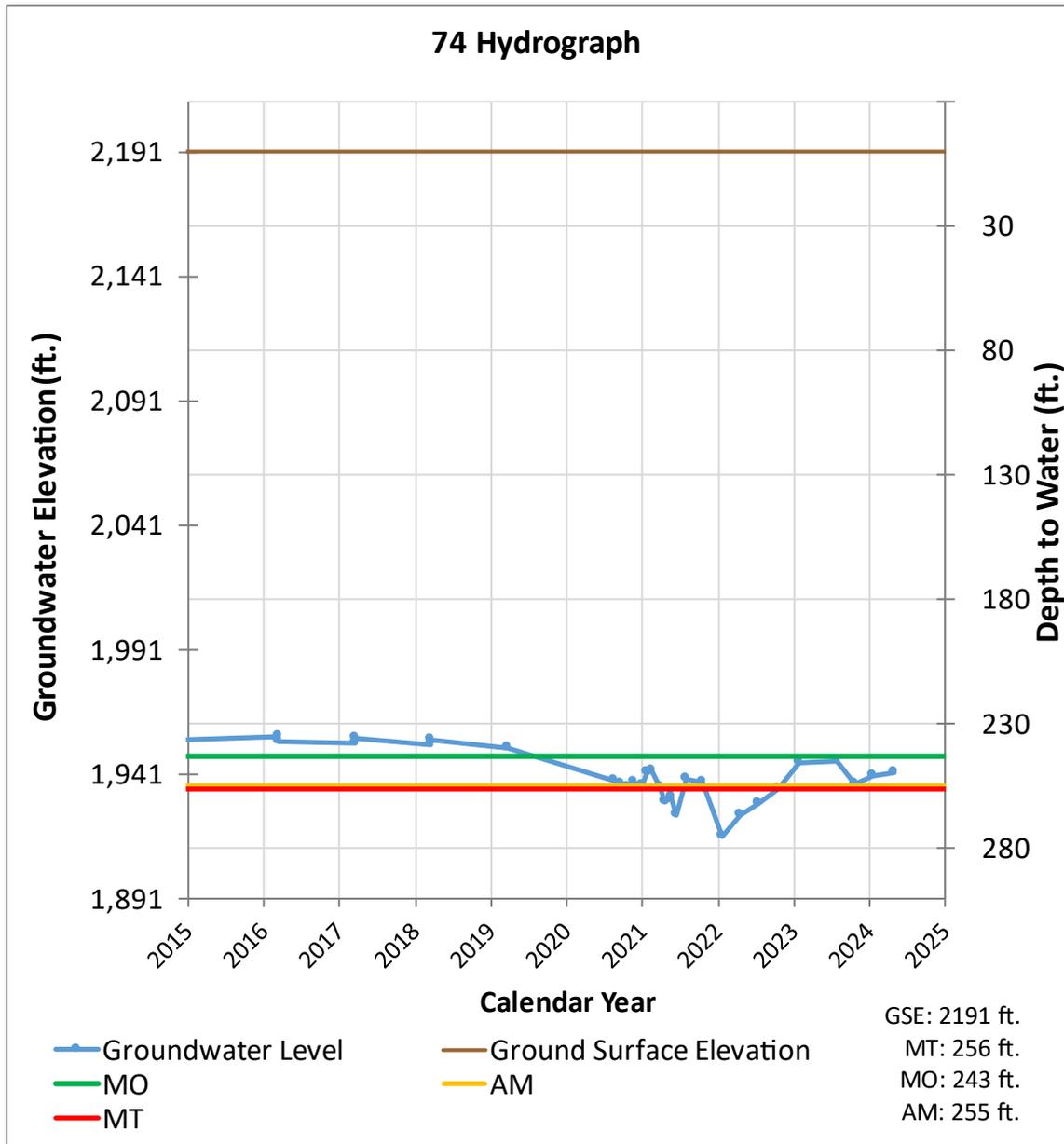




Figure 6: Western Region – Well 571

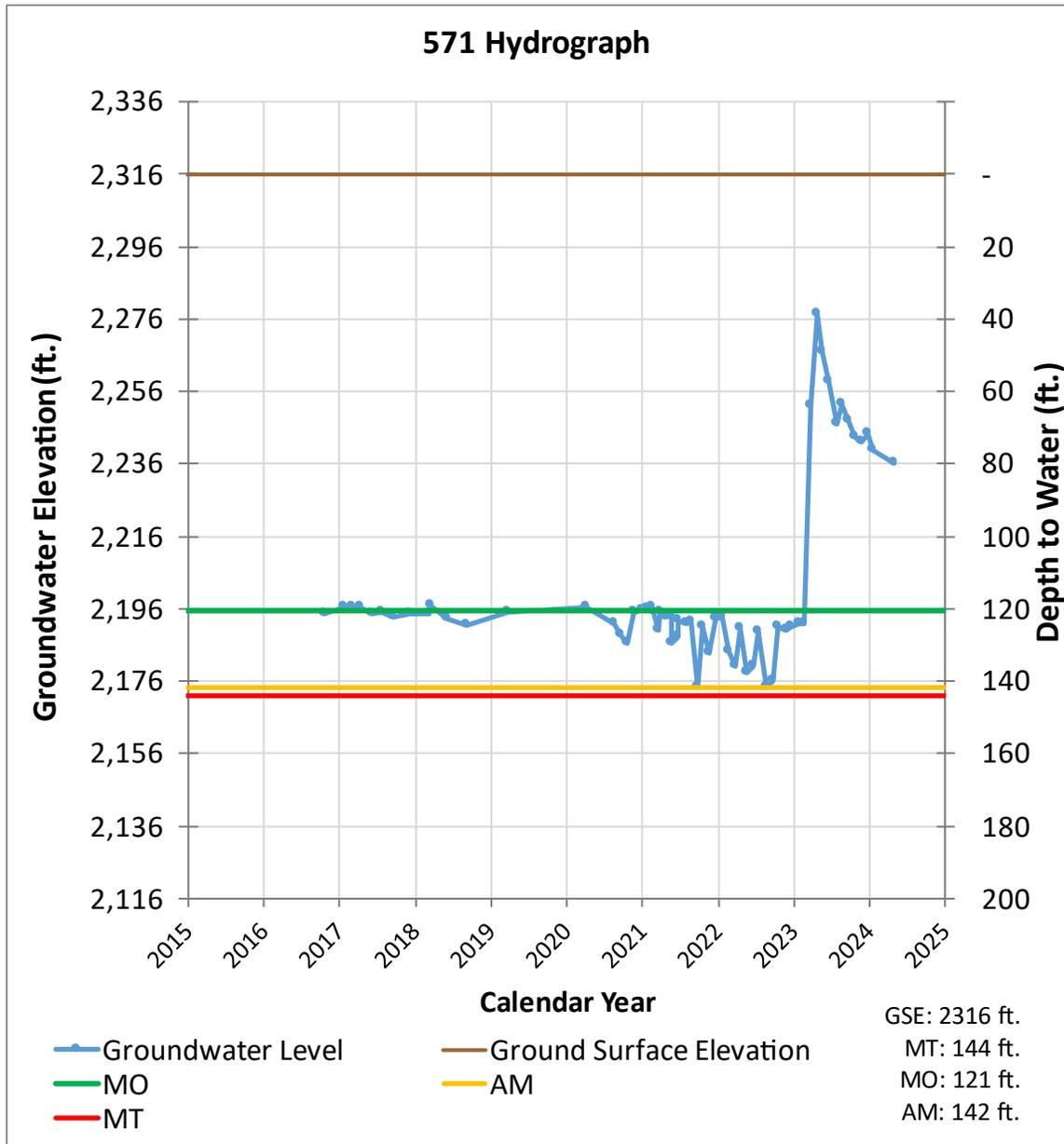
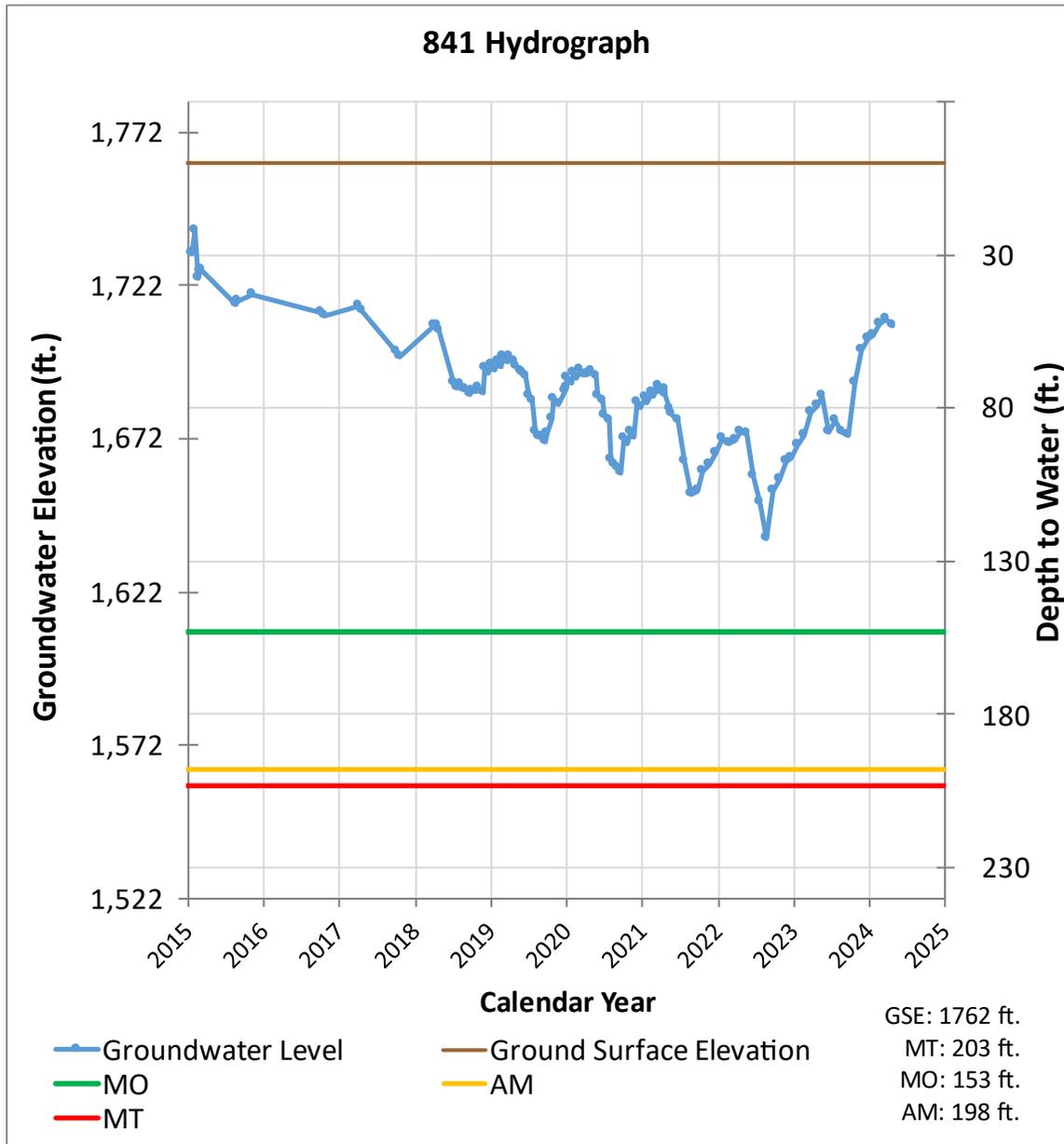




Figure 7: Northwestern Region – Well 841



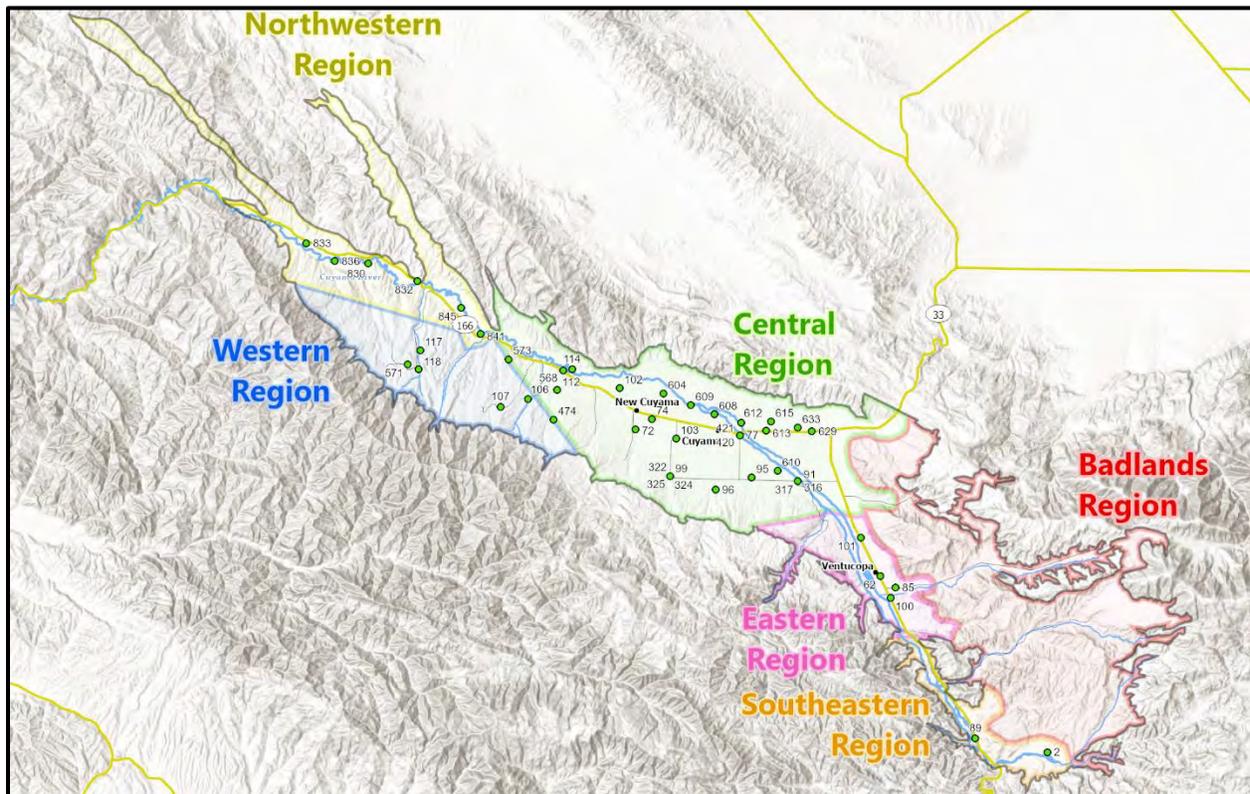


Figure 8: Threshold Regions in the Cuyama Groundwater Basin

5. MONITORING NETWORK UPDATES

As shown in Table 2, there are three wells with no measurement during the current monitoring period. These “no measurement codes” can have different causes as described below.

- Access agreements have not been established with the landowner:
 - Wells 98, 124
- Data not yet available due to transducer malfunction:
 - 102

Additionally, Well 608 is now confirmed to be “destroyed” and is no longer available for monitoring. The landowner and monitoring staff have identified a well within 100 ft that is suitable to continue monitoring in this location; the data from that new well is reported for well 608 in this version of the report. The groundwater level monitoring network will be modified to remove well 608 and add in this new well. The new well is in the process of being incorporated into Opti. The new well will use historical data from Well 608 as a proxy for future analysis conducted for GSP implementation.





TO: Standing Advisory Committee
Agenda Item No. 10c

FROM: Taylor Blakslee, Hallmark Group

DATE: July 25, 2024

SUBJECT: Board of Directors Agenda Review

Recommended Motion

None – informational only.

Discussion

The Cuyama Basin Groundwater Sustainability Agency Board of Directors agenda for the July 31st, 2024, Board of Directors meeting is provided as Attachment 1.



CUYAMA BASIN GROUNDWATER SUSTAINABILITY AGENCY

SPECIAL BOARD OF DIRECTORS MEETING

Board of Directors

Cory Bantilan Chair, Santa Barbara County Water Agency
Derek Yurosek Vice Chair, Cuyama Basin Water District
Arne Anselm Secretary, County of Ventura
Byron Albano Treasurer, Cuyama Basin Water District
Rick Burnes Cuyama Basin Water District
Steve Jackson Cuyama Basin Water District

Jimmy Paulding County of San Luis Obispo
Zack Scrivner County of Kern
Das Williams Santa Barbara County Water Agency
Deborah Williams Cuyama Community Services District
Jane Wooster Cuyama Basin Water District

AGENDA

July 31, 2024

Agenda for a meeting of the Cuyama Basin Groundwater Sustainability Agency Board of Directors to be held on Wednesday, July 31, 2024, at 2:00 PM at the **Cuyama Valley Family Resource Center 4689 CA-166, New Cuyama, CA 93254**. Participate via computer at: <https://rb.gy/1nxwv> or by going to Microsoft Teams, downloading the free application, then entering Meeting ID: 224 192 969 900 Passcode: jVHbgy or enter or telephonically at (469) 480-3918 Phone Conference ID: 956 062 525#.

Teleconference Locations:

4689 CA-166 New Cuyama, CA 93254	800 S. Victoria Ave. Ventura, CA 93009	900 Truxtun Ave, Ste 220 Bakersfield, CA 93308
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The order in which agenda items are discussed may be changed to accommodate scheduling or other needs of the Board or Committee, the public, or meeting participants. Members of the public are encouraged to arrive at the commencement of the meeting to ensure that they are present for discussion of all items in which they are interested.

In compliance with the Americans with Disabilities Act, if you need disability-related modifications or accommodations, including auxiliary aids or services, to participate in this meeting, please contact Taylor Blakslee at (661) 477-3385 by 4:00 p.m. on the Friday prior to this meeting. The Cuyama Basin Groundwater Sustainability Agency reserves the right to limit each speaker to three (3) minutes per subject or topic.

1. Call to Order (Bantilan) (1 min)
2. Roll Call (Blakslee) (1 min)
3. Pledge of Allegiance (Bantilan) (1 min)
4. Meeting Protocols (Blakslee) (2 min)
5. Standing Advisory Committee Meeting Report (Kelly) (3 min)

CONSENT AGENDA

Items listed on the Consent Agenda are considered routine and non-controversial by staff and will be approved by one motion if no member of the Board or public wishes to comment or ask questions. If comment or discussion is desired by anyone, the item will be removed from the Consent Agenda and will be considered in the listed sequence with an opportunity for any member of the public to address the Board concerning the item before action is taken.

6. Approve Meeting Minutes (Bantilan) (1 min)
 - a) May 1, 2024, Regular Board
 - b) May 23, 2024, Special Board

7. Approve Payment of Bills for April and May 2024 (Blakslee) (1 min)
8. Approve Financial Reports for April and May 2024 (Blakslee) (1 min)
9. Approve Monitoring Network Consultant Contract for FY 24-25 (Blakslee) (1 min)

ACTION ITEMS

All action items require a simple majority vote by default (50% of the vote). Items that require a super majority vote (75% of the weighted total) will be noted as such at the end of the item.

10. Groundwater Sustainability Plan Implementation
 - a) Update on Fault Investigation Study (Strandberg) (30 min)
 - b) Update on Cuyama Basin Water Resources Model (Beck/Van Lienden) (60 min)
11. Groundwater Sustainability Plan Amendment Components
 - a) Update on GSP Component Schedule (Blakslee/Van Lienden) (5 min)
 - b) Discuss and Take Appropriate Action on Project and Management Action Options [**Final Discussion**] (Blakslee/Van Lienden) (15 min)
 - c) Discuss and Take Appropriate Action on Basin-Wide Water Management Narrative (Beck/Van Lienden) (10 min)
 - d) Discuss and Take Appropriate Action on Updated CMA Boundary, Management Area Criteria, Use of an Operational Boundary and Use of Farm Units [**Final Discussion**] (Blakslee/Van Lienden) (60 min)
 - e) Discuss and Take Appropriate Action on Glidepath Methodology [**Final Discussion**] (Blakslee/Van Lienden) (30 min)
 - f) Discuss and Take Appropriate Action on Groundwater Allocation Program [**Final Discussion**] (Blakslee/Van Lienden) (30 min)
 - g) Discuss and Take Appropriate Action on Frequency of Changes to Pumping Reduction Program (Beck/Van Lienden) (20 min)
 - h) Discuss and Take Appropriate Action on GSP Draft Chapters: [**Final Discussion**] (Beck/Van Lienden) (30 min)
 - i. Chapter 2. Basin Setting
 - ii. Chapter 3. Undesirable Results
 - iii. Chapter 5. Sustainability Management Criteria
 - iv. Chapter 6. Data Management System (DMS)
 - i) Discuss and Take Appropriate Action on GSP Amendment Public Comment Process (Blakslee/Gardiner) (10 min)

REPORT ITEMS

13. Administrative Updates
 - a) Report of the Executive Director (Blakslee) (5 min)
 - b) Report of the General Counsel (Hughes) (5 min)
14. Technical Updates
 - a) Update on Groundwater Sustainability Plan Activities (Van Lienden) (5 min)
 - b) Update on Grant-Funded Projects (Van Lienden) (5 min)
 - c) Update on April 2024 Groundwater Conditions Report (Van Lienden) (5 min)
15. Report of Ad Hoc Committees (1 min)

16. Directors' Forum (1 min)
17. Public Comment for Items Not on the Agenda (5 min)
18. Correspondence (1 min)

CLOSED SESSION

19. Conference with Legal Counsel – Existing Litigation (15 min)
Pursuant to Government Code section 54956.9(d)(1)
 - (a) Bolthouse Land Company, LLC, et al v. All Persons Claiming a Right to Extract or Store Groundwater in the Cuyama Valley Groundwater Basin (BCV-21-101927)
20. Adjourn (xx p.m.)