Cuyama Basin Groundwater Sustainability Agency

Groundwater Sustainability Plan

January 2025

Woodard & Curran

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Cuyama Valley Groundwater Basin

Final 2025 Groundwater Sustainability Plan

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Table of Contents

Tables

Figures

Appendices

Appendices are organized by chapter at the end of this document.

Chapter 1

Appendix A – Preparation Checklist for Groundwater Sustainability Plan Submittal
Appendix B – Notification of Intent to Develop a Groundwater Sustainability Plan
Appendix C – Notice of Decision to Form a Groundwater Sustainability Agency
Appendix D – Groundwater Sustainability Plan Summary of Public Comments and Responses

Chapter 2

Appendix A – Cuyama Valley Groundwater Basin Hydrographs
Appendix B – White Paper: Subsidence and Subsidence Monitoring Techniques
Appendix C – Cuyama Basin Water Resources Model Documentation
Appendix D – Technical Memorandum: Verification of NCCAG-Identified Locations

Chapter 4

Appendix A – Monitoring Protocols for Groundwater Level Monitoring Network
Appendix B – USGS Ground-Water Data-Collection Protocols and Procedures for the National Water-Quality Assessment Program: Collection and Documentation of Water-Quality Samples and Related Data

Chapter 5

Appendix A – Hydrographs Showing Minimum Thresholds, Measurable Objectives and Interim Milestones

Chapter 6

Appendix A – Cuyama Basin Data Management System Opti Data Public User Guide

Acronyms

μg/L	Micrograms per liter
AF	Acre-feet (foot)
AFY	Acre-feet per year
AHOGS	Automated high output ground seeding system site
Basin	Cuyama Valley Groundwater Basin
BMP	Best management practice
CASGEM Program	California Statewide Groundwater Elevation Monitoring Program
CBGSA	Cuyama Basin Groundwater Sustainability Agency
CBWD	Cuyama Basin Water District
CBWRM	Cuyama Basin Water Resources Model
CCR	California Code of Regulations
CCSD	Cuyama Community Services District
CDFW	California Department of Fish and Wildlife
CEDEN	California Environmental Data Exchange Network
CEQA	California Environmental Quality Act
CGPS	Continuous global positioning system
CMWC	Cuyama Mutual Water Company
CUVHM	Cuyama Valley Hydrologic Model
DEM	Digital elevation model
DMS	Data management system
DWR	California Department of Water Resources
EKI	EKI Environment & Water, Inc.
EPA	United States Environmental Protection Agency
GAMA Program	California Groundwater Ambient Monitoring and Assessment Program
GDE	Groundwater dependent ecosystems
GPS	Global positioning system

GSE	Ground surface elevation
GSP	Groundwater Sustainability Plan
HCM	Hydrogeologic conceptual model
ID	Identification number
ILRP	Irrigated Lands Regulatory Program
IM	Interim milestone
InSAR	Interferometric synthetic aperture radar
IRWM	Integrated Regional Water Management
LID	Low impact development
LiDAR	Light detection and ranging
Ma	Million years
MCL	Maximum contaminant level
Mg/L	Milligrams per liter
MO	Measurable objective
MSC	Master State Well Code
MT	Minimum threshold
NAVSTAR	Original name for the Global Positioning System; satellite-based radionavigation system owned by the United States government and operated by the United States Air Force
NCCAG	Natural Communities Commonly Associated with Groundwater
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NRCS	Natural Resources Conservation Service
NWIS	National Watershed Information System
NWQMC	National Water Quality Monitoring Council
PBO	Plate Boundary Observatory
PG&E	Pacific Gas & Electric
PRISM	Parameter-Elevation Regressions on Independent Slopes Model
RCD	Resource Conservation District
RWQCB	Regional Water Quality Control Board

SAGBI	Soil Agricultural Groundwater Banking Index
SBCF	Santa Barbara Canyon Fault
SBCWA	Santa Barbara County Water Agency
SGMA	Sustainable Groundwater Management Act
SLOCFC&WCD	San Luis Obispo County Flood Control & Water Conservation District
SR	State Route
TDS	Total dissolved solids
TSS	Technical Support Services
UNAVCO	University NAVSTAR Consortium, a non-profit, university-governed consortium facilitating geoscience research and education using geodesy
USGS	United State Geological survey
VCWPD	Ventura County Watershed Protection District
VWSC	Ventucopa Water Supply Company
WDL	Water Data Library
WMP	Water Management Plan

EXECUTIVE SUMMARY

Introduction

In 2014, the California legislature enacted the Sustainable Groundwater Management Act (SGMA) in response to continued overdraft of California's groundwater resources. The Cuyama Groundwater Basin (Basin) is one of 21 basins and subbasins identified by the California Department of Water Resources (DWR) as being in a state of critical overdraft. SGMA requires preparation of a Groundwater Sustainability Plan (GSP) to address measures necessary to attain sustainable conditions in the Basin. Within the framework of SGMA, sustainability is generally defined as the conditions that result in long-term reliability of groundwater supply, and the absence of undesirable results.

Critical Dates for the Cuyama Basin

- ✓ 2020 By January 31: submit GSP to DWR (complete)
- ✓ 2025 Review and update GSP
- 2030 Review and update GSP
- 2035 Review and update GSP
- 2040 Achieve sustainability for the Basin

In 2017, in response to SGMA, the Cuyama Basin Groundwater Sustainability Agency (CBGSA) was formed. The CBGSA is a joint-powers agency that is comprised of Kern, Santa Barbara, San Luis Obispo and Ventura counties, the Cuyama Community Services District and the Cuyama Basin Water District. The CBGSA is governed by an 11-member Board of Directors, with one representative from Kern, San Luis Obispo and Ventura counties, two representatives from Santa Barbara County, one member from the Cuyama Community Services District, and five members from the Cuyama Basin Water District.

SGMA requires that the CBGSA develop a GSP that achieves groundwater sustainability in the Basin by the year 2040. The Draft Cuyama Basin GSP was adopted on December 4, 2019 by the CBGSA Board and submitted to DWR on January 28, 2020. On January 21, 2021, DWR determined that the GSP was "incomplete" and recommended CBGSA to amend the GSP to address four corrective actions. To address these corrective actions, CBGSA developed supplemental sections to the GSP and resubmitted to DWR on July 18, 2022. On March 2, 2023, DWR announced that the Revised GSP had been Approved.

This 2025 GSP Update is now available for public review and comment. SGMA requires the CBGSA to develop a GSP that achieves groundwater sustainability in the Basin by 2040. Although SGMA references 2015 as a basis for groundwater planning, SGMA does not require a GSP to address undesirable results that occurred before 2015. The GSP outlines the need for significant reductions in pumping in the central portion of the Basin and has identified projects and management actions that could help offset the projected reductions in pumping. Although current analysis indicates groundwater pumping reductions on the order of 60 percent may be required Basin-wide to achieve sustainability, additional efforts are required to confirm the amount and location of pumping reductions required to achieve sustainability. These efforts include collecting additional data and a review of the Basin's groundwater model, along with other efforts as outlined in this document.

Plan Area

The CBGSA's jurisdictional area is defined by DWR's 2013 Bulletin 118, and in the 2016 Interim Update[1]. The Basin generally underlies the Cuyama Valley, as shown in Figure ES-1, above.

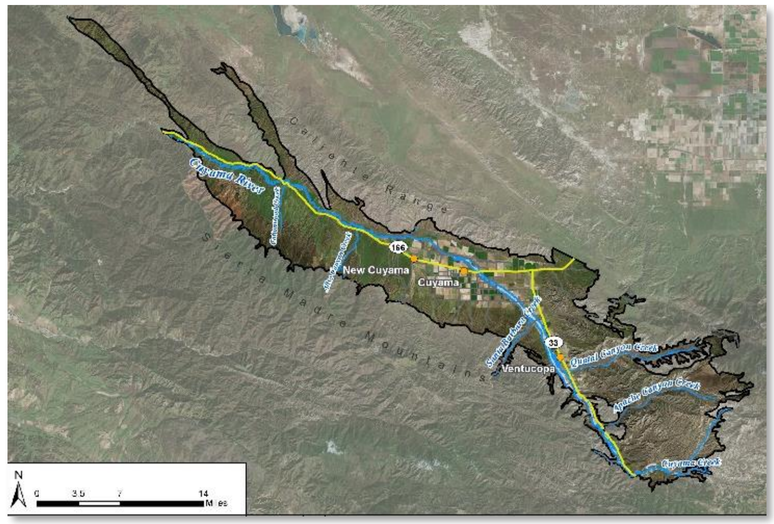

Figure ES- 1: GSP Plan Area

Outreach Efforts

A stakeholder engagement strategy was developed to ensure that the interests of all beneficial users of groundwater in the Basin were considered. The strategy incorporated monthly CBGSA Standing Advisory Committee (SAC) meetings, monthly CBGSA Board meetings, quarterly community workshops, and information distribution to all property owners and residents in the Basin. A total of 131 public meetings were held between June 2017 and August 2024 as summarized in the table below. Figure ES-2 shows attendees at one of the community workshops conducted during development of the GSP.

Figure ES- 2: Community Workshops

Public Meeting	Number
Cuyama Basin GSA Board Meetings	59
Cuyama Basin GSA Standing Advisory Committee Meetings	53
Joint Meetings of Cuyama Basin GSA Board and Standing Advisory Committee	10
Community Workshops	9

The SAC was established to encourage active involvement from diverse social, cultural, and economic elements of the population in the Basin. The SAC members represent large and small landowners and growers from different geographic locations in the Basin, longtime residents including Hispanic community members, and a manager of an environmental educational non-profit organization. The

[1] https://water.ca.gov/Programs/Groundwater-Management/Bulletin-118

community workshops were conducted in both English and Spanish creating an opportunity for local individuals to engage in the GSP development process.

Basin Setting

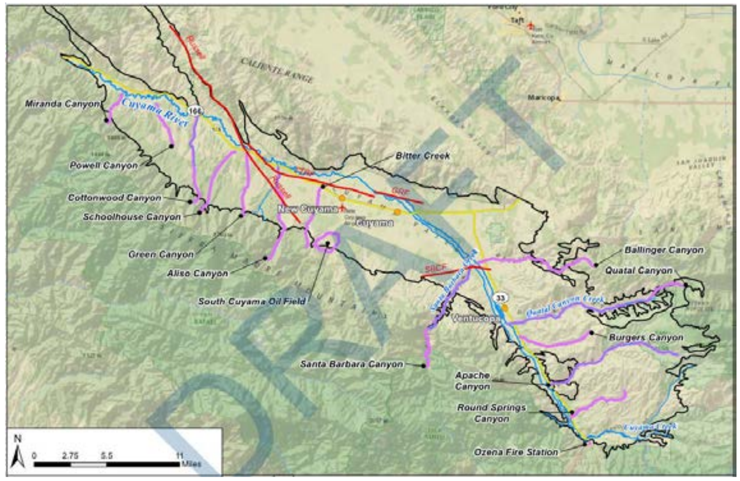

Figure ES- 3: Basin Setting

The Basin is at the southeastern end of the California Coast Ranges, near the San Andreas and Santa Maria River fault zones, and is bounded on the north and south by faults. These faults create several constraints on groundwater flow through the Basin. Groundwater and surface water generally flow from the eastern portions of the Basin toward the westernmost portion of the Basin. The major surface stream is the Cuyama River. Multiple smaller streams flow into the Cuyama River; and the Cuyama River flows to the west and eventually joins with the Santa Maria River. The location of the Basin is shown in Figure ES-3.

Existing Groundwater Conditions

Groundwater levels in some portions of the Basin have been declining for many years, while other areas of the Basin have experienced no significant change in groundwater levels. Figure ES-4 shows depth-to-groundwater contours for fall 2023, which reflects the most recent recorded status of groundwater levels in the Basin. The change in groundwater levels vary across the Basin, with the greatest declines occurring in the central portion of the Basin, where the greatest concentration of irrigated agriculture occurs. The western and eastern portions of the Basin have experienced significantly less change in groundwater levels. However, additional irrigated agricultural acreage has been developed recently in the western portion of the Basin, warranting additional levels of monitoring to determine if there are any impacts to long-term groundwater levels and sustainability.

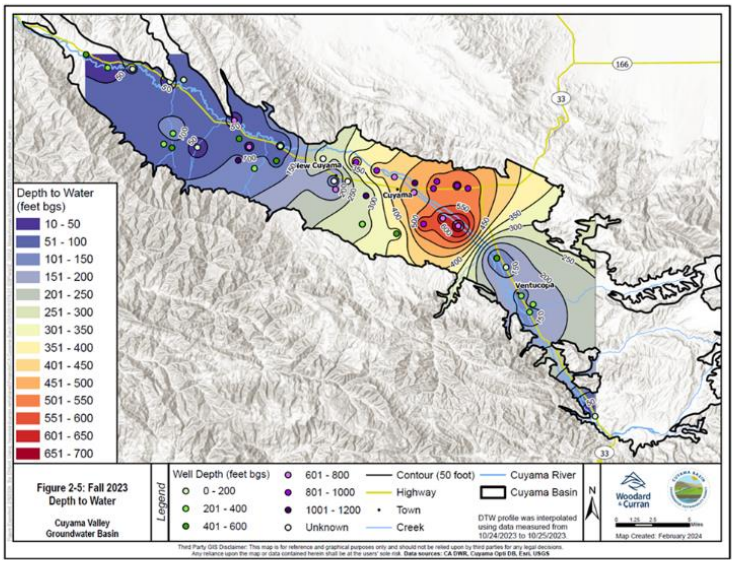

Figure ES- 4: Depth-to-Groundwater in Fall 2023

Groundwater quality in the Basin varies, particularly along the Basin boundary. Water quality in the Basin has historically had high levels of total dissolved solids (TDS) and sulfates. The United States Geological Survey (USGS) has conducted several water quality studies in the Basin. High concentrations of other constituents, including nitrate and arsenic, are generally localized and not widespread. Groundwater quality ranges from hard to very hard and is predominantly of the calcium-magnesium-sulfate type. Average TDS concentrations across the Basin in the last year are about 1,100 to 1,300 milligrams per liter (mg/L) along portions of the Basin's southern boundary. These values exceed the California recommended secondary maximum contaminant level (MCL) for drinking water of 500 mg/L.

Undesirable Results

Undesirable results are conditions that cause significant and unreasonable reduction in the long-term viability of domestic, agricultural, municipal, or environmental uses of the Basin's groundwater. SGMA identifies six defined areas for classification of undesirable results, as shown in the adjacent callout. The one undesirable result that does not impact the Basin is seawater intrusion. Water quality in the Basin is generally poor due to high TDS and other constituents, and there is limited subsidence in the Basin, but the major areas of undesirable results are associated with the following:

- Chronic lowering of groundwater levels
- Significant and unreasonable reduction in groundwater storage
- Depletions of interconnected surface water

Undesirable Results Categories

- Chronic lowering of groundwater levels indicating a significant and unreasonable depletion of supply if continued over the planning and implementation horizon
- Significant and unreasonable reduction of groundwater storage
- Significant and unreasonable seawater intrusion (does not apply in the Basin)
- 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
- Depletions of interconnected surface water that have significant and unreasonable adverse impacts on beneficial uses of the surface water

Figure ES-5 is a graph showing the modeled annual and cumulative long-term reduction in groundwater storage in the Basin. This reduction in groundwater storage coincides with the observed lowering of groundwater levels.

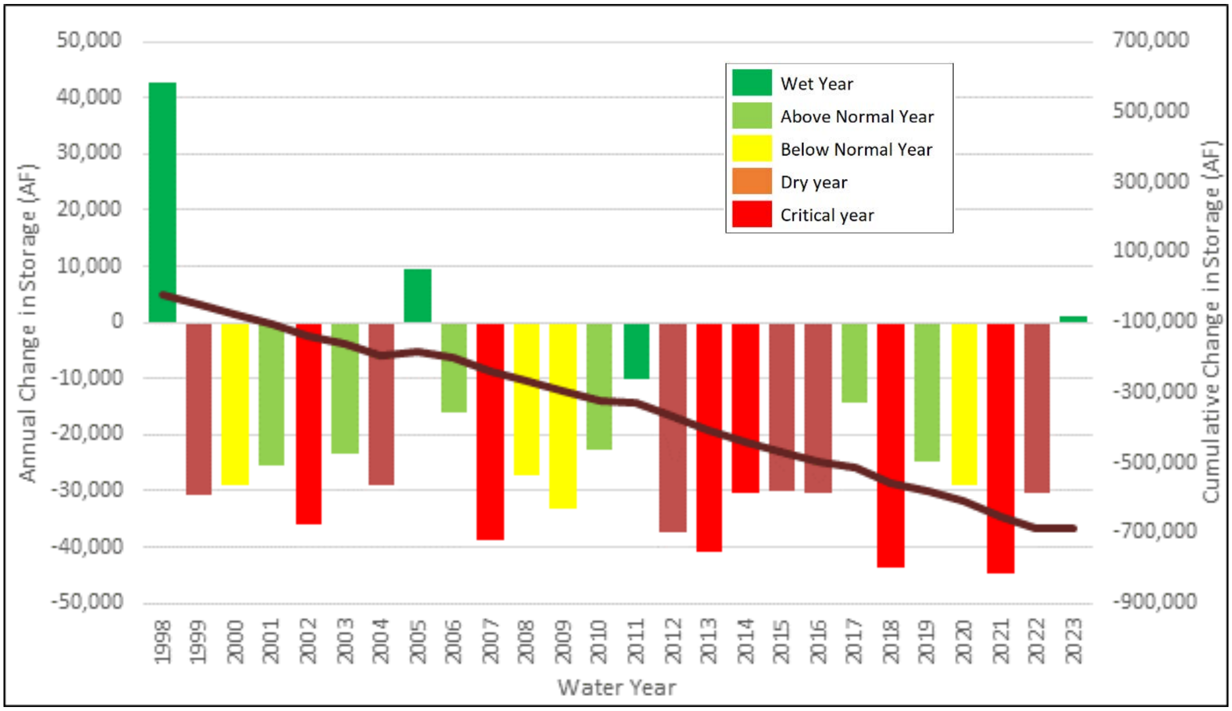

Figure ES- 5: Annual and Cumulative Changes in Groundwater Storage

The lowering of groundwater levels has corresponded with degradation of groundwater quality, and particularly in elevated levels of TDS. Additionally, lowering of groundwater levels has contributed to some subsidence in the central portion of the Basin (i.e., about 1 foot over the past 20 years), and has contributed to depletions in interconnections of surface and groundwater systems.

Sustainability

SGMA introduces several terms to measure sustainability, including the following:

- **Sustainability Goals** – These goals are the culmination of conditions resulting in an absence of undesirable results within 20 years.
- **Undesirable Results** – Undesirable results are the significant and unreasonable occurrence of conditions that adversely affect groundwater use in the Basin.

- **Sustainability Indicators** – Sustainability indicators refer to any of the adverse effects caused by groundwater conditions occurring throughout the Basin that, when significant and unreasonable, cause undesirable results, including the following:
  - Lowering groundwater levels
  - Reduction of groundwater storage
  - Seawater intrusion (does not apply in the Basin)
  - Degraded water quality
  - Land subsidence
  - Depletion of interconnected surface water
- **Minimum Thresholds** – Minimum thresholds are a numeric value for each sustainability indicator and are used to define when undesirable results occur, including if minimum thresholds are exceeded in a percentage of sites in the Basin's monitoring network.
- **Measurable Objectives** – Measurable objectives are a specific set of quantifiable goals for the maintenance or improvement of groundwater conditions. They will be included in the adopted GSP, and will help the CBGSA achieve their sustainability goal for the Basin.

Representative wells were identified in the Basin to provide a basis for measuring groundwater conditions without having to measure each existing well, which would have been cost prohibitive. Representative wells were selected based on availability, their history of recorded groundwater levels, and their potential to effectively represent groundwater conditions near the identified well. During GSP implementation, well owners have to consent to the use of their wells for monitoring. During the first four years of GSP implementation, monitoring networks have been revised to provide efficient and adequate coverage of the Basin while expanding data collection efforts.

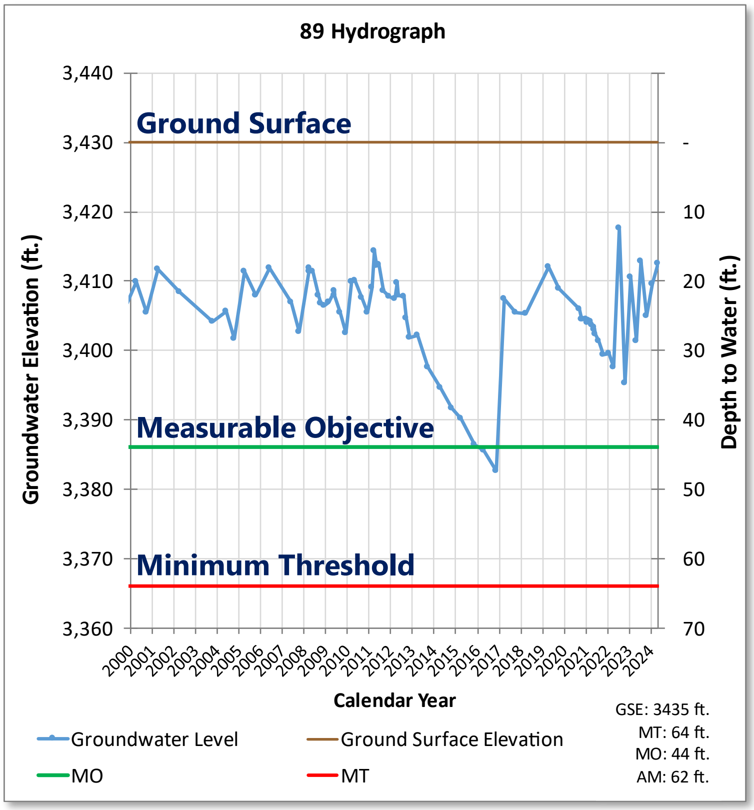

Figure ES- 6: Sample Relationship Between Minimum Threshold and Measurable Objective

The revised groundwater level representative network includes 49 wells, and the revised groundwater quality monitoring network includes 27 wells. There are also five selected ground surface subsidence monitoring stations. Using groundwater level data as the basis for measuring change in groundwater storage, these representative wells and subsidence monitoring stations provide the basis for measuring the five potential undesirable results across the Basin.

Minimum thresholds and measurable objectives were developed for each of the identified representative wells. Figure ES-6 shows a typical relationship of the minimum thresholds, measurable objectives, and other data for a sample well.

Minimum thresholds were developed through a stepwise function that utilizes a well/GDE protection depth, historical data, projected modeled glidepath declines, and the saturated thickness in areas with greater geologic understanding. Measurable objectives were calculated by using the same margin of operation flexibility as described in the original GSP but utilizing the new minimum thresholds as the starting value.

A table summarizing minimum thresholds and measurable objectives is included in the GSP Section 5. Graphs showing the minimum threshold and measurable objective for each representative well are in an appendix to the GSP.

Water Budgets

The Basin has been in an overdraft condition for many years. Overdraft conditions in the Basin were first documented in the 1950s. Since then, groundwater pumping has increased in response to increased levels of agricultural production, leading to increased levels of groundwater overdraft.

The current analysis was prepared using the best available information and through development of groundwater modeling tool. The groundwater model was significantly updated in advance of the 2025 GSP Update to reflect information collected to date, including updated geologic representation reflecting Airborne Electromagnetic (AEM) survey data and the results of a fault investigation conducted by the CBGSA, updated pumping well location and land use information, and updated evapotranspiration estimates that were calibrated to better match metered pumping data for 2022 and 2023. Although the Basin has been studied for many years, the available data are still not as robust in areas outside the center of the Basin as compared to many other basins, thus leading to some level of uncertainty in the analyses. 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 in the future.

The groundwater evaluations conducted as a part of this 2025 GSP Update provided estimates of historical, current and future groundwater budget conditions.

These analyses show that at current groundwater pumping levels, the average annual overdraft is estimated to be approximately 17,500 acre-feet, and the reduction in groundwater pumping required to achieve sustainability is approximately 25,600 acre-feet per year. Future groundwater conditions in the Basin will continue to show decreased groundwater levels based on projections of current land and water uses. Assuming no projected changes in land use or population in the Basin, the projected annual decline in groundwater storage is estimated to be the same as under current conditions.

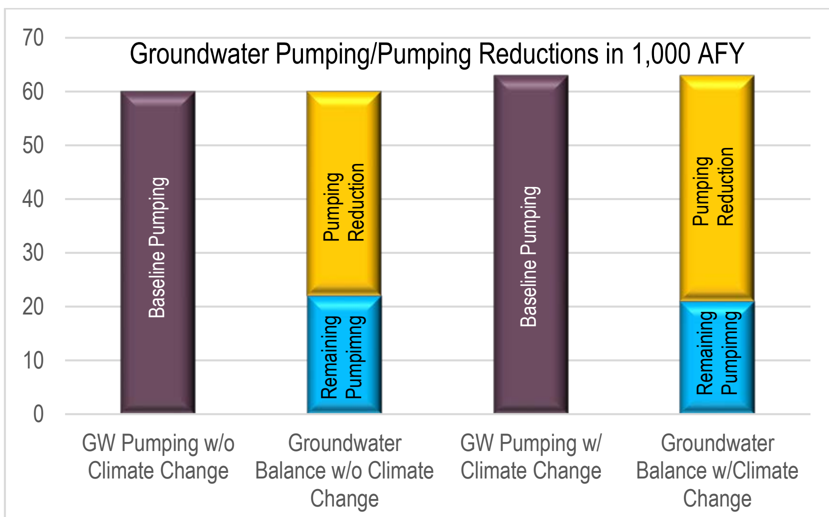

Figure ES- 7: Basin-Wide Groundwater Pumping and Reductions Required to Achieve Sustainability

The projected Basin water budget was also evaluated under climate change conditions. Under the intermediate climate change scenario prescribed by DWR, the annual groundwater overdraft is projected to increase to approximately 20,000 acre-feet, requiring an approximate 28,300 acre-feet per year reduction in groundwater pumping to achieve sustainability. These changes are shown in Figure ES-7.

Analysis of the Basin as a whole shows that much of the Basin is in hydrologic balance. Existing and projected groundwater levels in the western portions of the Basin, along with the southeastern region, show those areas to be sustainable under current and projected conditions. However, the model results project significant groundwater level reductions in the central portion of the Basin.

Monitoring Networks

The GSP outlines the monitoring networks for the five sustainability indicators that apply to the Basin. The objective of these monitoring networks is to monitor conditions across the Basin and to detect trends toward undesirable results. Specifically, the monitoring network was developed to do the following:

- Monitor impacts to the beneficial uses or users of groundwater
- Monitor changes in groundwater conditions relative to measurable objectives and minimum thresholds
- Demonstrate progress toward achieving measurable objectives described in the GSP

Five Sustainability Indicators Applicable to the Cuyama Groundwater Basin

- Chronic lowering of groundwater levels
- Reduction in groundwater storage
- Degraded water quality
- Land subsidence
- Depletions of interconnected surface water

The monitoring networks, such as the groundwater level monitoring network shown in Figure ES-8, were designed by evaluating data sources provided by DWR, including the California Statewide Groundwater Elevation Monitoring (CASGEM) Program, the USGS, participating counties, and private landowners. The monitoring network consists of wells that are already being used for monitoring in the Basin and was updated in September of 2023 following an evaluation of the existing monitoring network by the CBGSA. Additional wells have been added with DWR grant funding and by the DWR Technical Support Services program. The wells in the monitoring network are measured by the CBGSA on either a quarterly schedule. Historical measurements have been entered into the Basin Data Management System (DMS), as well as data collected during GSP implementation. All future data will also be stored in the Basin DMS.

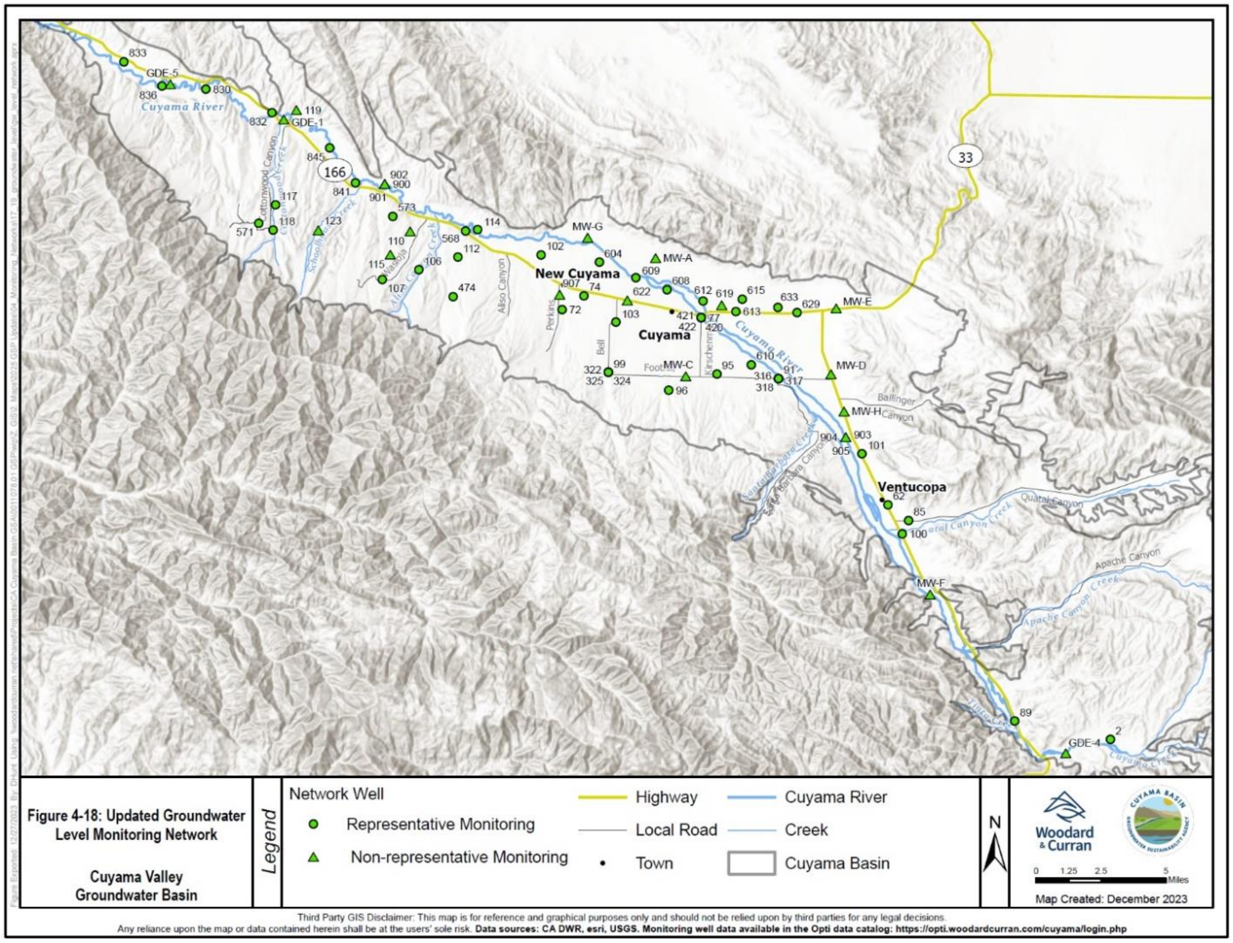

Figure ES- 8: Groundwater Monitoring Wells

Data Management System

The Basin DMS was built on a flexible, open software platform that uses familiar Google maps and charting tools. Typical views generated by the Basin DMS are shown in Figure ES-9. The Basin 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 about collected data and analysis results.

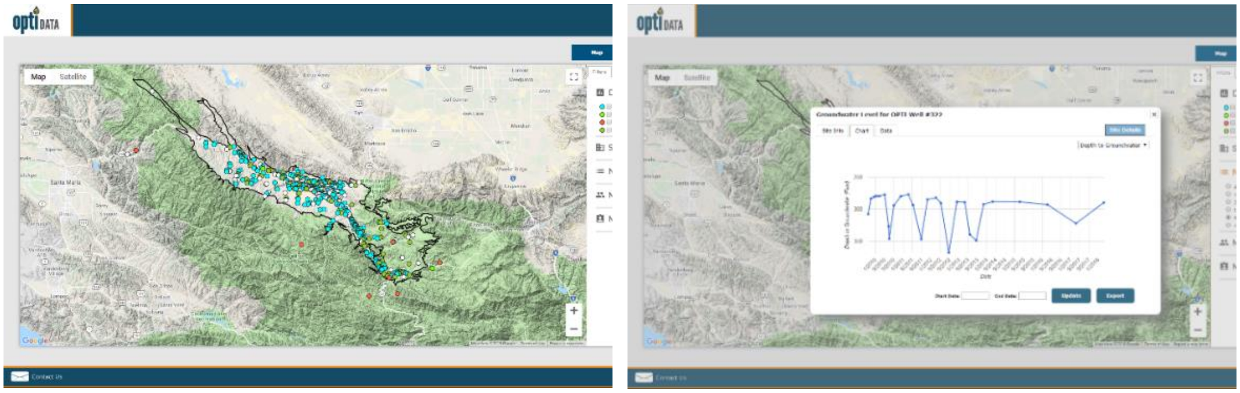

Figure ES- 9: Opti DMS Screenshots

The Basin DMS is web-based; the public can easily access this portal using common web browsers such as Google Chrome, Firefox, and Microsoft Edge. The Basin DMS is currently populated with available historical data; additional data will be entered into the system as it is collected.

The Basin DMS portal provides easy access and the ability to query information stored in the system. Groundwater data can be plotted for any of the available data points, providing a pictorial view of historical and current data. The DMS can be accessed at https://opti.woodardcurran.com/cuyama/login.php.

Projects and Management Actions

Achieving sustainability in the Basin requires implementation of management actions and, if demonstrated to be feasible, projects that will increase water supply. One management action, reductions in groundwater pumping through pumping allocations, is required to achieve sustainability irrespective of the feasibility of any other water supply projects. The exact amount of required reduction in groundwater pumping has been reevaluated since the submittal of the original GSP and updated for the 2025 GSP Update. Based on current information, groundwater pumping reductions are estimated to need to be about 60 percent. Additional evaluations of pumping reductions will continue during GSP implementation. These additional evaluations may lead to modification of levels of pumping reduction associated with the attainment of reliability.

Additional management actions included in the GSP include the following:

- Monitoring and recording groundwater levels, groundwater quality, and subsidence data
- Maintaining and updating the Basin DMS with newly collected data
- Monitoring groundwater use using satellite imagery
- Annual monitoring of progress toward sustainability
- Annual reporting of Basin conditions to DWR as required by SGMA

Several alternative projects to potentially increase water supply availability in the Basin were identified and considered. The initial set of alternatives were reviewed with the CBGSA SAC and Board of Directors, resulting in two potential water supply projects included in the GSP. These projects require further analysis and permitting to determine feasibility and cost effectiveness, and are listed below.

The first project is rainfall enhancement through what is commonly referred to as cloud seeding. Cloud seeding is a type of weather modification with the objective to increase the amount of precipitation that would fall in the Basin watershed. The concept is to introduce silver iodide, or a similar substance, into the clouds to induce greater rainfall. Cloud seeding has been used in numerous areas throughout California and other western states. Preliminary estimates suggest up to approximately 4,000 acre-feet per year of additional water supply could be added to the Basin. The target area for rainfall enhancement is shown in Figure ES-11.

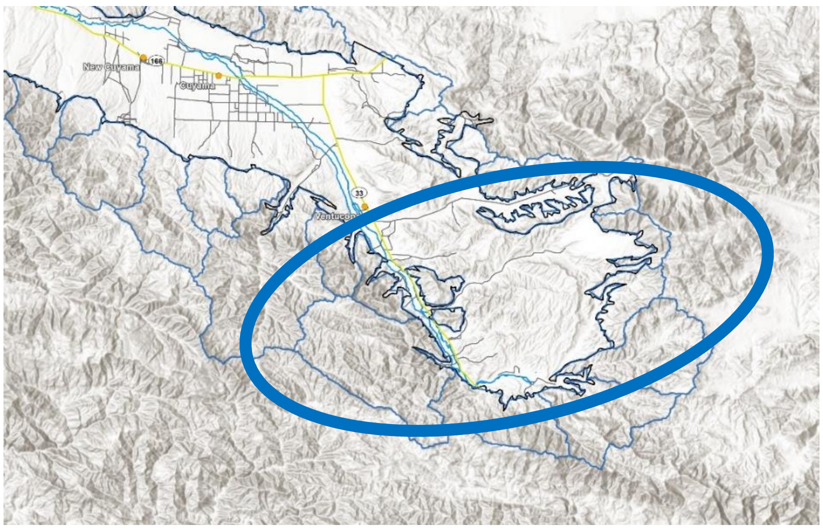

Figure ES- 10: Target Area for Potential Rainfall Enhancement

The next step toward implementation of this water supply project is to refine the analysis to better determine the potential increase in precipitation that could be achieved, and to refine the estimated cost of implementation. An analysis was performed in 2024 to provide updated information. Full implementation of a precipitation enhancement project would require completion of an environmental document consistent with the requirements of the California Environmental Quality Act (CEQA).

The second potential project is capture of high stormwater flows in the Cuyama River and diversion into recharge basins that would be sited in the Central region of the Basin. The captured stormwater flows would percolate into the groundwater basin resulting in increased recharge of groundwater. The potential stormwater recharge project has several challenges associated with it, including water rights availability, managing sediment that will be present in any diverted stormwater flows, and obtaining lands for construction of the recharge basins. Preliminary estimates suggest that up to 4,000 acre-feet per year of additional water supply could be added to the Basin. The general location of the potential recharge basins are shown in Figure ES-12.

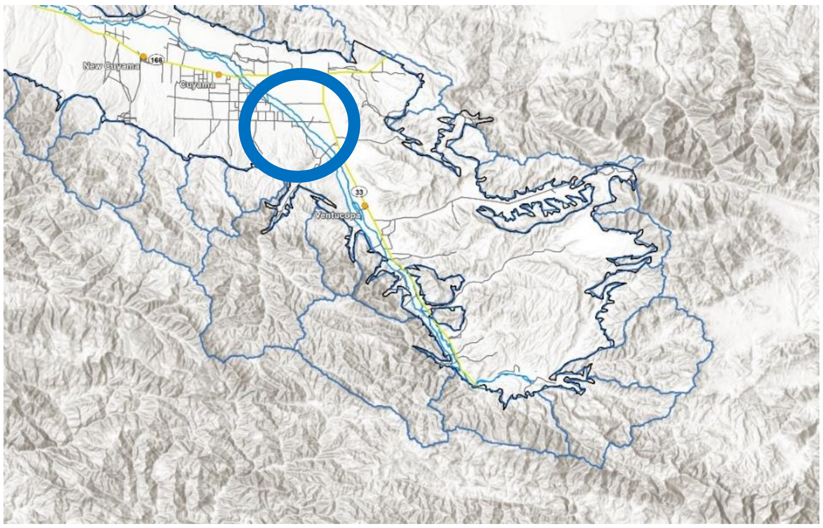

Figure ES- 11: General Location of Potential Recharge Basins

Since the original GSP was submitted, the CBGSA performed an analysis of the frequency of diversions that could be available for diversion, which indicated that upstream diversions could be made in approximately 11% of all years (i.e. 7 out of 62 years from 1962-2023). The next step toward implementation of this potential project is to evaluate each of these areas of uncertainty and to develop more refined estimates of potential water supply benefit and cost.

The GSP also includes projects specific to the domestic water systems in Ventucopa, Cuyama, and New Cuyama. These projects include installing new wells to secure reliability of water supply to residents of these communities. Implementation of these community well projects would be the responsibility of each of the three communities, as the projects address reliability of available supply for each community.

GSP Implementation

Achieving sustainability in the Basin requires implementation of management actions and, if demonstrated to be feasible, projects that will increase water supply. One management action, which is reductions in groundwater pumping, is required to achieve sustainability irrespective of the feasibility of any other water supply projects. Implementing project and management actions can best be achieved through development of Basin Management Areas to focus necessary activities on the areas of the Basin with projected long-term overdraft.

Two Management Areas have been established in the Basin to aid in administering projects and management actions, as shown in Figure ES-13. The Central and Ventucopa management areas were identified based on the model's projection of groundwater levels decreasing at a rate of 2 feet or more per year over a 50-year hydrologic period.

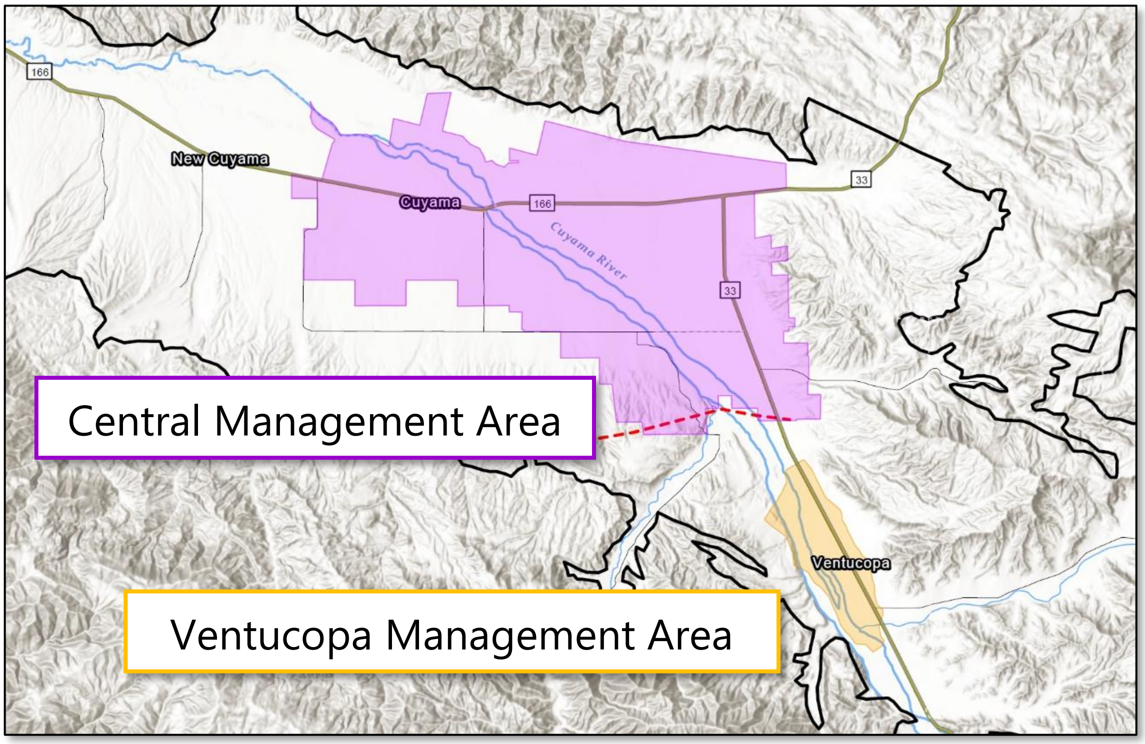

Figure ES- 12: Location of Central and Ventucopa Management Areas

Figure ES-13 depicts the general boundaries of the proposed Management Areas. The highlighted colors show the projected annual change in groundwater levels, with clear and green indicating no change to less than 2 feet of projected annual decline in groundwater levels, and the yellow, orange and red areas indicating areas of increasing projections of annual declines in groundwater levels, ranging from more than 2 feet per year up to more than 6 feet per year.

Overdraft conditions in the Central Management Area requires reductions in groundwater pumping. The exact amount of required reduction in groundwater pumping will be reevaluated after additional data are collected and analyzed. However, based on current information, total Basin-wide groundwater pumping may have to be reduced by as much as 60 percent, with the major proportion or reduction required in the Central Management Area.

Management actions and projects within the Cuyama Basin Water District (CBWD) may be managed by the CBWD if agreed to by the CBGSA.

Implementing the GSP will require numerous management activities that will be undertaken by the CBGSA, including the following:

- Preparing annual reports summarizing the conditions of the Basin and progress towards sustainability and submitting them to DWR
- Monitoring groundwater conditions for all five sustainability indicators twice each year
- Entering updated groundwater data into the Basin DMS
- Monitoring basin-wide groundwater use using satellite imagery
- Updating the GSP as necessary
- Preparing Periodic Evaluations once every five years and submitting to DWR

The CBGSA Board adopted a preliminary schedule for reduction of groundwater pumping in the Central Management Area.

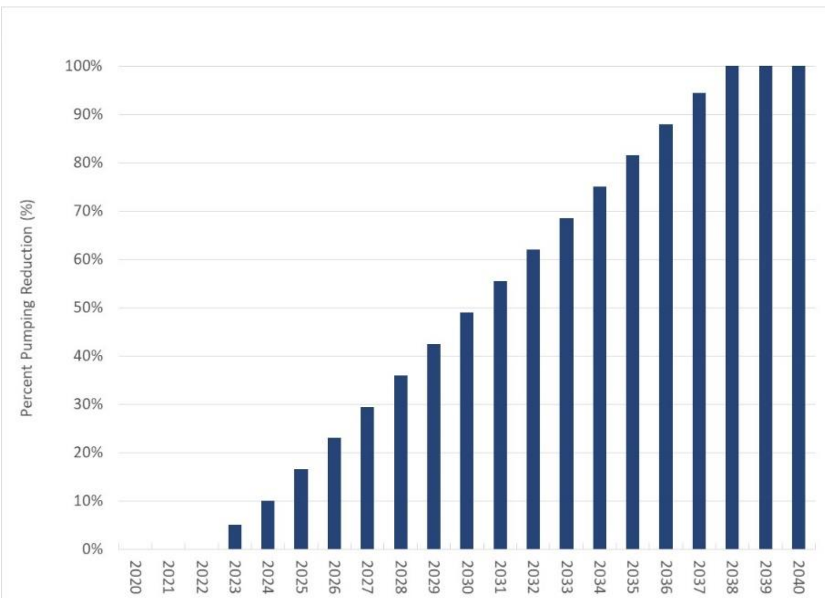

Figure ES- 13: Schedule for Proposed Reductions in Groundwater Pumping

For the Central Management Area, pumping reductions began in 2023 with full implementation by 2038, as shown in Figure ES-14. This approach provides adequate time to put into place methods necessary to monitor groundwater use and reductions. A pumping reporting program has been established, and a flow meter calibration program is currently being developed.

Pumping reductions are not currently recommended for the Ventucopa Area. The recommendation is to perform additional monitoring, incorporate new monitoring wells, and further evaluate groundwater conditions in the area. Once additional data are obtained and evaluated, the need for any reductions in pumping will be determined.

The CBGSA has also begun implementing other projects and management actions. These include:

- Completing a water rights study for Project 1, Flood and Stormwater Capture
- Completing a preliminary study for Project 2, Precipitation Enhancement.
- Supporting the CCSD in the efforts to replace their supply well (Project 4)
- Completing Management Action 1, Basin-Wide Economic Analysis
- Establishing pumping allocations under Management Action 2 (this will continue)

The table below presents an overall schedule of GSP activities over the 20-year planning horizon.

Time Range	2020 to 2024	2025 to 2029	2030 to 2034	2035 to 2040
Phase	Set up and initiate monitoring and pumping allocation programs	Project implementation and GSP evaluation/update	Project implementation and GSP evaluation/update	Achieve Basin sustainability
Tasks	• Establish monitoring network and initiate monitoring and reporting • Evaluate/refine thresholds and monitoring network • Install new wells • Develop pumping monitoring program* • Set up and initiate pumping allocation program* • Project analysis and feasibility • Public outreach	• CBGSA conducts five-year evaluations/update • Monitoring and reporting continues • Evaluate/refine thresholds and monitoring network • Refine water budget • Pumping monitoring program continues* • Continue implementation of pumping allocation program* • Plan/design/construct small- to medium-sized projects* • Public outreach continues	• CBGSA conducts five-year evaluations/update • Monitoring and reporting continues • Evaluate/refine thresholds and monitoring network • Refine water budget • Pumping monitoring program continues* • Continue implementation of pumping allocation program* • Plan/design/construct larger projects* • Public outreach continues	• CBGSA conducts five-year evaluations/update • Monitoring and reporting continues • Evaluate/refine thresholds and monitoring network • Refine water budget • Pumping monitoring program continues* • Pumping allocation program fully implemented* • Project implementation completed* • Public outreach continues
Status	Complete	In Progress	Planned	Planned
*Represents activities that will take place in CBGSA-designated management areas				

Funding

Implementation of the GSP requires funding. To the degree they become available, outside grants will be sought to help reduce the cost of implementation. However, funds will need to be collected to support implementation, and costs associated with Basin-wide management and GSP implementation will likely be borne by residents and landowners across the Basin. These costs include the following:

- CBGSA administration
- Groundwater level monitoring and reporting
- Groundwater quality monitoring and reporting
- Ground surface subsidence monitoring and reporting
- Water use estimation
- Data management
- Stakeholder engagement
- Annual report preparation and submittal to DWR
- Funding mechanism development and implementation
- Grant applications
- GSP updates and submittal to DWR (every five years)

For budgetary purposes, the estimated initial cost of these activities ranges from $800,000 to $1.3 million per year. The CBGSA Board of Directors will evaluate options for securing needed funding. Options for funding include instituting fees based on groundwater pumping, acreage, or combinations of these, and pursuit of any available grant funds.

Activities associated with the two Management Areas will be borne by the landowners and water users within the two Management Areas.

The CBGSA Board of Directors will evaluate options for securing the needed funding. Similar to the funding options for the CBGSA basin-wide activities, options for funding management area costs include fees based on groundwater pumping, acreage, or combinations of these, and pursuit of any available grant funds.

Funding for new community wells or well improvements is the responsibility of the three Basin communities. There are potential opportunities for securing grant funds, depending on timing and State and federal grant funding availability.

1. AGENCY INFORMATION, PLAN AREA, AND COMMUNICATION

1.1 Introduction and Agency Information

This section describes the Cuyama Basin Groundwater Sustainability Agency (CBGSA), its authority in relation to the Sustainable Groundwater Management Act (SGMA), and the purpose of this Groundwater Sustainability Plan (GSP).

This GSP meets regulatory requirements established by the California Department of Water Resources (DWR) as shown in the completed *Preparation Checklist for GSP Submittal* (Appendix A). The CBGSA's Notification of Intent to Develop a Groundwater Sustainable Plan is in Appendix B.

On June 6, 2016, Santa Barbara County Water Agency (SBCWA) sent DWR a notice of intent to form a Groundwater Sustainability Agency (GSA). Following this submittal, the CBGSA Board of Directors was organized, and now includes the following individuals:

- Cory Bantilan, Chair, SBCWA
- Matt Vickery, Vice Chair, Cuyama Basin Water District (CBWD)
- Arne Anselm, Secretary, County of Ventura
- Byron Albano, Treasurer, CBWD
- Rick Burnes, CBWD
- Jimmy Paulding, County of San Luis Obispo
- Zack Scrivner, County of Kern
- Das Williams, SBCWA
- Deborah Williams, Cuyama Community Services District (CCSD)
- Jane Wooster, CBWD
- Derek Yurosek, CBWD

In addition, the following individuals serve as alternatives to regular CBGSA Board members:

- Darcel Elliott – SBCWA
- Steve Lavagnino – SBCWA
- Juan Gonzalez – CCSD
- Brad DeBranch – CBWD
- Matt Klinchuch – CBWD
- Kim Loeb – County of Ventura
- Blaine Reely – County of San Luis Obispo

- Katelyn Zenger – County of Kern

During development of the 2020 GSP, board meetings were held on the first Wednesday of every month at 4 pm in the Cuyama Family Resource Center, at 4689 California State Route 166, in New Cuyama, California. During development of the 2025 GSP Update, the board meets 6 times per year at the same location.

The CBGSA's established boundary corresponds to DWR's *California's Groundwater Bulletin 118 – Update 2003* (Bulletin 118) groundwater basin boundary for the Cuyama Valley Groundwater Basin (Basin) (DWR, 2003). No additional areas were incorporated.

1.1.1 Contact Information

Contact information for the CBGSA is shown below.

- Cuyama Basin General Manager/CBGSA Director: Jim Beck
- Phone Number: (661) 447-3385
- Email: tblakslee@hgcpm.com
- Physical and Mailing Address: 4900 California Avenue, Tower B, 2nd Floor, Bakersfield, CA. 93309
- Website: http://cuyamabasin.org/index.html

1.1.2 Management Structure

The CBGSA is governed by an 11-member Board of Directors that meets six times a year. The General Manager manages the day-to-day operations of the CBWD, while Board Members vote on actions of the CBGSA; the Board is the CBGSA's decision-making body.

During GSP development, a Standing Advisory Committee (SAC) was formed to act in an advisory capacity to the CBGSA Board of Directors. The SAC includes the following individuals:

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

- David Lewis

1.1.3 Legal Authority

Per Section 10723.8(a) of the California Water Code, SBCWA gave notice to DWR on behalf of the CBGSA of its decision to form a GSA, which is Basin 3-013, per DWR's Bulletin 118 (Appendix C).

1.2 Plan Area

This section describes the Basin, including major streams and creeks, institutional entities, agricultural and urban land uses locations of groundwater production wells, locations of state lands and geographic boundaries of surface water runoff areas. This section also describes existing surface water and groundwater monitoring programs, existing water management programs, and general plans in the Basin. The information contained in this section reflects information from publicly available sources and may not reflect all information that will be used for GSP technical analysis.

This section of the GSP satisfies Section 354.8 of the SGMA regulations.

1.2.1 Plan Area Definition

The Basin is in California's Central Coast Hydrologic Region. It is beneath the Cuyama Valley, which is bounded by the Caliente Range to the northwest and the Sierra Madre Mountains to the southeast. The Basin was initially defined in Bulletin 118. The boundaries of the Cuyama Basin were delineated by DWR because they were the boundary between permeable sedimentary materials and impermeable bedrock. 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."

1.2.2 Plan Area Setting

Figure 1-1 shows the Basin and its key geographic features. The Basin encompasses an area of about 378 square miles and includes the communities of New Cuyama and Cuyama, which are located along State Route (SR) 166 and Ventucopa, which is located along SR 33. The Basin encompasses an approximately 55-mile stretch of the Cuyama River, which runs through the Basin for much of its extent before leaving the Basin to the northwest and flowing towards the Pacific Ocean. The Basin also encompasses stretches of Wells Creek in its north-central area, Santa Barbara Creek in the south-central area, the Quatal Canyon drainage and Cuyama Creek in the southern area of the Basin. Most of the agriculture in the Basin occurs in the central portion east of New Cuyama, and along the Cuyama River near SR 33 through Ventucopa.

Figure 1-2 shows the CBGSA boundary. The CBGSA boundary covers all of Cuyama Basin. The CBGSA was created by a Joint Exercise of Powers Agreement among the following agencies:

- Counties of Kern, San Luis Obispo, and Ventura
- SBCWA, representing the County of Santa Barbara
- CBWD
- CCSD

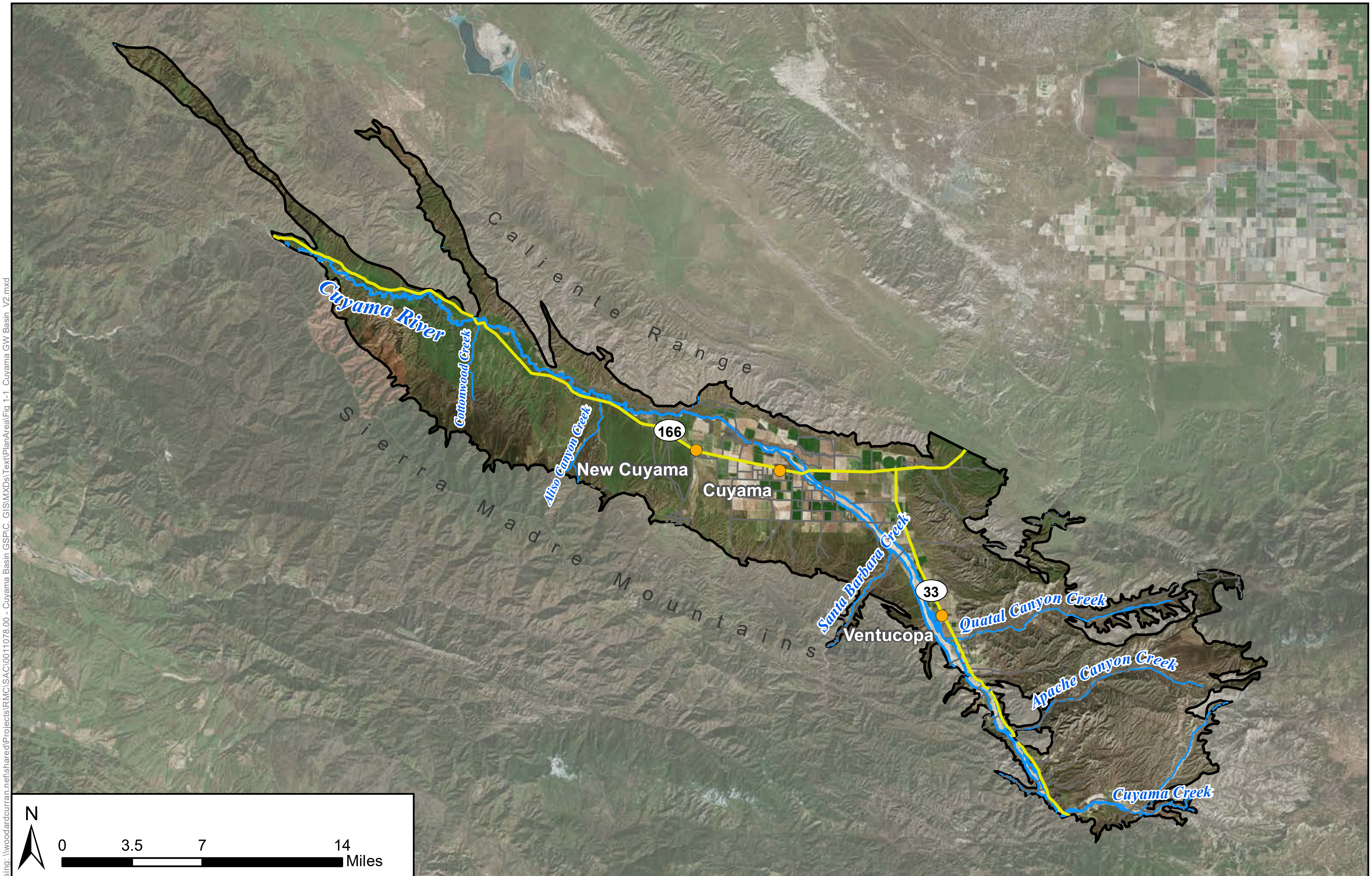

Figure 1-1 - Cuyama Valley Groundwater Basin

Cuyama Basin Groundwater Sustainability Agency

Cuyama Valley Groundwater Basin Groundwater Sustainability Plan

April 2019

WOODARD & CURRAN

Legend

- Towns
- Cuyama Basin
- Highways
- Local Roads
- Cuyama River
- Streams/Creeks

Figure Exported: 7/9/2018 By: mwicks Using: \\woodardcurran.net\shared\Projects\RMC\SAC\0011078.00 - Cuyama Basin GSP\C. GIS\MXDs\Text\PlanArea\Fig 1-1 Cuyama GW Basin V2.mxd

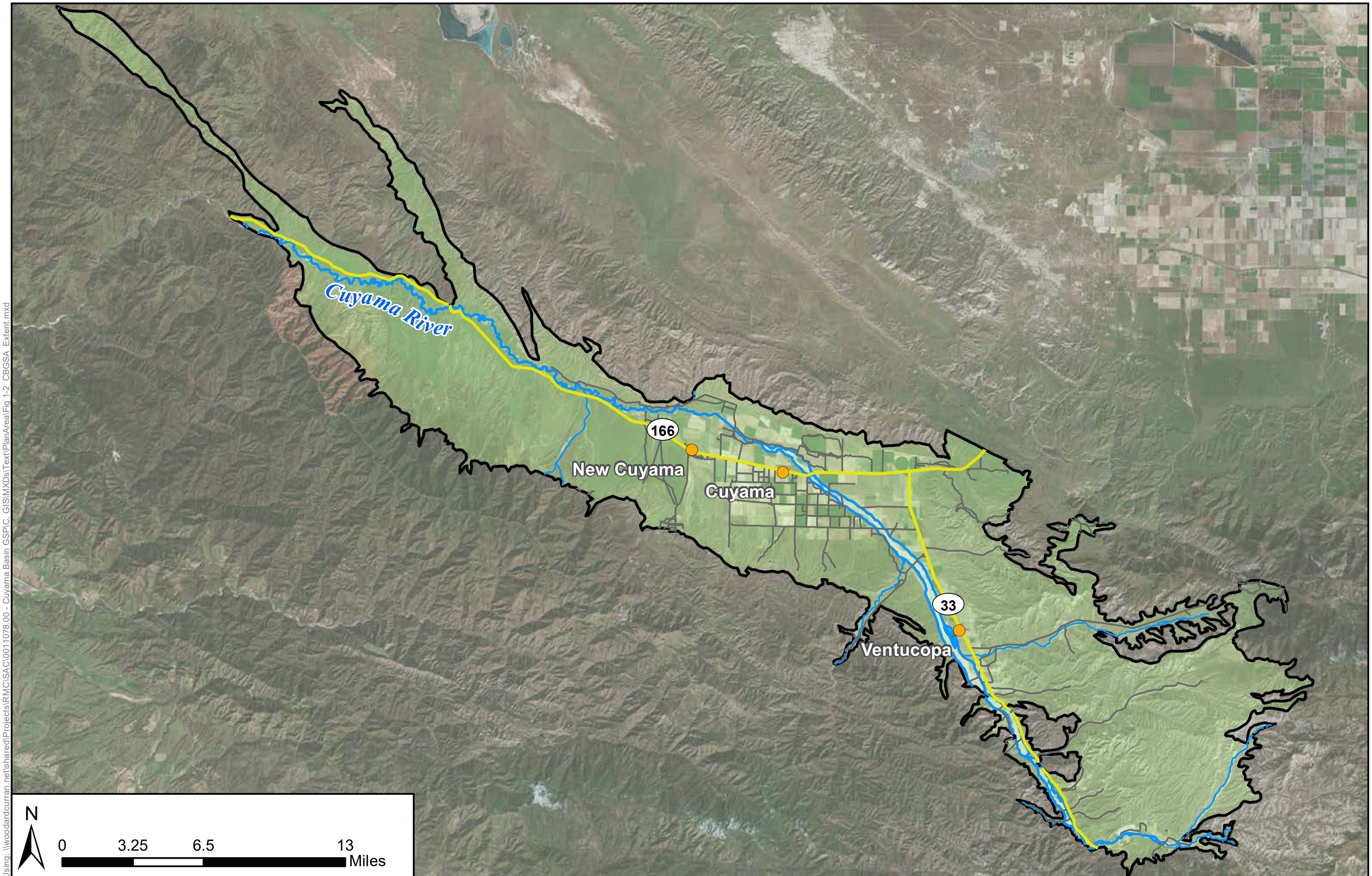

Figure 1-2 - Cuyama Valley Groundwater Sustainability Agency Boundary

Cuyama Basin Groundwater Sustainability Agency

Cuyama Valley Groundwater Basin Groundwater Sustainability Plan

April 2019

WOODARD & CURRAN

Legend

- Towns
- Cuyama Basin GSA
- Highways
- Local Roads
- Cuyama River
- Streams/Creeks

Figure 1-3 shows the Basin and neighboring groundwater basins. The Carrizo Plain Basin is located immediately northeast of the Cuyama Basin and they share a boundary about 5 miles east of the intersection of SR 166 and SR 133. The San Joaquin Valley Basin is located just east of the Carrizo Plain Basin. The Basin also shares a boundary with the Mil Potrero Area Basin, which is located just east of one of the Basin's southeastern tips, and the Lockwood Valley Basin is located close to the Basin's southern area but does not share a boundary with it. To the southwest, and more distant from the Basin, are the Santa Maria, San Antonio Creek Valley and Santa Ynez River Valley basins, which are located about 30 to 40 miles southwest of the Cuyama Basin.

Figure 1-4 depicts the Basin's extent relative to the boundaries of the various counties that overlie the Basin. Santa Barbara County has jurisdiction over the largest portion of the Basin (168 square miles), covering most of the area south of the Cuyama River, as well as Ventucopa and a small area to the north of that community. San Luis Obispo County has jurisdiction over areas north of the Cuyama River (covering 77 square miles). The Cuyama River marks the boundary between San Luis Obispo County and Santa Barbara County. Kern County has jurisdiction over the smallest extent of Cuyama Basin area compared to the other counties (13 square miles). Its jurisdictional coverage is located just east of the SR 166 and SR 33 intersection, as well as tips of the Basin in the Quatal Canyon area. Ventura County has jurisdiction over the southeastern area of the Basin (covering 120 square miles), including the area east of Ventucopa.

Figure 1-5 shows the non-county jurisdictional boundaries in the Basin. The CBWD was formed in 2016 and covers a large area of the Basin (about 130 square miles), from a location about 5 miles west of Wells Creek to 2 miles east of the intersection of SR 166 and SR 33, and south of Ventucopa along SR 33. The CCSD was formed in 1977 and covers a small area of the Basin (about 0.5 square miles) located along SR 166 in the community of New Cuyama.

Figure 1-6 through Figure 1-16 show the agricultural and urban land uses in the Cuyama Basin for the years 1996, 2000, 2003, 2006, 2009, 2012, 2014, 2016, 2018, 2020, and 2022, respectively. The 1996 land use data are from historical DWR county land use surveys[1] while the 2014 through 2022 land use data were developed for DWR using remote sensing data.[2]Data for the remaining years were developed by the CBGSA using the same remote sensing method that DWR used for 2014 through 2022. Agricultural land is located primarily in the New Cuyama and Ventucopa areas, and along the SR 166 and SR 33 corridors between those communities. There were about 34,000 acres of irrigated land in 2022, including about 19,000 acres of idle land. There is a regular rotation of crops with between 9,000 and 19,000 acres of agricultural area left idle each year between 2000 and 2022. Areas that are in active agricultural use primarily produce miscellaneous truck crops, carrots, potatoes and sweet potatoes,

[1] https://www.water.ca.gov/Programs/Water-Use-And-Efficiency/Land-And-Water-Use/Land-Use-Surveys

[2] https://gis.water.ca.gov/app/CADWRLandUseViewer/

miscellaneous grains and hay, and grapes. Various other crop types are produced in the Basin as well, such as fruit and nut trees, though at smaller production scales.

In addition to the crop types shown on the maps, much of the land area in the Basin, particularly in the western and eastern areas, consists of non-irrigated pasture. These are not present on the map because they are not detected by the remote sensing approach. Some recently planted crops are also not shown on the maps because they were either not detected by the remote sensing approach or were planted subsequent to the most recently mapped year of 2016. These include a new vineyard along SR 166 in the western part of the basin (which the remote sensing approach identifies as "idle" in 2016) and new olive orchards along SR 33. These additional land uses will be accounted for in the numerical modeling used to develop water budgets for the GSP.

Figure 1-17 shows 2022 land use by water source in the Basin. Almost all of the water use in the Basin is served by groundwater. There are 40 surface water rights permits in the Basin that allow up to 116 acre-feet per year. The areas that are supplied by small seeps and washes and are not designated as surface water on the map. Much of the surface water use is for stock watering of pastureland, which may not be included in the land use dataset shown in Figure 1-17.

Figure 1-18 shows the number of domestic wells per square mile and the average depth of domestic wells in each square mile in the Basin. Figure 1-18 shows a grid pattern where each block on the grid is a section that covers 1 square mile of land. The number in each square represents the average depth of the well(s) in the section. Most of the sections in the Basin that have domestic wells contain only one well, while fourteen sections contain two wells each, three sections contain three wells each, six sections contain four wells each. Wells range in depth broadly across the Basin, from as shallow as 120 feet below ground surface in the southeast portion of the Basin to 1,000 feet below ground surface in the central portion of the Basin.

Figure 1-19 shows the density and average depth of production wells in the Basin per square mile. There is a wide distribution of production well density in the Basin (between 1 and 12 wells per square mile). Depths of production wells range from 50 feet below ground surface (bgs) on the outer edges of the Basin, to over 1,200 feet bgs in the central portion of the Basin. Figure 1-20 shows the density and average depth of public wells in the Cuyama Basin. The Basin contains four public wells, one just south of New Cuyama, one southwest of New Cuyama, one east of Ventucopa and one at the southern tip of the Basin. These wells have depths of 855, 400, 280 and 800 feet, respectively.

Information presented in Figure 1-18 through Figure 1-20 reflects information contained in DWR's well completion report database, which contains information about the majority of wells drilled after 1947. However, some wells may not have been reported to DWR (potentially up to 30 percent of the total), and therefore are not included in the database or in these figures. Furthermore, designations of each well as a domestic, production, or public well were developed by DWR based on information contained in the well completion reports and have not been modified for this document. In addition, the database includes wells which have been abandoned or destroyed but have not been noted as such.

Figure 1-21 shows the active pumping well list in the Basin as confirmed since adoption of the 2020 GSP by the CBGSA. There are 262 active wells in the basin split into two categories production and domestic. Since the GSP adoption the CBGSA has undertaken steps to create this create this active well list by reaching out directly to landowners to receive information on their wells and locations, including a landowner well survey that got distributed to the community. This active well dataset was posted on the Cuyama Basin website for landowners to review and provide feedback to verify accuracy of the data. A survey was also conducted specifically for de-minimus users to obtain locations of their wells. Because it is the most complete and accurate dataset available, this active well dataset will be utilized by the CBGSA in place of the DWR well completion report data for any future analysis of potential impacts to beneficial users.

Figure 1-22 shows the public lands in and around the Basin. Some portions of the land that overlies the Cuyama Basin, and most of the areas immediately surrounding the Basin, have a federal or State jurisdictional designation. The Los Padres National Forest covers most of the Basin's northwestern arm, then runs just outside the Basin's western boundary until the Forest boundary turns east at about Ventucopa where it covers the southern part of the basin. The balance of the northwestern arm consists of private holdings and the state-owned Carrizo Plains Ecological Reserve which extends into the basin to the Santa Barbara County-San Luis Obispo County line at the Cuyama River. A portion of the Basin north of Ventucopa, as well as an area nearby that is immediately outside the Basin, is designated as the Bitter Creek National Wildlife Refuge. The Bureau of Land Management has jurisdiction over a large area outside the Basin, and along the Basin's northern boundary, including small parts of the Basin north of the Cuyama River. Most of the northeastern arm of the Basin is designated as State Lands.

Figure 1-23 shows that the Basin is located within the Cuyama Watershed, which lies within the larger Santa Maria watershed, with the Basin occupying roughly the entirety of the Santa Maria Basin's eastern contributing watershed, and a small part of the Cuyama Basin's northeastern arm that flows into the Estrella River Basin due to the topography present in this area. Figure 1-23 illustrates the Cuyama Watershed's location in the Santa Maria Basin, as well as the larger Basin's major receiving water bodies, which include the Santa Maria River, the Cuyama River, Aliso Canyon Creek, Cottonwood Creek, Apache Canyon Creek, Santa Barbara Creek, the Quatal Canyon drainage, and Cuyama Creek.

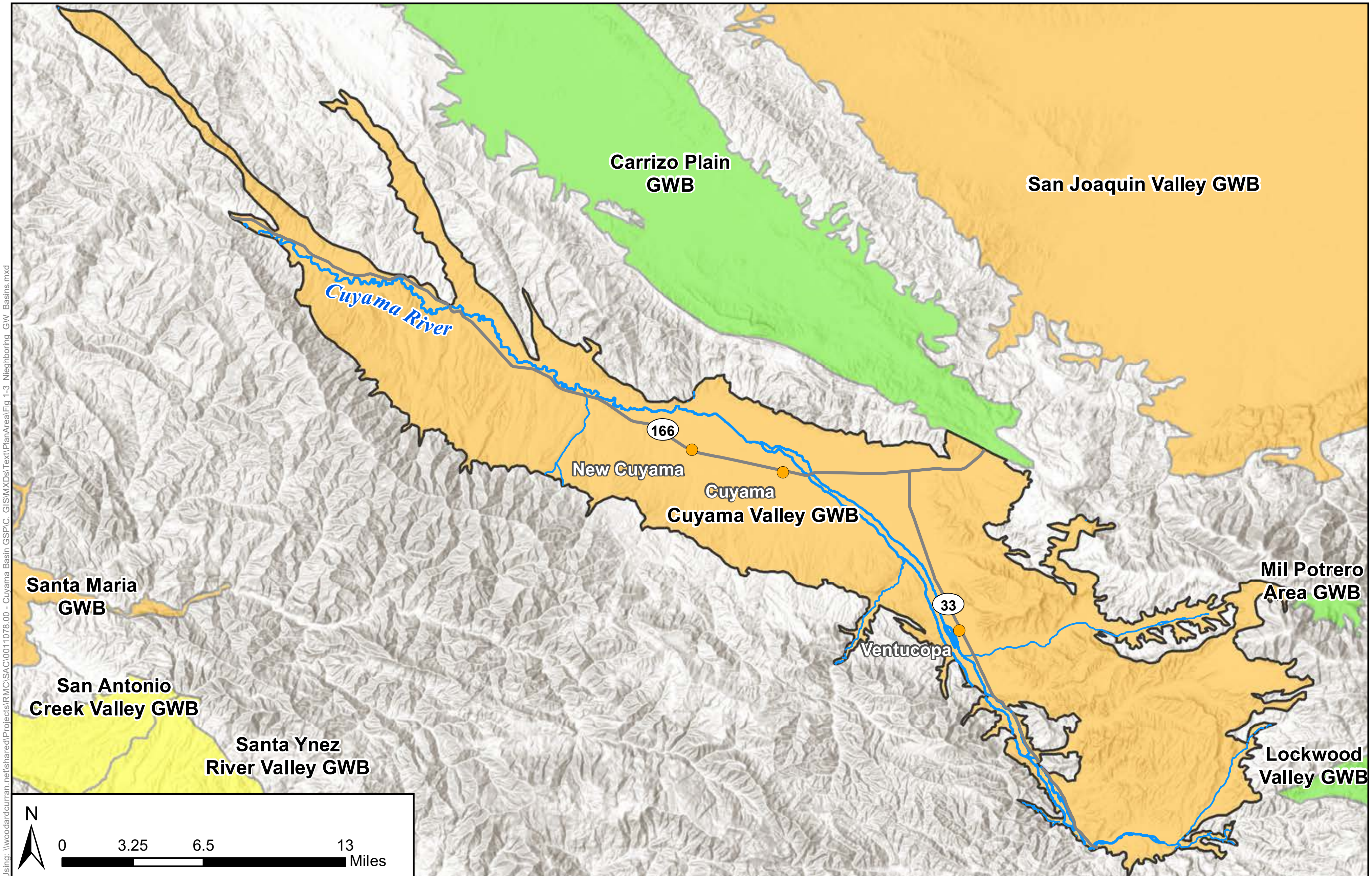

Figure 1-3 - Neighboring Groundwater Basins

Cuyama Basin Groundwater Sustainability Agency

Cuyama Valley Groundwater Basin Groundwater Sustainability Plan

April 2019

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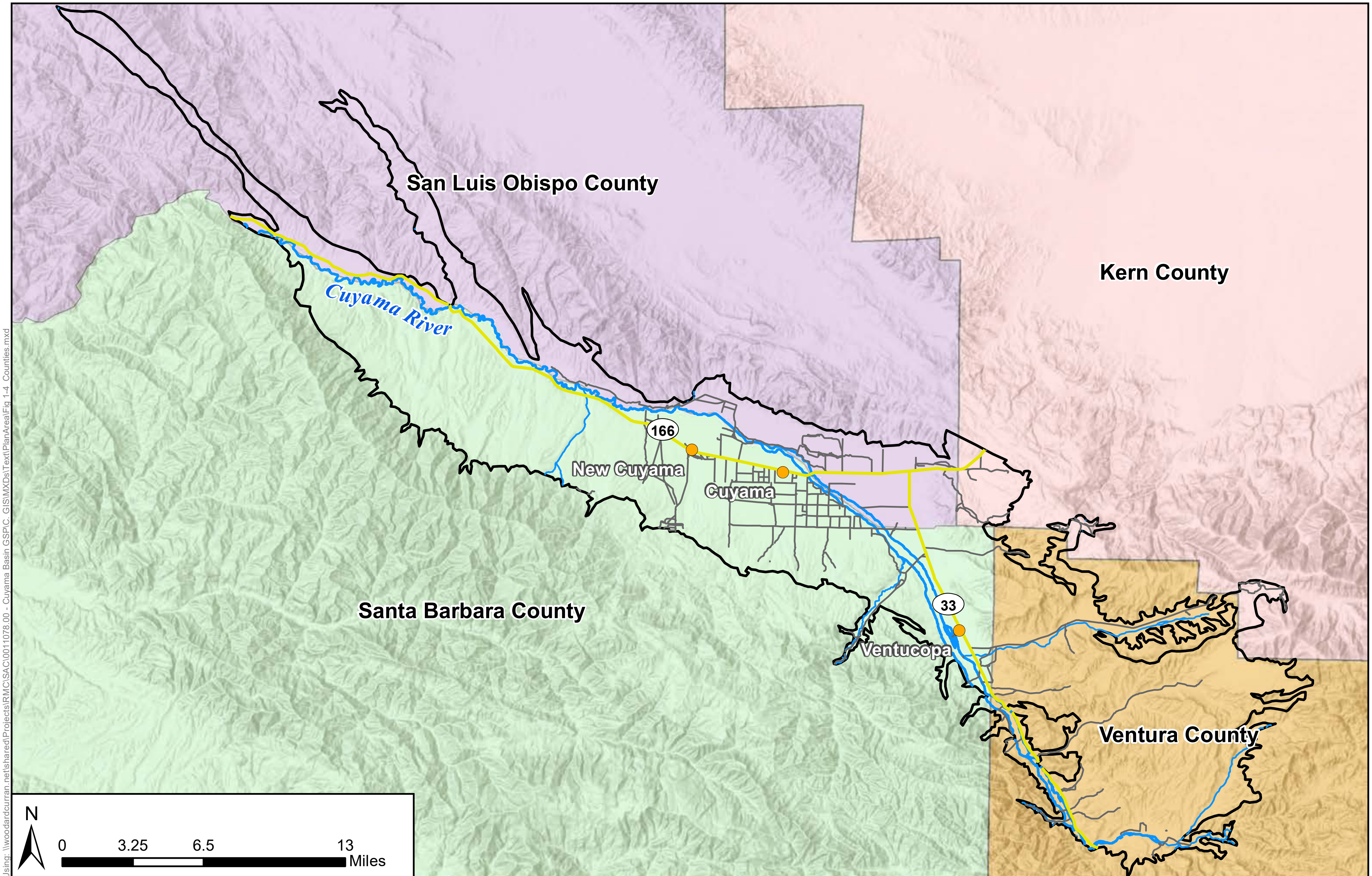
Legend

- Towns
- Cuyama Basin
- Highways
- Cuyama River
- Streams/Creeks

Basin Priority

- High Priority
- Medium Priority
- Low Priority
- Very Low Priority



Legend

- Towns
- Cuyama Basin
- Highways
- Local Roads
- Cuyama River
- Streams/Creeks

County

- Kern County
- San Luis Obispo County
- Santa Barbara County
- Ventura County

Figure 1-4 - Counties Overlying Cuyama Basin

Cuyama Basin Groundwater Sustainability Agency

Cuyama Valley Groundwater Basin Groundwater Sustainability Plan

April 2019

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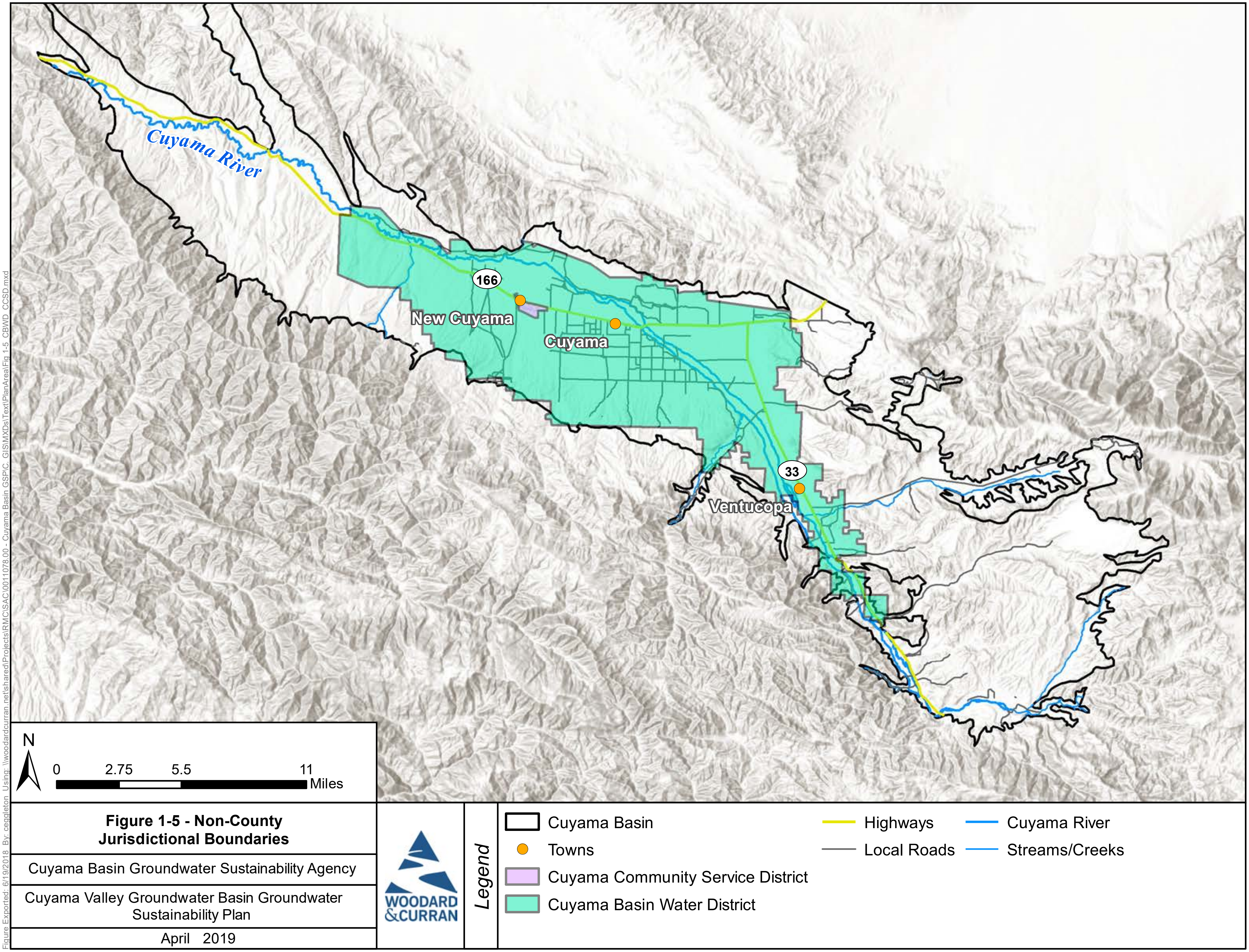

Figure 1-5 - Non-County Jurisdictional Boundaries

Cuyama Basin Groundwater Sustainability Agency

Cuyama Valley Groundwater Basin Groundwater Sustainability Plan

April 2019

Figure Exported: 6/19/2018 By: ceggleton Using: \\woodardcurran.net\shared\Projects\RMC\SAC\0011078.00 - Cuyama Basin GSP\C. GIS\MXDs\Text\PlanArea\Fig 1-5 CBWD CCSD.mxd

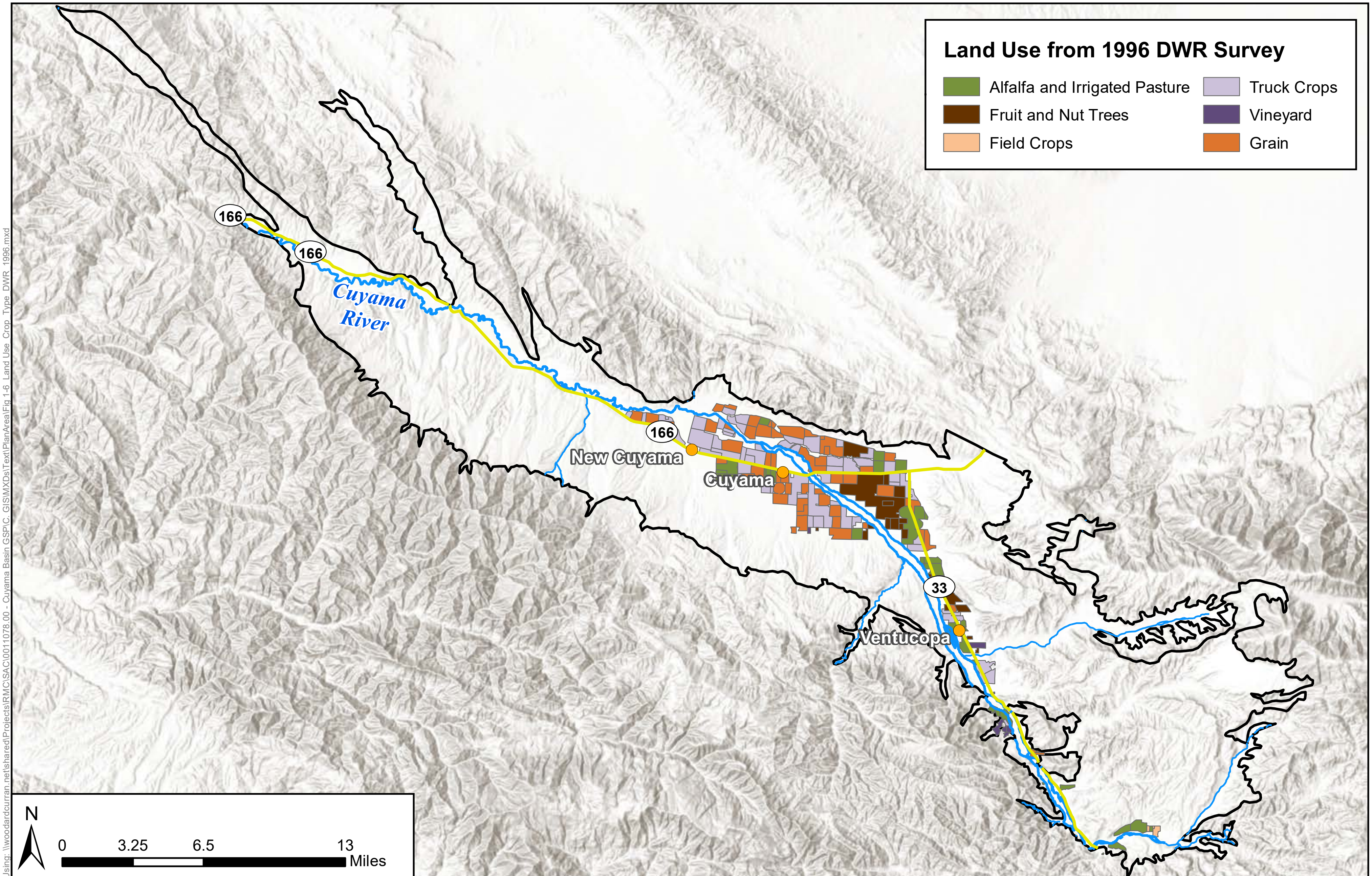

Figure 1-6 - 1996 Land Use

Cuyama Basin Groundwater Sustainability Agency

Cuyama Valley Groundwater Basin Groundwater Sustainability Plan

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Legend

Cuyama Basin
Towns
Highways
Cuyama River
Streams/Creeks

Source: California Department of Water Resources County Land Use Surveys, 1996 dataset.
https://www.water.ca.gov/Programs/Water-Use-And-Efficiency/Land-And-Water-Use/Land-Use-Surveys

Figure Exported: 6/19/2018 By: mwicks Using: \\woodardcurran.net\shared\Projects\RMC\SAC\0011078.00 - Cuyama Basin GSP\C_GIS\MXDs\TextPlanArea\Fig 1-6_Land Use_Crop_Type_DWR_1996.mxd

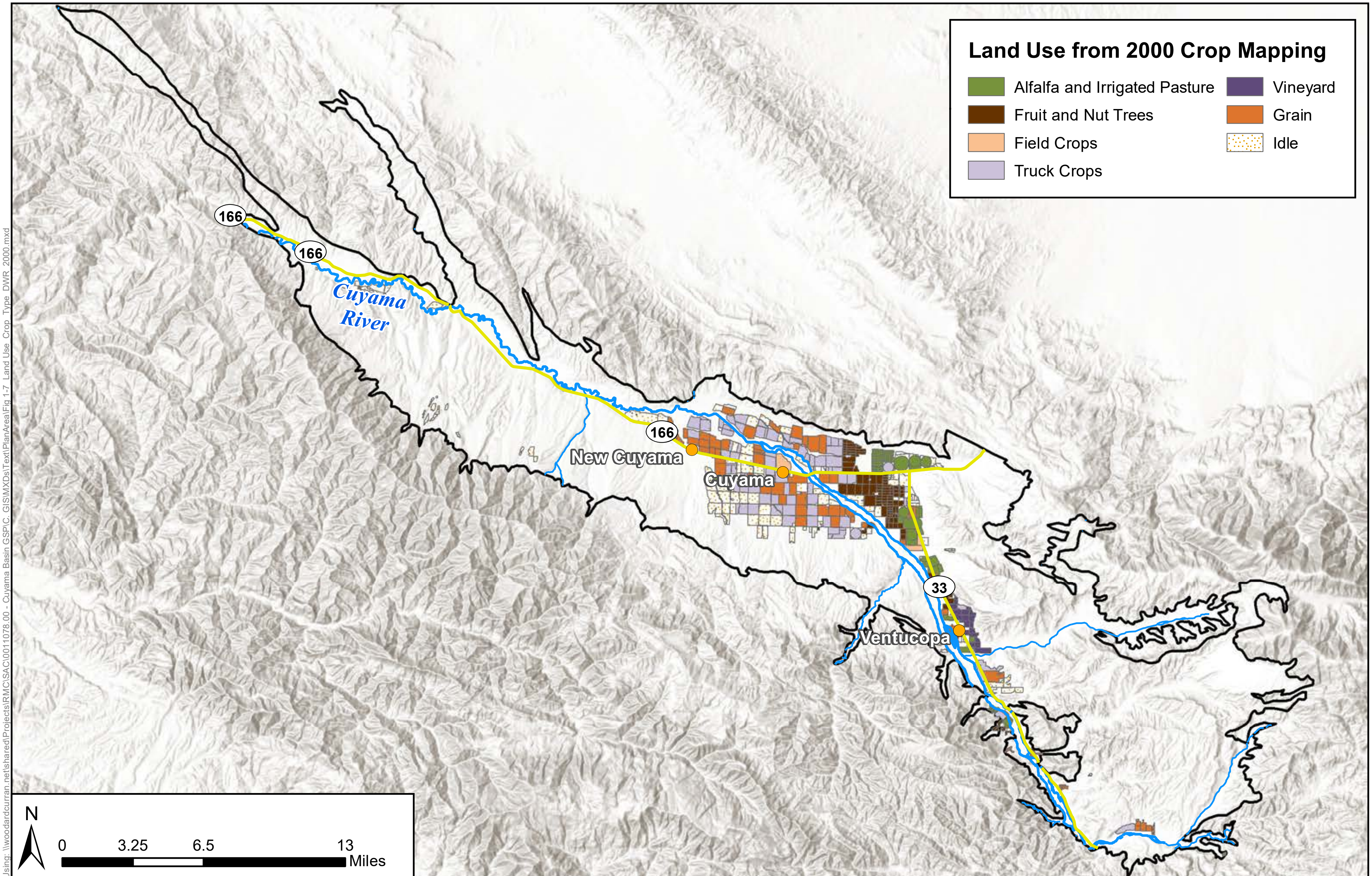

Figure 1-7 - 2000 Land Use

Cuyama Basin Groundwater Sustainability Agency

Cuyama Valley Groundwater Basin Groundwater Sustainability Plan

April 2019

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Legend

Cuyama Basin
Towns
Highways
Cuyama River
Streams/Creeks

Source: Crop Mapping developed by LandIQ for the Cuyama Basin GSA, 2000 dataset

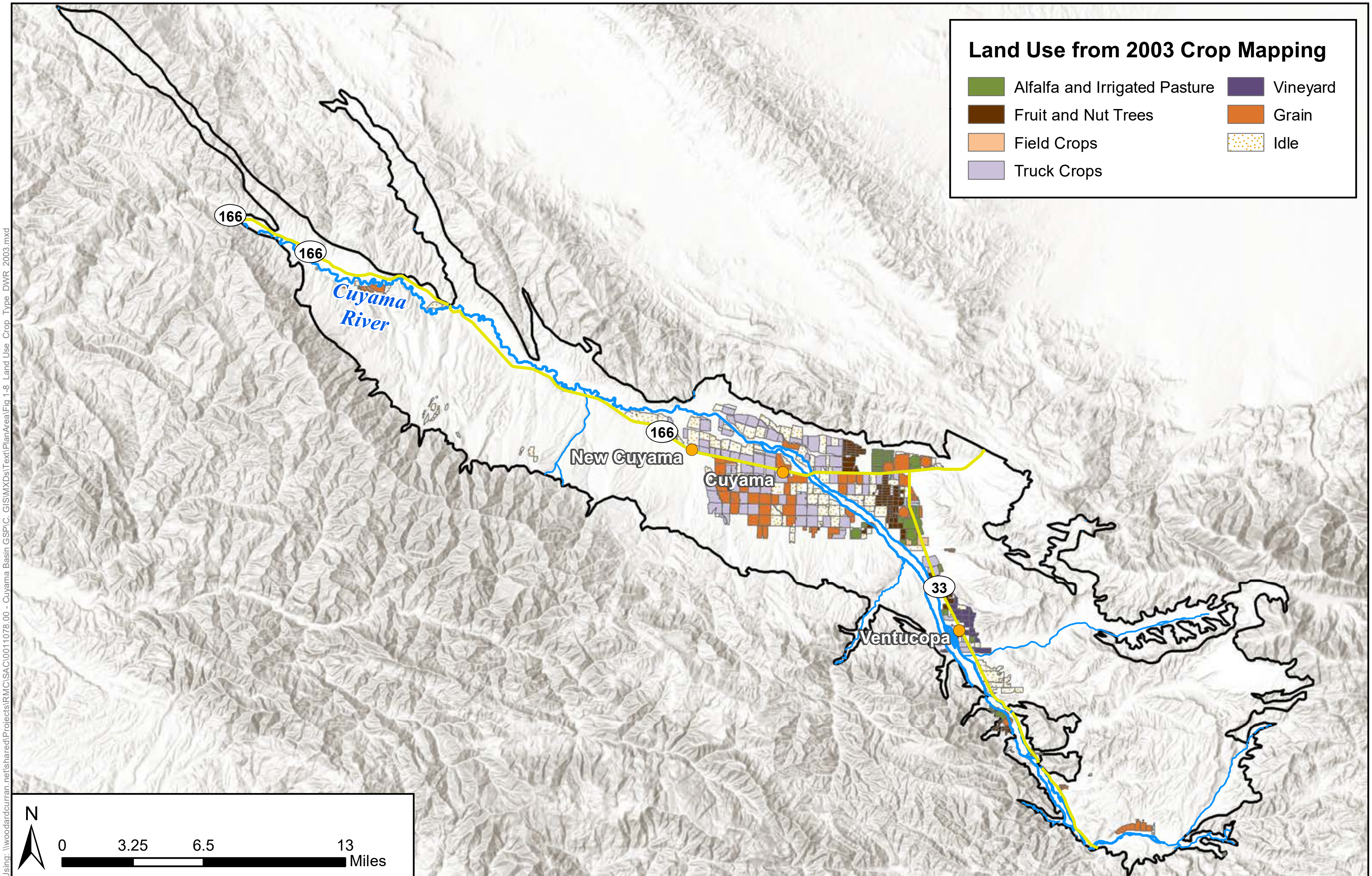

Figure 1-8 - 2003 Land Use

Cuyama Basin Groundwater Sustainability Agency

Cuyama Valley Groundwater Basin Groundwater Sustainability Plan

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Legend

Cuyama Basin
Towns
Highways
Cuyama River
Streams/Creeks

Source: Crop Mapping developed by LandIQ for the Cuyama Basin GSA, 2003 dataset.

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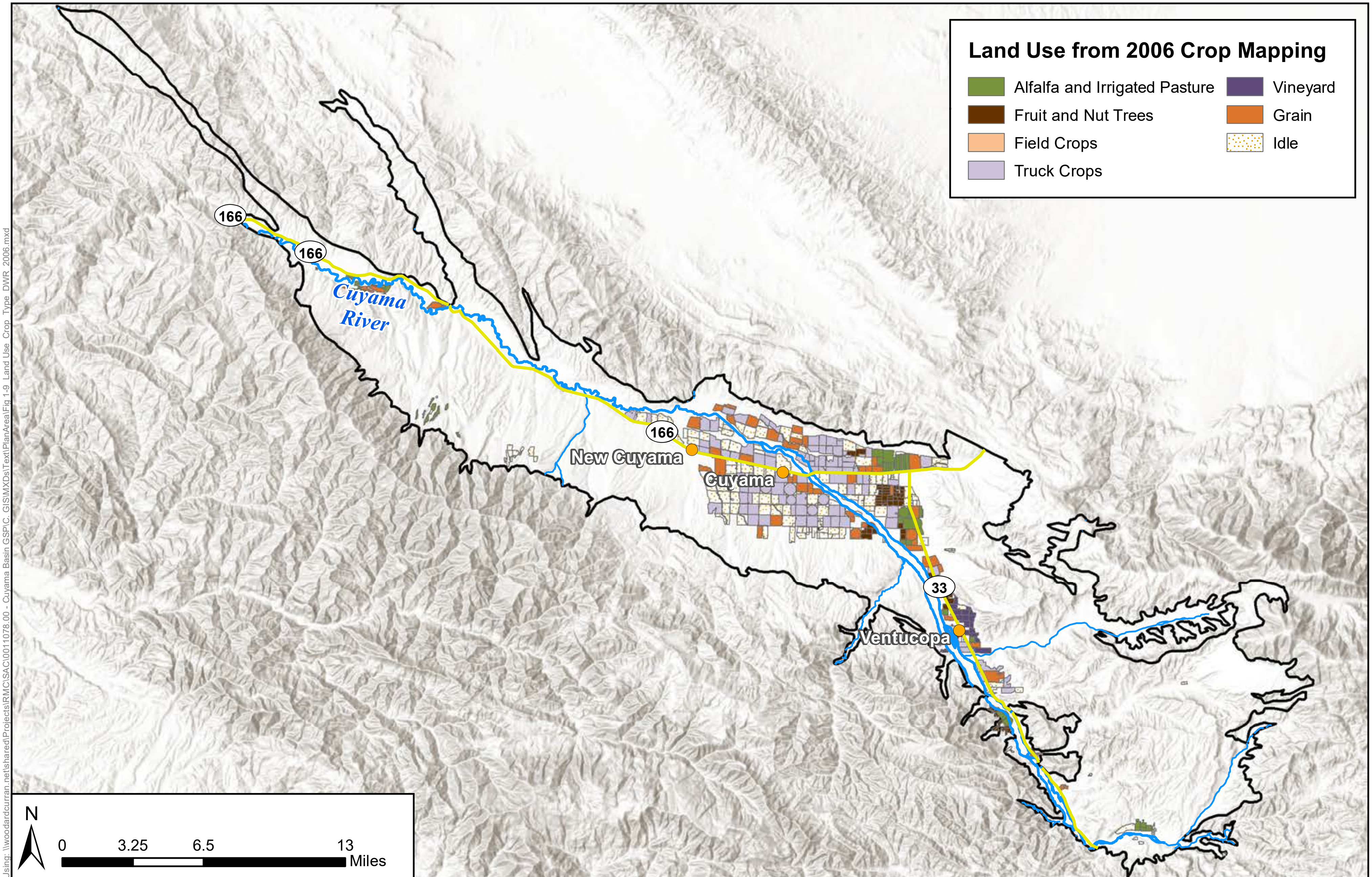

Figure 1-9 - 2006 Land Use

Cuyama Basin Groundwater Sustainability Agency

Cuyama Valley Groundwater Basin Groundwater Sustainability Plan

April 2019

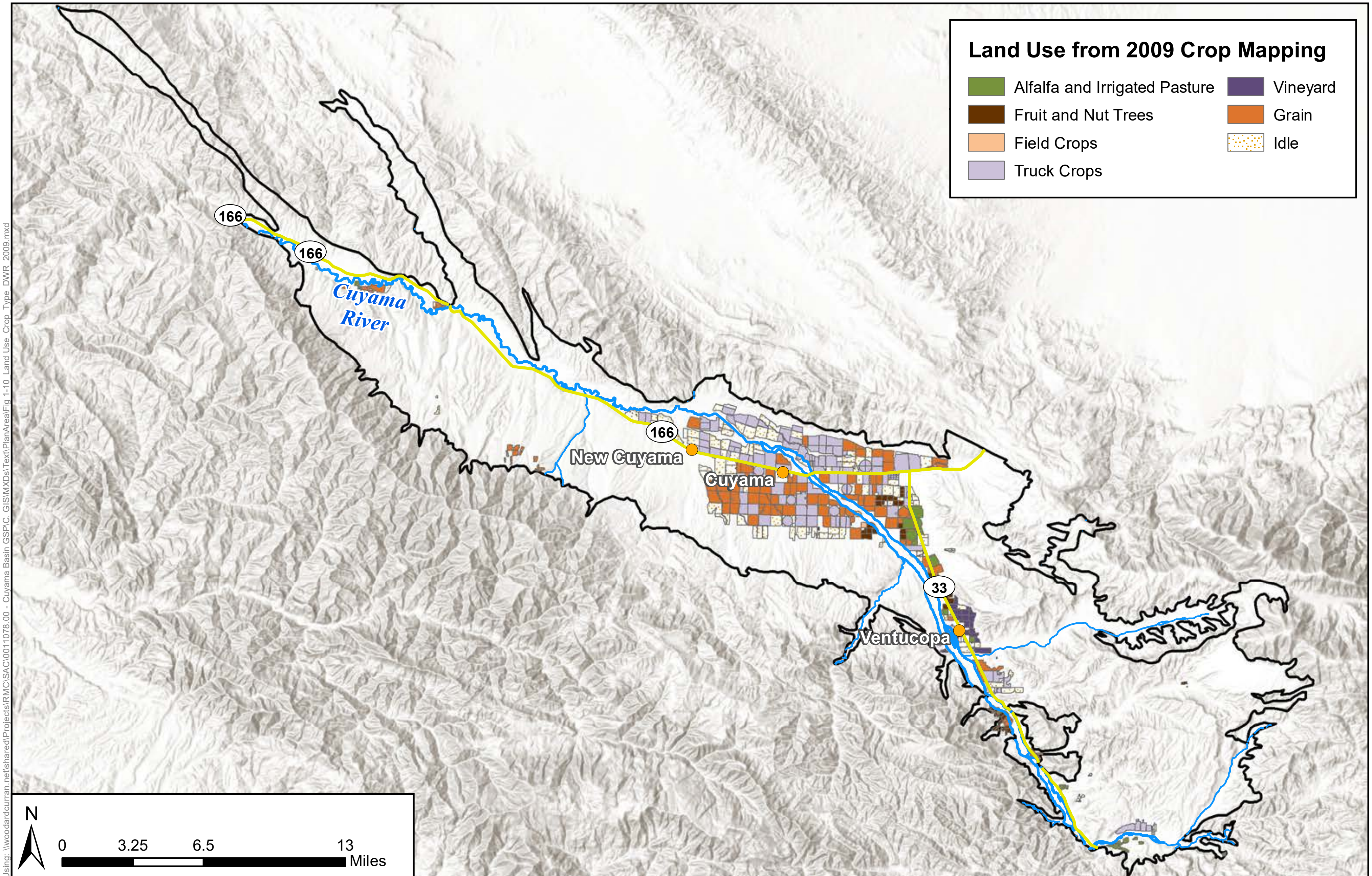

Figure 1-10 - 2009 Land Use

Cuyama Basin Groundwater Sustainability Agency

Cuyama Valley Groundwater Basin Groundwater Sustainability Plan

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Legend

- Cuyama Basin
- Towns
- Highways
- Cuyama River
- Streams/Creeks

Source: Crop Mapping developed by LandIQ for the Cuyama Basin GSA, 2009 dataset.

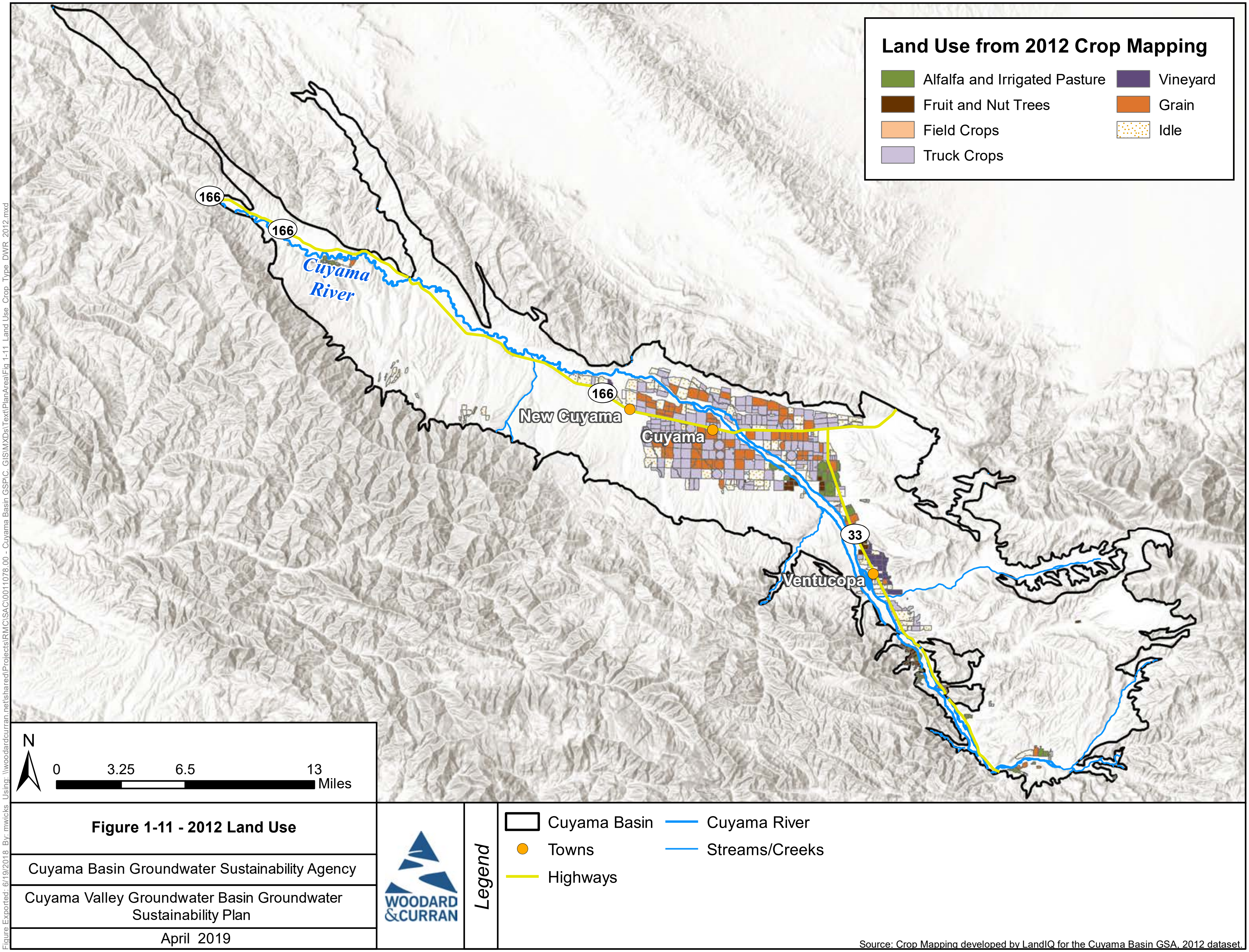

Figure 1-11 - 2012 Land Use

Cuyama Basin Groundwater Sustainability Agency

Cuyama Valley Groundwater Basin Groundwater Sustainability Plan

April 2019

Source: Crop Mapping developed by LandIQ for the Cuyama Basin GSA, 2012 dataset.

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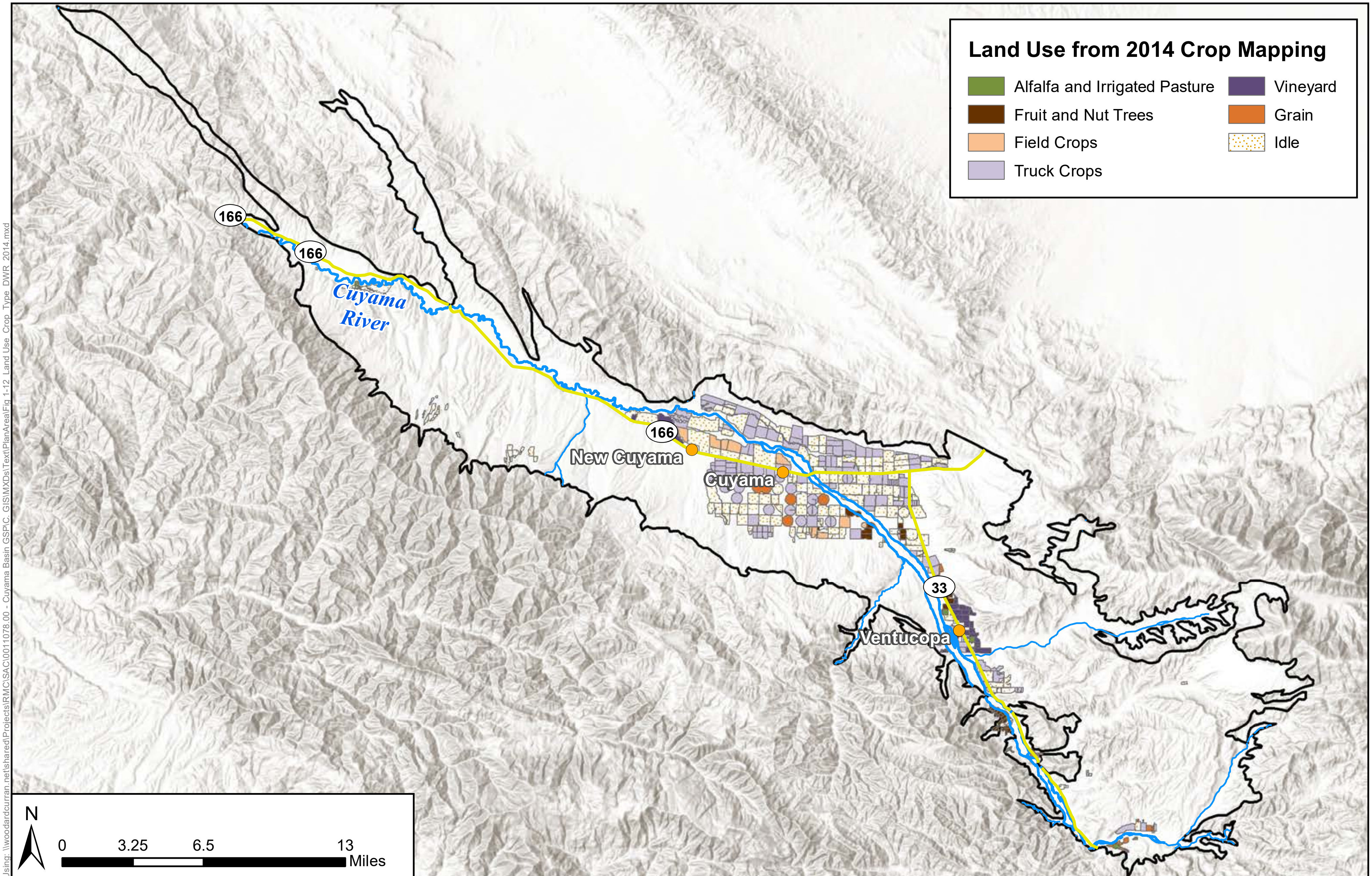

Figure 1-12 - 2014 Land Use

Cuyama Basin Groundwater Sustainability Agency

Cuyama Valley Groundwater Basin Groundwater Sustainability Plan

April 2019

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Legend

Cuyama Basin
Towns
Highways
Cuyama River
Streams/Creeks

Source: California Department of Water Resources County Land Use Surveys, 2014 dataset.
https://gis.water.ca.gov/app/CADWRLandUseViewer/

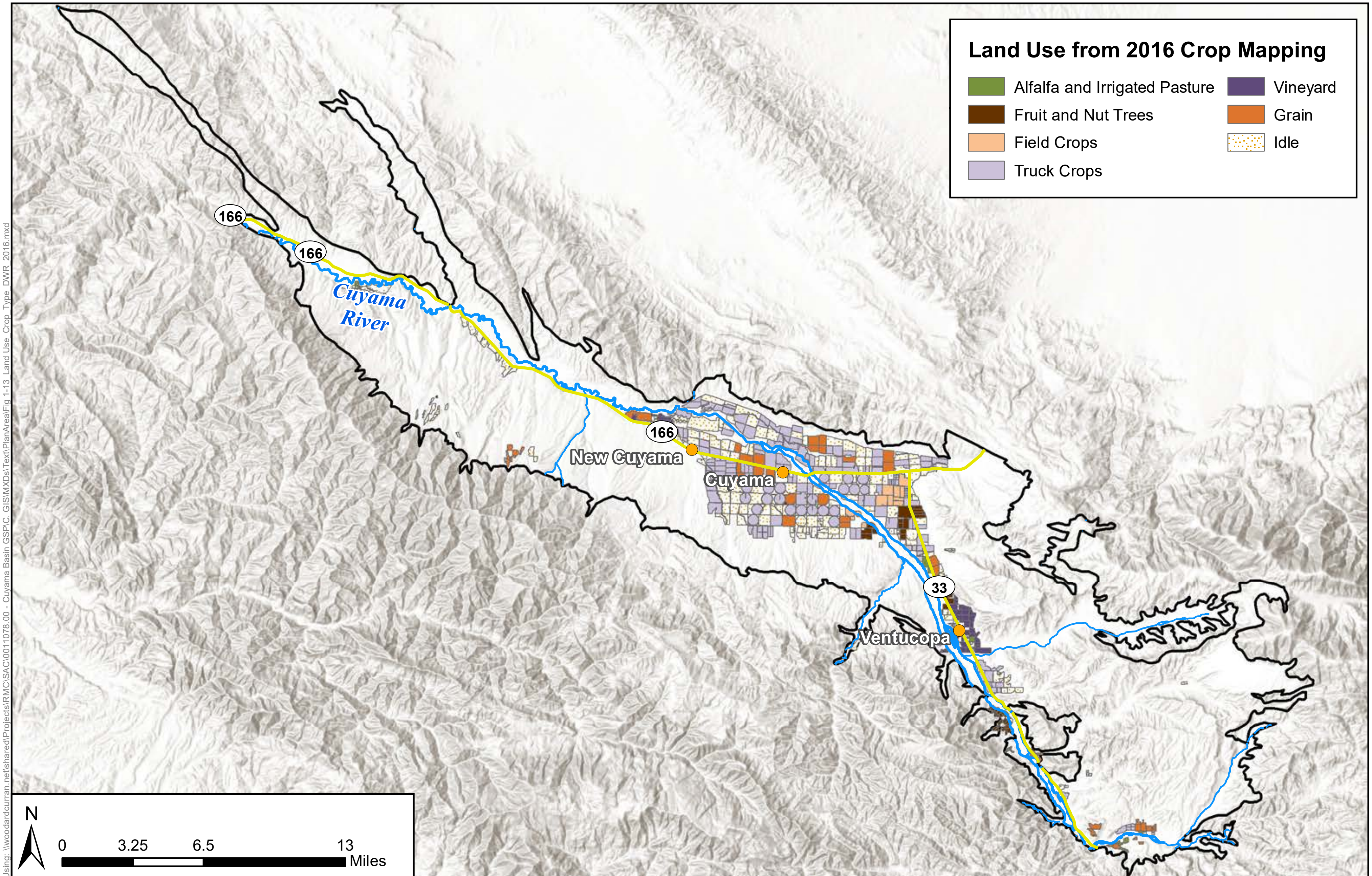

Figure 1-13 - 2016 Land Use

Cuyama Basin Groundwater Sustainability Agency

Cuyama Valley Groundwater Basin Groundwater Sustainability Plan

April 2019

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Legend

- Cuyama Basin
- Towns
- Highways
- Cuyama River
- Streams/Creeks

Source: California Department of Water Resources County Land Use Surveys, 2016 dataset.
https://gis.water.ca.gov/app/CADWRLandUseViewer/

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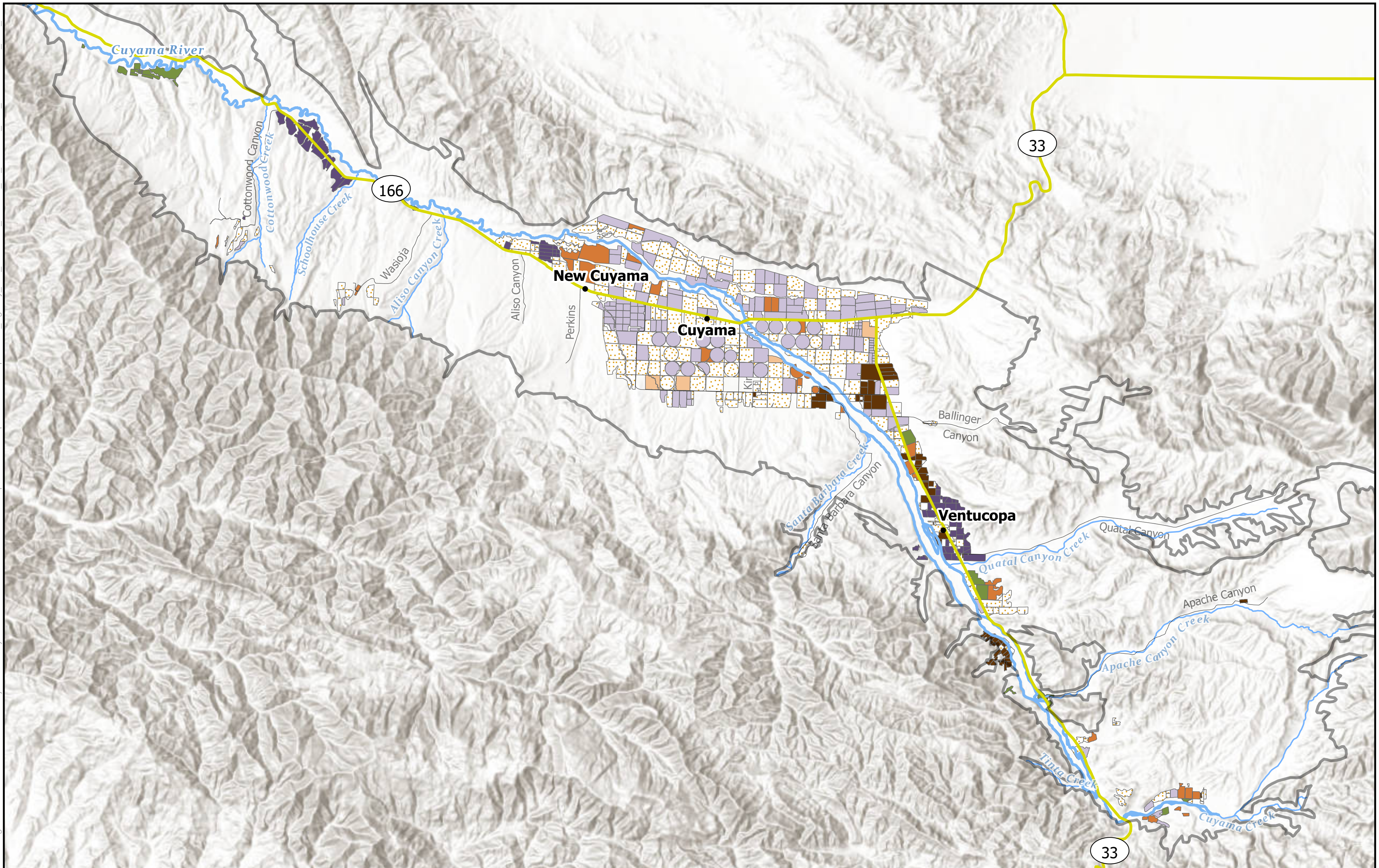

Figure 1-14: 2018 Land Use

Cuyama Valley Groundwater Basin

Legend

Land Use from 2018 Crop Mapping
- Alfalfa and Irrigated Pasture
- Fruit and Nut Trees
- Field Crops
- Truck Crops
- Vineyard
- Grain
- Idle
- Highway
- Local Road
- Town
- Cuyama River
- Creek
- Cuyama Basin

N

0 1.25 2.5 5 Miles

Map Created: December 2023

Woodard & Curran

Cuyama Basin Groundwater Sustainability Agency

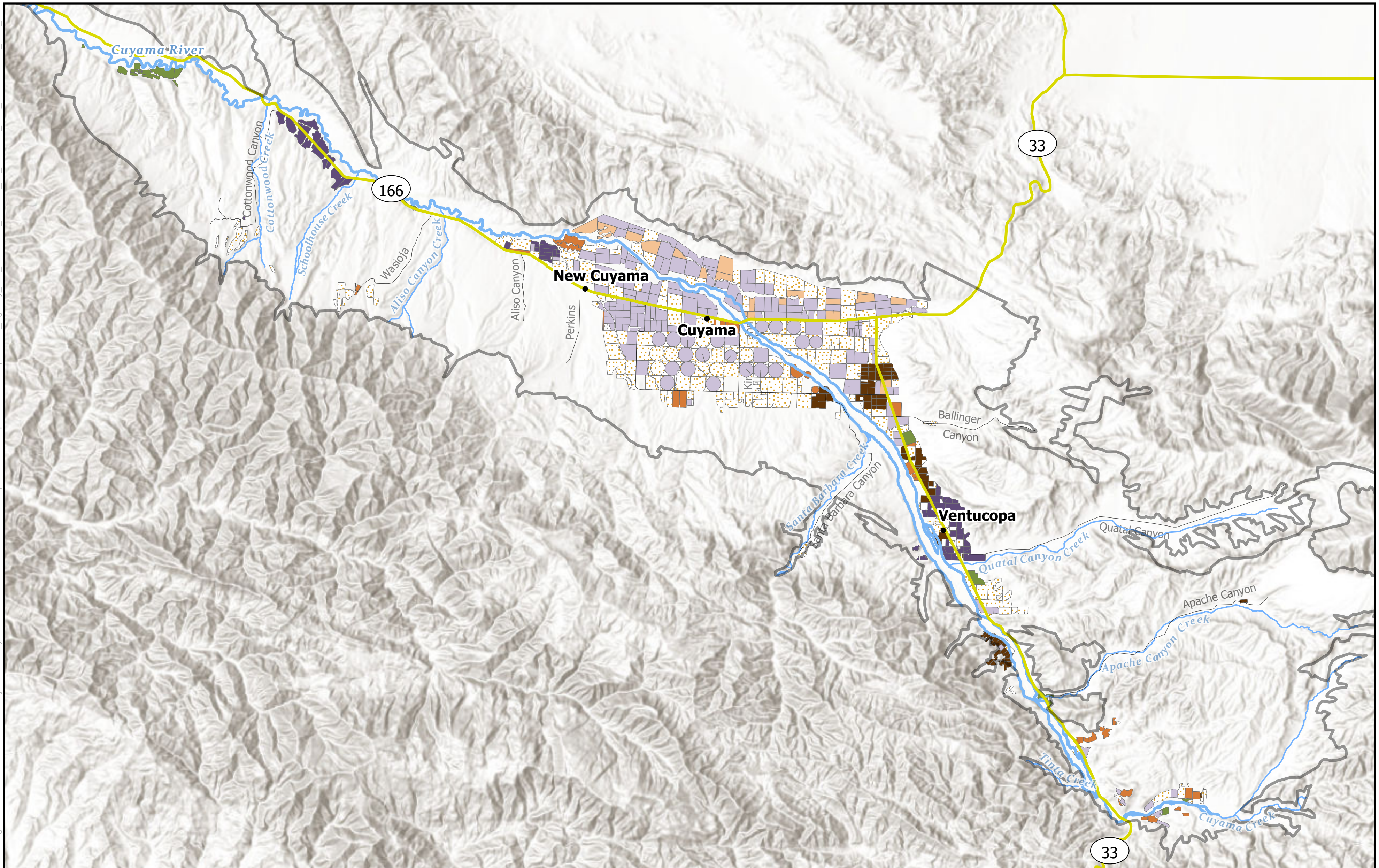

Figure 1-15: 2020 Land Use

Cuyama Valley Groundwater Basin

Legend

Land Use from 2020 Crop Mapping
- Alfalfa and Irrigated Pasture
- Fruit and Nut Trees
- Field Crops
- Truck Crops
- Vineyard
- Grain
- Idle

- Highway
- Local Road
- Town
- Cuyama River
- Creek
- Cuyama Basin

N

0 1.25 2.5 5 Miles

Map Created: December 2023

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. Land Use data prepared by LandIQ, 2022.**

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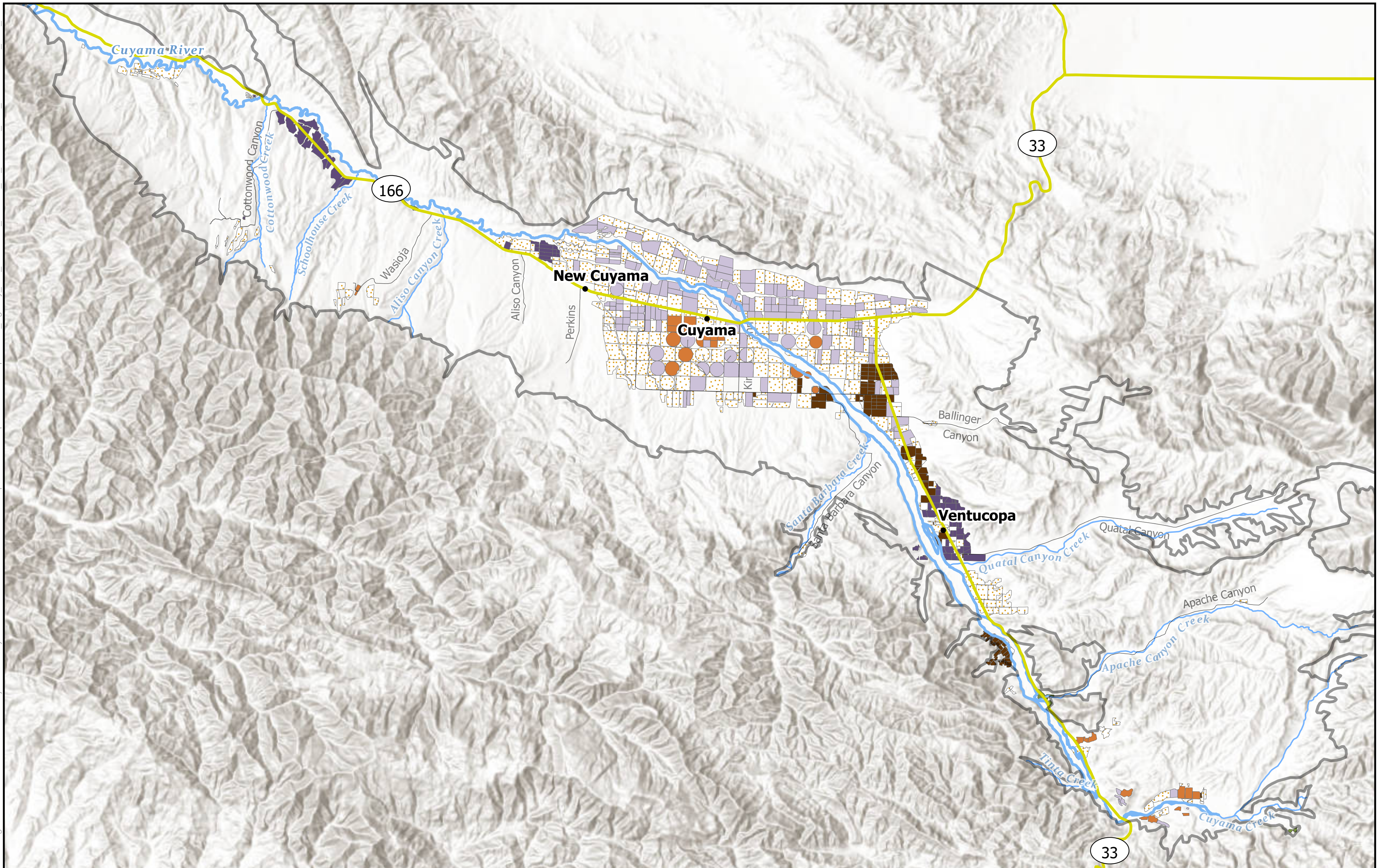

Figure 1-16: 2022 Land Use

Cuyama Valley Groundwater Basin

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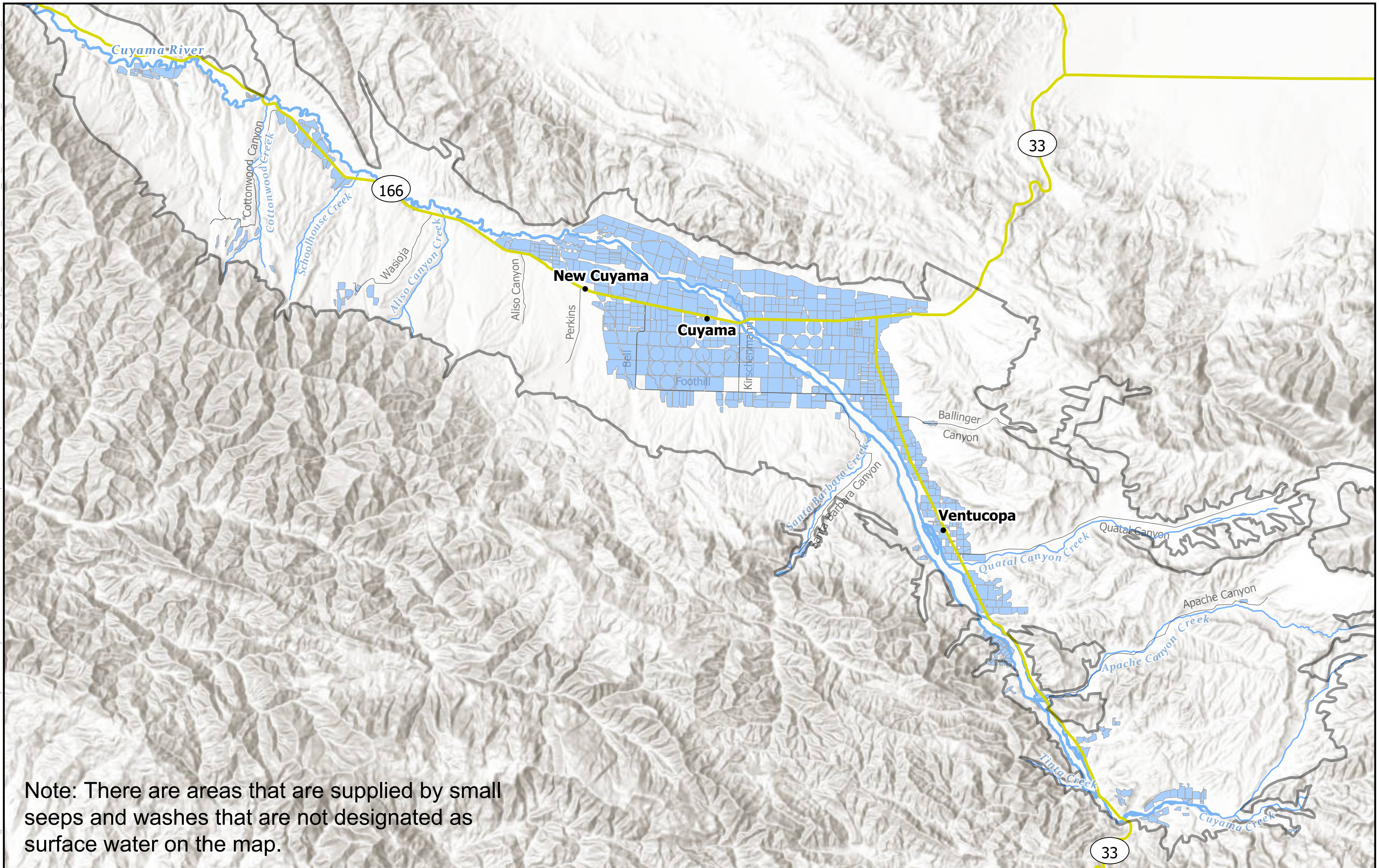

Figure 1-17: Water Source for Land Use

Cuyama Valley Groundwater Basin

Legend

Water Source
- Irrigated by Surface Water
- irrigated by Surface and Groundwater
- Irrigated by Groundwater

- Highway
- Local Road
- Town
- Cuyama River
- Creek
- Cuyama Basin

N

Woodard & Curran

CUYAMA BASIN GROUNDWATER SUSTAINABILITY AGENCY

0 1.25 2.5 5 Miles

Map Created: December 2023

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. Water source extrapolated from 2022 LandIQ land use data.**

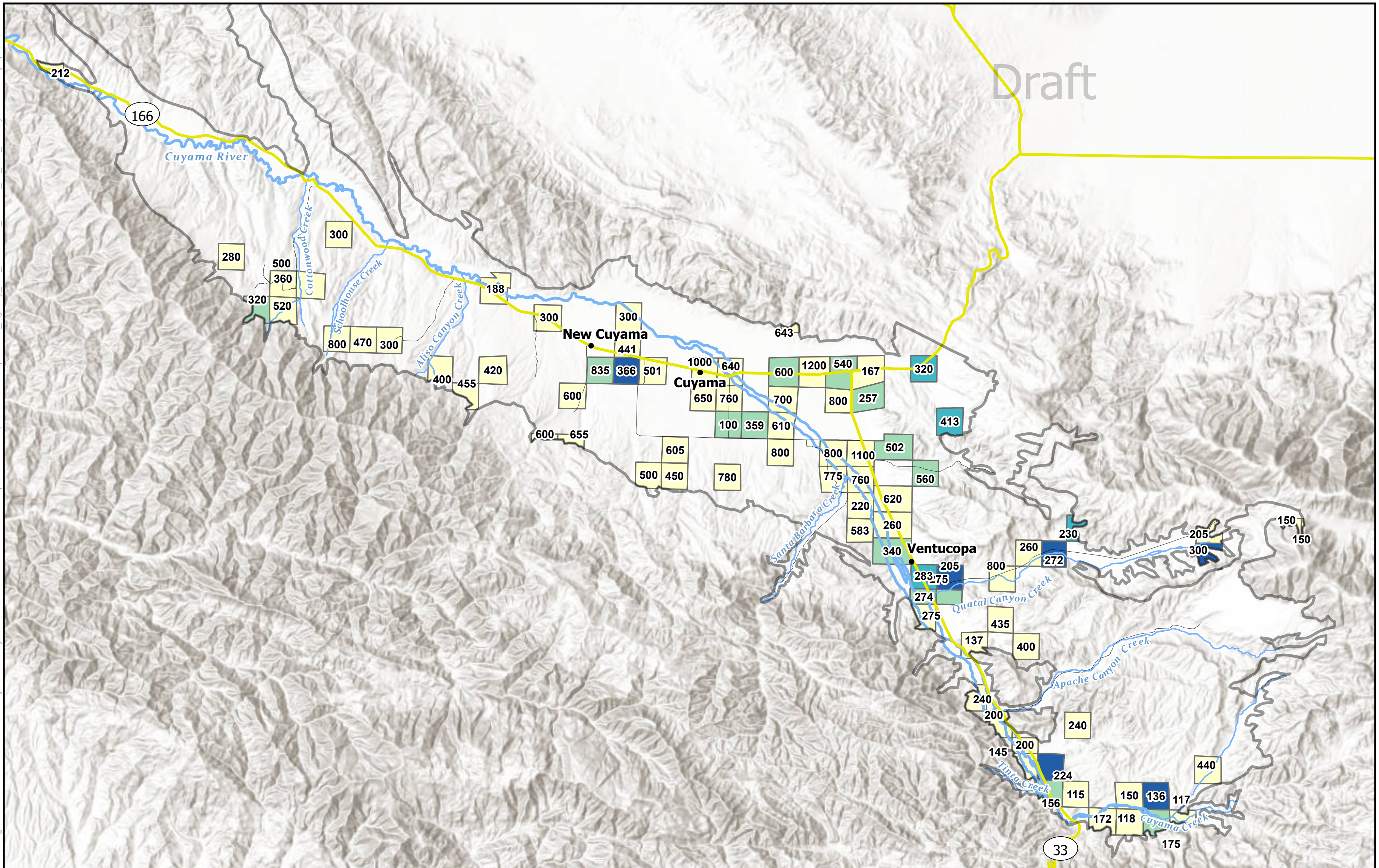

Figure 1-18: Domestic Well Density and Average Depth

Depth reported in feet bgs

Cuyama Valley Groundwater Basin

Legend

Domestic Well Count by Township & Range
- 1
- 2
- 3
- 4

- Highway
- Local Road
- Town
- Cuyama River
- Creek
- Cuyama Basin

N

0 1.25 2.5 5 Miles

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Cuyama Basin Groundwater Sustainability Agency

Map Created: December 2023

Data sources: CA DWR, esri, USGS. Well data (December 2023): https://dwr.maps.arcgis.com/apps/webappviewer/index.html?id=181078580a214c0986e2da28f8623b37

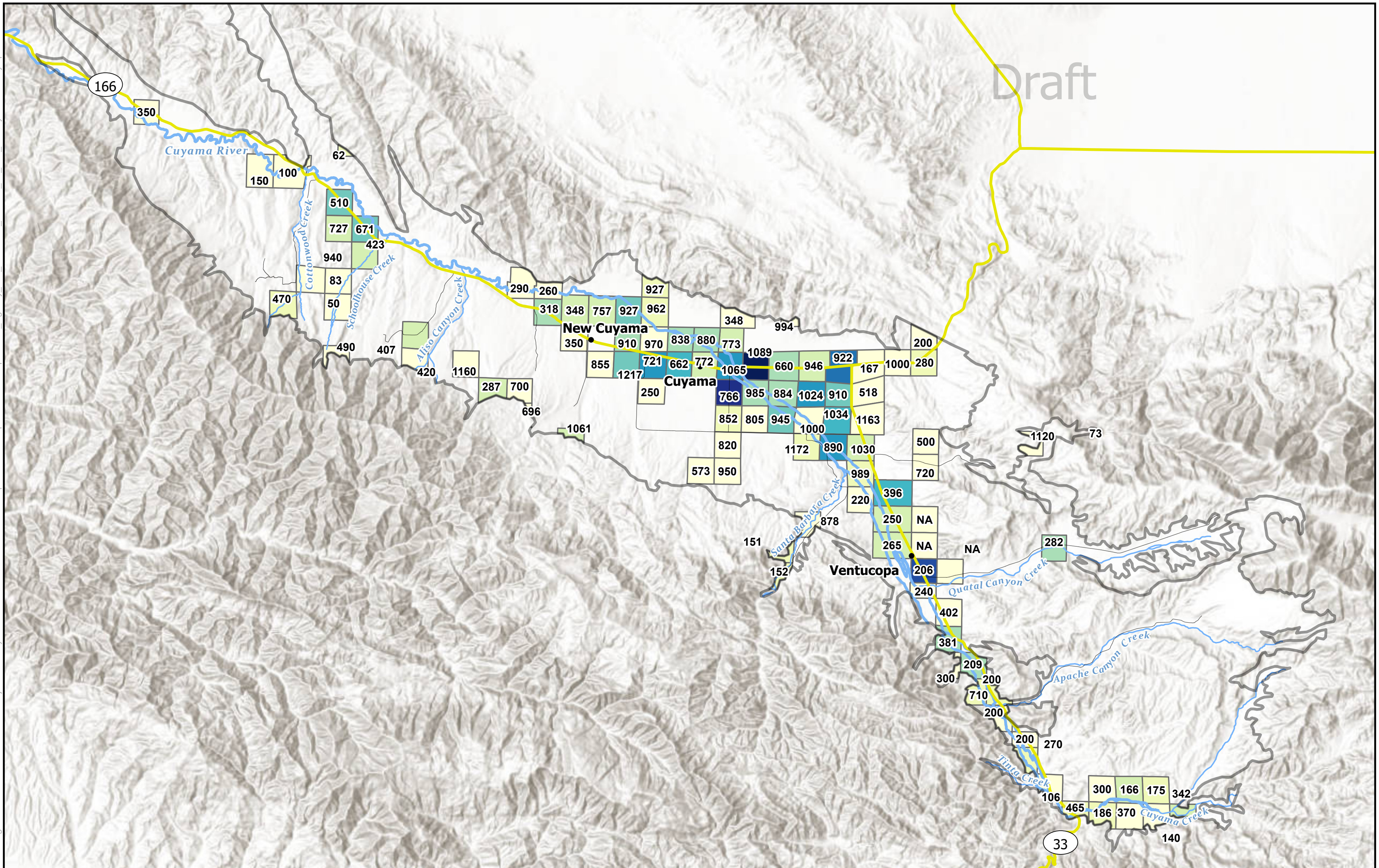

Figure 1-19: Production Well Density and Average Depths

Depth reported in feet bgs

Cuyama Valley Groundwater Basin

Legend

Production Well Count by Township & Range

- 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- 9
- 10
- 12

- Highway
- Local Road
- Town
- Cuyama River
- Creek
- Cuyama Basin

N

0 1.25 2.5 5 Miles

Map Created: December 2023

Woodard & Curran

Cuyama Basin Groundwater Sustainability Agency

Data sources: CA DWR, esri, USGS. Well data (December 2023): https://dwr.maps.arcgis.com/apps/webappviewer/index.html?id=181078580a214c0986e2da28f8623b37

Figure 1-20: Public Well Density and Average Depths

Depth reported in feet bgs

Cuyama Valley Groundwater Basin

Legend

Public Well Count by Township & Range

1

Highway

Local Road

Town

Cuyama River

Creek

Cuyama Basin

N

0 1.25 2.5 5 Miles

Map Created: December 2023

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Data sources: CA DWR, esri, USGS. Well data (December 2023): https://dwr.maps.arcgis.com/apps/webappviewer/index.html?id=181078580a214c0986e2da28f8623b37

Figure Exported: 12/21/2023 By: DHunt Using: \\woodardcurran.net\shared\Projects\CA Cuyama Basin GSA\0011078.01 GSP\wip\Z. GIS\2. Maps\2025 GSP Update\01_Agency_Info_Plan Area_Com\19_20_well_densityWellDensity.aprx

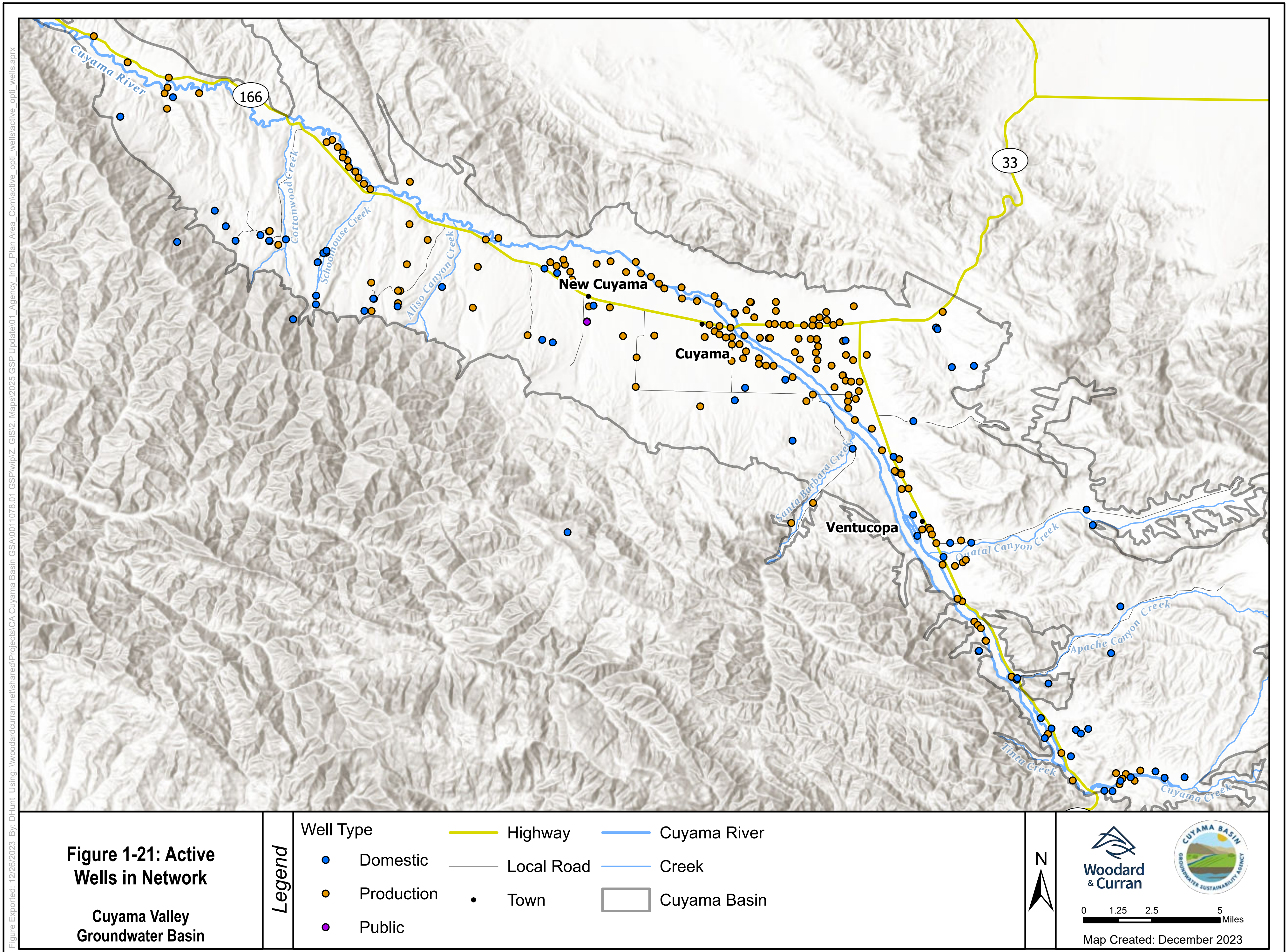

Figure 1-21: Active Wells in Network

Cuyama Valley Groundwater Basin

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**

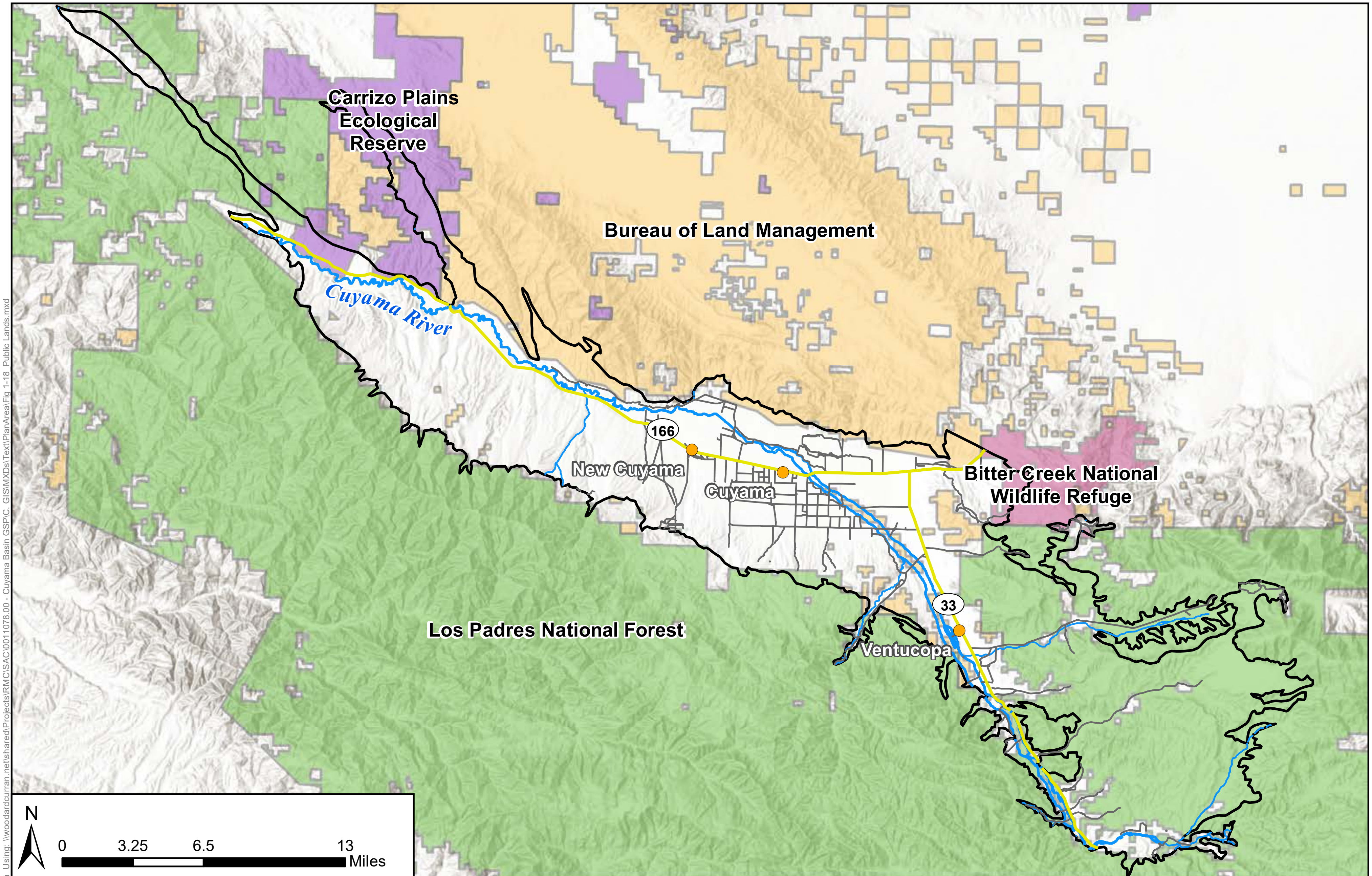

Figure 1-22 - Federal and State Lands

Cuyama Basin Groundwater Sustainability Agency

Cuyama Valley Groundwater Basin Groundwater Sustainability Plan

April 2019

WOODARD &CURRAN

Legend

Cuyama Basin	Local Roads	Bureau of Land Management
Towns	Cuyama River	US Forest Service
Highways	Streams/Creeks	US Fish and Wildlife
		State Lands

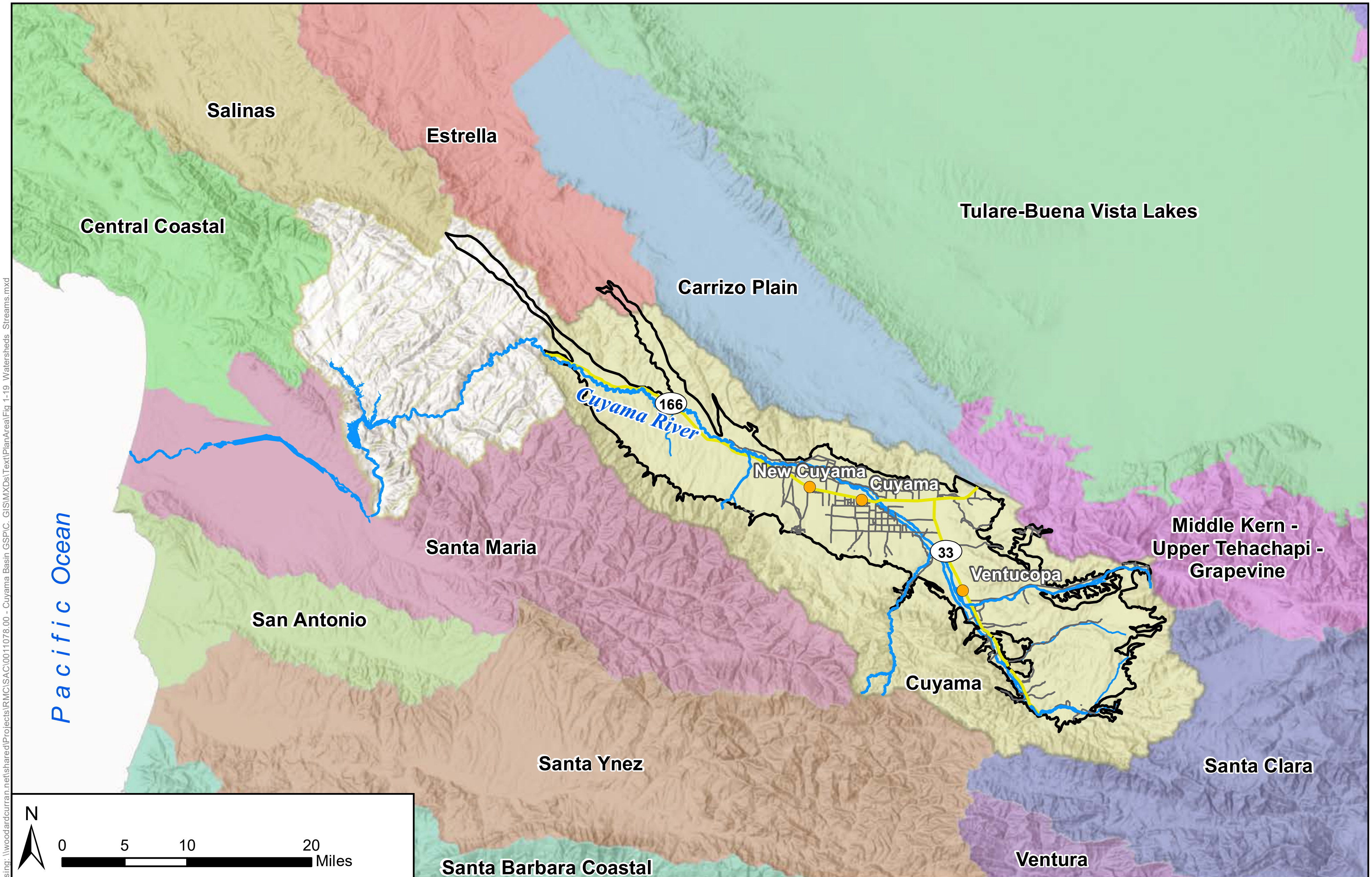

Figure 1-23 - Regional Watersheds

Cuyama Basin Groundwater Sustainability Agency

Cuyama Valley Groundwater Basin Groundwater Sustainability Plan

April 2019

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Legend

- Cuyama Basin
- Towns
- Highways
- Local Roads
- Cuyama River
- Streams/Creeks

Cuyama Watershed

- Contributes to Cuyama GW Basin
- Does Not Contribute to Cuyama GW Basin

Watershed Data Source: USGS TNM Hydrography (WBD), U.S. Geological Survey - National Geospatial Program
Watersheds are 8-digit Hydrologic Units

Figure Exported: 7/4/2018 By: mwicks Using: \\woodardcurran.net\shared\Projects\RMC\SAC\0011078.00 - Cuyama Basin GSP\C. GIS\MXDs\TextPlanArea\Fig 1-19 Watersheds_Streams.mxd

1.2.3 Existing Surface Water Monitoring Programs

Existing surface water monitoring in the Cuyama Basin is extremely limited. Surface water monitoring in the basin is limited to DWR's California Data Exchange Center program, and monitoring performed by the United States Geological Survey (USGS). The only California Data Exchange Center gage in the Cuyama River watershed is at Lake Twitchell, which is downstream of the Cuyama Basin. The USGS has four active gages that capture flows in the Cuyama River watershed upstream of Lake Twitchell, as well as three deactivated gages (Figure 1-24). A new stream gage was installed in 2021 on the Cuyama River near New Cuyama (ID11136710). In addition, gage 11136500, which was previously deactivated, was reactivated in 2021. Table 1-1 lists the active and deactivated gages in the Basin.

Table 1-1: USGS Surface Flow Gages in the Cuyama Basin

Gage Number	Location	Status	Years of Record
11136800	Cuyama River below Buckhorn Canyon near Santa Maria	Active	1959-2023
11136710	Cuyama River near New Cuyama	Active	2021-2023
11136650	Aliso Canyon Creek near New Cuyama	Deactivated	1963-1972
11136600	Santa Barbara Canyon Creek near Ventucopa	Active	2009-2023
11136500	Cuyama River near Ventucopa	Active	1945-1958; 2009-2014; 2021-2023
11136480	Reyes Creek near Ventucopa	Deactivated	1972-1978
11136400	Wagon Road Creek near Stauffer	Deactivated	1972-1978

The four active gages include one gage on the Cuyama River downstream of the Basin (ID 11136800), which is located just upstream of Lake Twitchell. This gage has 64 recorded years of streamflow measurements from 1959 to 2023. Another active gage is south of the city of Ventucopa along Santa Barbara Canyon Creek (ID 11136600) and has thirteen recorded years of streamflow measurements ranging from 2010 to 2023. The new gage located farther upstream of the Twitchell Reservoir near New Cuyama began measurements on October 1, 2021; there are currently 3 years of recorded data. The reactivated gage near Ventucopa now has about 21 years of recorded data. These stream gages provide a more comprehensive picture of surface water flows in the Cuyama Basin than was previously available, including information about the inflow and outflow of surface water in different parts of the Basin.

The 2020 GSP identified surface water gages to measure stream flows on the Cuyama River as a data gap. The CBGSA identified the optimal locations for a new gage and for the reactivation of the previous gage and they were installed by USGS under the SGMA Category 1 grant from DWR in 2021. With the addition of these new active stream gages in the Cuyama Basin, CBSGA has filled this data gap and effectively monitors surface water flows in the basin.

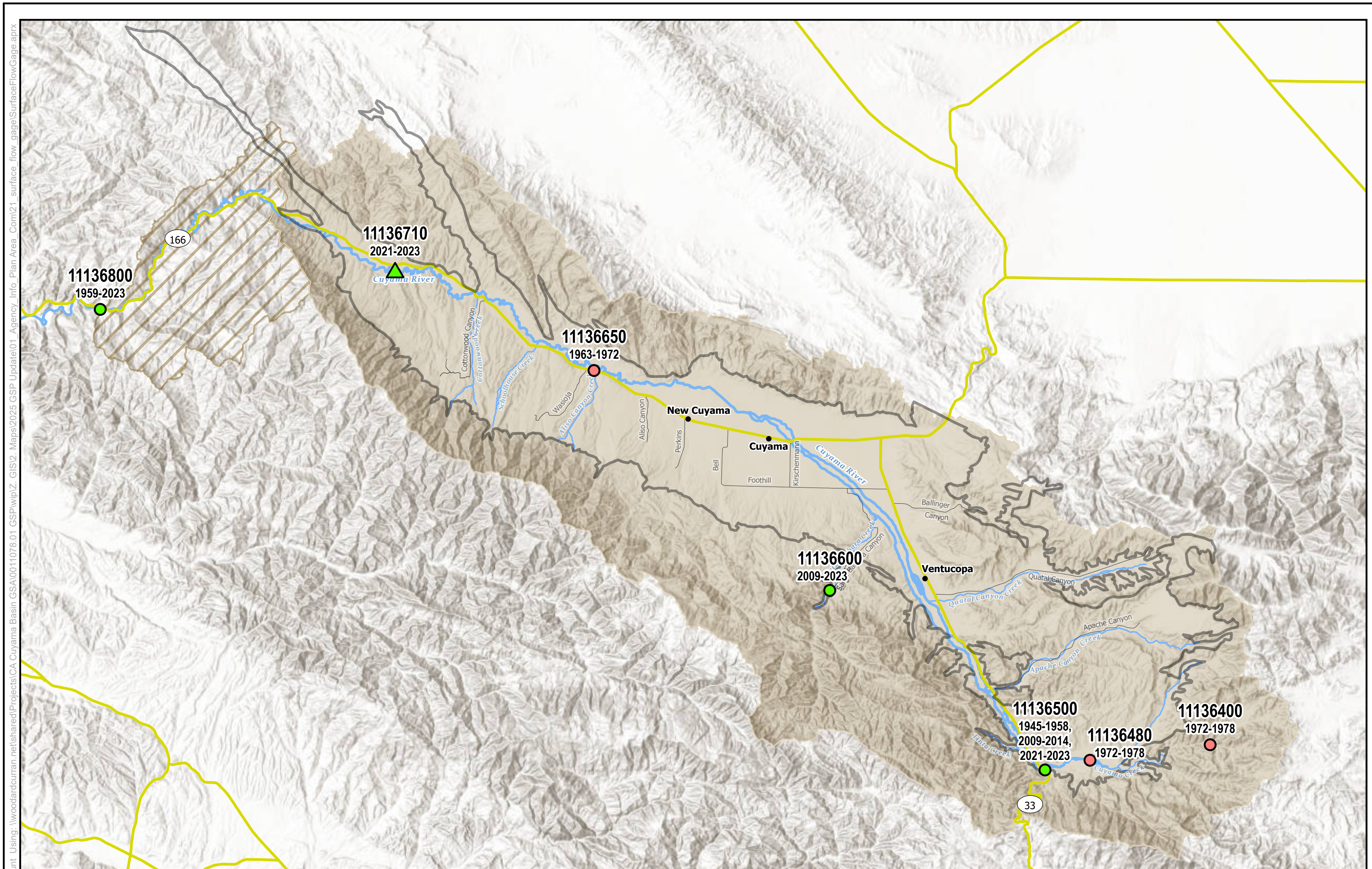

Figure 1-24: Rivers, Streams, and Surface Flow Gages

Cuyama Valley Groundwater Basin

Legend

Cuyama Watershed
- Contributes to Cuyama GW Basin
- Does not Contribute to Cuyama GW Basin
- Active Flow Gages
- New Active Flow Gages
- Inactive
- Highway
- Local Road
- Town
- Cuyama River
- Creek
- Cuyama Basin

N

0 1.75 3.5 7 Miles

Map Created: December 2023

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1.2.4 Existing Groundwater Monitoring Programs

Existing groundwater monitoring programs in the Basin are primarily operated by regional, state, and federal agencies. Existing groundwater monitoring programs in the Basin collect data on groundwater elevation, groundwater quality and subsidence at varying temporal frequencies. Each groundwater monitoring program in the Basin is described below. The following sections describe the different monitoring programs that were described in the 2020 GSP. The existing groundwater monitoring programs have stayed the same with the addition of different datasets being integrated into these platforms to increase public access. Specially, the DWR's Water Data Library and Groundwater Ambient Monitoring and Assessment (GAMA) have included additional datasets published in their databases since the first GSP. Specific activities and data sources utilized by the CBGSA for the current Cuyama Basin groundwater elevation and quality monitoring networks are provided in Chapter 4.

Groundwater Elevation Monitoring

DWR Water Data Library

DWR's Water Data Library (WDL) is a database that stores groundwater elevation measurements from wells in the Basin measured from 1946 through the present. Data contained in the WDL are from several different monitoring entities, including the Ventura County Watershed Protection District (VCWPD), SBCWA, Santa Barbara County Flood Control and Water Conservation District, and San Luis Obispo County Flood Control and Water Conservation District (SLOCFC&WCD), and USGS.

USGS – National Water Information System

The USGS's National Water Information System contains extensive water data, including manual measurements of depth to water in wells throughout California. Wells are monitored by the USGS in the Santa Barbara County Flood Control and Water Conservation District's jurisdictional area. There are eight wells currently categorized as active while most wells groundwater monitoring points in the basin are inactive and no longer collect measurements. All these active wells have measurements that start in 2017 or 2018. Groundwater level measurements at these wells are taken approximately every few years.

California Statewide Groundwater Elevation Monitoring Program

The California Statewide Groundwater Elevation Monitoring (CASGEM) Program monitors seasonal and long-term groundwater elevation trends in dedicated groundwater basins throughout California. Monitoring entities establish CASGEM dedicated monitoring wells and report seasonal groundwater levels to CASGEM's database. The GASGEM database has 77 wells that are all reported on a voluntary basis with measurements starting in 1968. The primary collecting organizations include Ventura County Flood Control District and CA DWR with one well submitted by Santa Barbra County Water Agency.

DWR Sustainable Groundwater Management Act Data Viewer

DWR's Sustainable Groundwater Management Act (SMGA) data viewer has replaced Groundwater Information Center Interactive Map (GICIMA). This database collects and stores groundwater elevations and depth-to-water measurements among other groundwater quantity and quality information. Groundwater elevations are measured biannually in the spring and fall by local monitoring agencies. Depth-to-water and groundwater elevation data are submitted to the SGMA data viewer by various entities including the Cuyama Basin GSA, CA DWR, SBCWA, County of Ventura Watershed Protection district and San Luis Obispo County Flood Control and Water Conservation District. The SGMA Data Viewer contains 96 wells with groundwater elevation data from 2017 to 2023 with a total of 3204 groundwater elevation measurements submitted during this time frame. Historically, these agencies had individual monitoring programs and databases. However, the CBGSA is now able to download all of this data directly from the SGMA Data Viewer.

Groundwater Quality Monitoring

Groundwater Ambient Monitoring and Assessment Program (GAMA)

The State Water Resources Control Board (SWRCB) established the Groundwater Ambient Monitoring and Assessment (GAMA) Program to monitor groundwater quality throughout the state of California in 2020. The GAMA Program compiles and standardizes groundwater quality data across different regulatory agencies to increase public availability and access to data. This program also conducts groundwater studies related to groundwater vulnerability, groundwater quality for domestic wells and impact of non-point source contamination. The GAMA Program receives data from a variety of monitoring entities including DWR, USGS, and the SWRCB. In the Basin, these three agencies submit data from monitoring wells for a suite of constituents including TDS, nitrates and nitrites, arsenic, and manganese.

DWR Water Data Library

DWR's Water Data Library (WDL) contains monitoring data for groundwater quality. Samples are collected from a variety of well types including irrigation, stock, domestic, and some public supply wells. Wells are not regularly sampled, and most wells have only one- or two-days' worth of sampling measurements and large temporal gaps between the results. Constituents most frequently monitored include dissolved chloride, sodium, calcium, boron, magnesium, and sulfate. Measurements taken include conductance, pH, total alkalinity and hardness (more than 1,000 total samples per parameter). Additional dissolved nutrients, metals, and total dissolved solids (TDS) are also sampled but have fewer sample results available. This data is updated to GAMA yearly.

GeoTracker

GeoTracker is the SWRCB's data management system for sites that have potential to impact or currently impact groundwater, especially those sites that require groundwater cleanup. These sites include leaking underground storage tanks, Department of Defense and site cleanup programs, and permitted facilities which could impact groundwater such oil and gas production. GeoTracker is a portal that has a GIS interface and retrieves records from SWRCB programs. This data is updated in GAMA monthly.

National Water Information System

The USGS's National Water Information System monitors groundwater for chemical, physical, and biological properties in water supply wells throughout the Basin and data are updated to GAMA on a quarterly basis. The majority of wells with groundwater quality data were monitored prior to 2015.

Irrigated Lands Regulatory Program

The Irrigated Lands Regulatory Program, established in 2003, regulates discharges from irrigated agriculture to surface and ground waters and establishes waste discharge orders for selected regions. The Irrigated Lands Regulatory Program focuses on priority water quality issues, such as pesticides and toxicity, nutrients, and sediments. Wells are sampled biannually, once between March and June, and once between September and December. This data is now available in GAMA and updated monthly.

Division of Drinking Water

The State Water Resources Control Board's Division of Drinking Water, (formerly the Department of Health Services) monitors public water system wells per the requirements of Title 22 of the California Code of Regulations relative to levels of organic and inorganic compounds such as metals, microbial compounds and radiological analytes. Data are available for active and inactive drinking water sources, for water systems that serve the public, and wells defined as serving 15 or more connections, or more than 25 people per day. In the Basin, Division of Drinking Water wells were monitored for Title 22 requirements, including pH, alkalinity, bicarbonate, calcium, magnesium, potassium, sulfate, barium, copper, iron, zinc, and nitrate. This data is now available in GAMA and updated quarterly.

Subsidence Monitoring

In the Basin, subsidence monitoring is performed using continuous global positioning system (CGPS) stations monitored by the University NAVSTAR Consortium's (UNAVCO) Plate Boundary Observatory (PBO) program. There are no known extensometers in the Basin.

UNAVCO PBO

The UNAVCO PBO network consists of a network of about 1,100 CGPS and meteorology stations in the western United States used to monitor multiple pieces of information, including subsidence. There are two stations in the Cuyama Basin: CUHS, located near the city of New Cuyama, and VCST, located south of the city of Ventucopa. The CUHS station has subsidence data from 2000 through 2023, and the VCST station has subsidence data from 2001 through 2023.

1.2.5 Existing Water Management Programs

Santa Barbara County Integrated Regional Water Management Plan 2019

The *Santa Barbara County Integrated Regional Water Management Plan 2019* (IRWM Plan 2019) is the main integrated regional water management planning document for the Santa Barbara County IRWM Region (County of Santa Barbara, 2019). A plan was developed in 2013 with an update in 2019 to reflect changes in DWR's 2016 IRWM Guidelines, Volume 2. IRWM Plan 2019 emphasizes multi-agency collaboration, stakeholder involvement and collaboration, regional approaches to water management, water management involvement in land use decisions, and project monitoring to evaluate results of current practices. The changes made in IRWM Plan 2019 focus on cooperating partners and their key water management issues for involved agency collaboration, the impact of SGMA, changes to the sub-regions for synergistic project planning, change in prioritization of climate change vulnerabilities including drought. Additionally, a new county hosted database was developed for their data management system and 3 subcommittees were created for cultural and disadvantage communities. IRWM Plan 2019 identifies regionally and locally focused projects that help achieve regional objectives and targets while working to address water-related challenges in the region.

The following IRWM Plan 2019 objectives related to groundwater use would potentially influence implementation of the GSP:

- Protect, conserve, and augment water supplies
- Protect, manage, and increase groundwater supplies
- Practice balanced natural resource stewardship
- Protect and improve water quality
- Maintain and enhance water and wastewater infrastructure efficiency and reliability.

IRWM Plan 2019 provides valuable resources related to potential concepts, projects and monitoring strategies that can be incorporated into the CBGSA GSP.

San Luis Obispo County 2019 IRWM Plan

The San Luis Obispo 2019 IRWM Plan presents a comprehensive water resources management approach to managing the region's water resources, focusing on strategies to improve the sustainability of current and future needs of San Luis Obispo County (County of San Luis Obispo, 2019). The 2019 Plan builds off the 2014 IRWM Plan with changes to a few relevant sections including governance and stakeholder involvement, region description of groundwater and quality issues to reflect SGMA. Much of the 2014 IRWM Plan was based on the San Luis Obispo County Water Master Report (SLOCFC&WCD, 2012) There were no significant changes to the goals in the 2019 update.

The following 2019 IRWM Plan goals related to groundwater use would potentially influence implementation of the GSP:

- **Water Supply Goal:** Maintain or improve water supply quantity and quality for potable water, fire protection, ecosystem health, and agricultural production needs; as well as to cooperatively address limitations, vulnerabilities, conjunctive-use, and water-use efficiency.
- **Ecosystem and Watershed Goal:** Maintain or improve the health of the Region's watersheds, ecosystems, and natural resources through collaborative and cooperative actions, with a focus on assessment, protection, and restoration/enhancement of ecosystem and resource needs and vulnerabilities.
- **Groundwater Monitoring and Management (Groundwater) Goal:** Achieve sustainable use of the region's water supply in groundwater basins through collaborative and cooperative actions.
- **Water Resources Management and Communications (Water Management) Goal:** Promote open communications and regional cooperation in the protection and management of water resources, including education and outreach related to water resources conditions, conservation/water use efficiency, water rights, water allocations, and other regional water resource management efforts.

The 2019 IRWM Plan provides valuable resources related to potential concepts, projects, and monitoring strategies that can be incorporated into the CBGSA GSP.

Ventura County 2019 IRWM Plan

The Ventura County 2019 IRWM Plan reflects the unique needs of a diverse region in Ventura County, which encompasses three major watersheds, 10 cities, portions of the Los Padres National Forest, a thriving agricultural economy, and is home to more than 823,000 people (Watersheds Coalition of Ventura County, 2019). The 2019 IRWM Plan is a comprehensive document that primarily addresses region-wide water management and related issues. The 2019 Plan amendment was developed for the existing 2014 Plan to address revisions required by DWR 2016 Prop 1 IRWM program guidelines and plan standards.

The following 2019 IRWM Plan goals related to groundwater use would potentially influence implementation of the GSP:

- Protect, conserve, and augment local water-supply portfolio to increase local water resilience
- Protect and improve water quality
- Protect and restore habitat and ecosystems in watersheds

The 2019 IRWM Plan provides valuable resources related to potential concepts, projects and monitoring strategies that can be incorporated into the CBGSA GSP.

Kern County 2020 IRWM Plan

The Kern County 2020 IRWM Plan covers most of Kern County but does not include the portion of the county that includes the Cuyama Basin (Kern County Water Agency, 2020). Therefore, the IRWM Plan is not relevant to the Cuyama GSP and is not addressed here.

1.2.6 General Plans in Plan Area

As illustrated in Figure 1-4, the Cuyama Basin is located within the geographic boundaries of four counties, including Kern, San Luis Obispo, Santa Barbara and Ventura. Each of these counties have an existing process for permitting new or replacement groundwater wells, which has continued during implementation of this GSP. In addition, implementation of the CBGSA GSP would be affected by the policies and regulations outlined in the General Plans of these counties, given that the Cuyama Basin, and long-term land use planning decisions that would affect the Basin, are under the jurisdiction of these counties.

This section describes how implementation of the various General Plans may change water demands in the Basin, for example due to population growth and development of the built environment, how the General Plans may influence the GSP's ability to achieve sustainable groundwater use, and how the GSP may affect implementation of General Plan land use policies.

Santa Barbara County Comprehensive Plan

The Santa Barbara County Comprehensive Plan is a means by which more orderly development and consistent decision making in the county can be accomplished. The Plan involves a continuing process of research, analysis, goal-setting and citizen participation, the major purpose of which is to enable the County Board of Supervisors and Planning Commission to more effectively determine matters of priority in the allocation of resources, and to achieve the physical, social and economic goals of the communities in the county (County of Santa Barbara, 2016).

Relevant Santa Barbara County Comprehensive Plan Principles and Policies

The following Santa Barbara County Comprehensive Plan Land Use Element policies related to groundwater use would potentially influence implementation of the GSP:

- **Land Use Development Policy 4:** Prior to issuance of a development permit, the County shall make the finding, based on information provided by environmental documents, staff analysis, and the applicant, that adequate public or private services and resources (i.e., water, sewer, roads, etc.) are available to serve the proposed development.
- **Hillside and Watershed Protection Policy 7:** Degradation of the water quality of groundwater basins, nearby streams, or wetlands shall not result from development of the site. Pollutants, such as chemicals, fuels, lubricants, raw sewage, and other harmful waste, shall not be discharged into or alongside coastal streams or wetlands either during or after construction.

The following Santa Barbara County Comprehensive Plan Conservation Element, Groundwater Resources Section goals and policies related to groundwater use would potentially influence implementation of the GSP:

- **Goal 1:** To ensure adequate quality and quantity of groundwater for present and future county residents, and to eliminate prolonged overdraft of any groundwater basins.
  - **Policy 1.1:** The County shall encourage and assist all of the county's water purveyors and other groundwater users in the conservation and management, on a perennial yield basis, of all groundwater resources.
  - **Policy 1.2:** The County shall encourage innovative and/or appropriate, voluntary water conservation activities for increasing the efficiency of agricultural water use in the county.
  - **Policy 1.3:** The County shall act within its powers and financial abilities to promote and achieve the enhancement of groundwater basin yield.
- **Goal 2:** To improve existing groundwater quality, where feasible, and to preclude further permanent or long-term degradation in groundwater quality.
  - **Policy 2.1:** Where feasible, in cooperation with local purveyors and other groundwater users, the County shall act to protect groundwater quality where quality is acceptable, improve quality where degraded, and discourage degradation of quality below acceptable levels.
  - **Policy 2.2:** The County shall support the study of adverse groundwater quality effects which may be due to agricultural, domestic, environmental and industrial uses and practices.
- **Goal 3:** To coordinate County land use planning decisions and water resources planning and supply availability.
  - **Policy 3.1:** The County shall support the efforts of the local water purveyors to adopt and implement groundwater management plans pursuant to the Groundwater Management Act and other applicable law.
  - **Policy 3.2:** The County shall conduct its land use planning and permitting activities in a manner which promotes and encourages the cooperative management of groundwater resources by local agencies and other affected parties, consistent with the Groundwater Management Act and other applicable law.
  - **Policy 3.3:** The County shall use groundwater management plans, as accepted by the Board of Supervisors, in its land use planning and permitting decisions and other relevant activities.
  - **Policy 3.4:** The County's land use planning decisions shall be consistent with the ability of any affected water purveyor(s) to provide adequate services and resources to their existing customers, in coordination with any applicable groundwater management plan.
  - **Policy 3.5:** In coordination with any applicable groundwater management plan(s), the County shall not allow, through its land use permitting decisions, any basin to become seriously over drafted on a prolonged basis.

- **Policy 3.6:** The County shall not make land use decisions which would lead to the substantial over commitment of any groundwater basin.
- **Policy 3.7:** New urban development shall maximize the use of effective and appropriate natural and engineered recharge measures in project design, as defined in design guidelines to be prepared by the Santa Barbara County Flood Control and Water Conservation District in cooperation with P&D.
- **Policy 3.8:** Water-conserving plumbing, as well as water-conserving landscaping, shall be incorporated into all new development projects, where appropriate, effective, and consistent with applicable law.
- **Policy 3.9:** The County shall support and encourage private and public efforts to maximize efficiency in the pre-existing consumptive M&I use of groundwater resources.
- **Policy 3.10:** The County, in consultation with the cities, affected water purveyors, and other interested parties, shall promote the use of consistent "significance thresholds" by all appropriate agencies with regard to groundwater resource impact analysis.

- **Goal 4:** To maintain accurate and current information on groundwater conditions throughout the county.
  - **Policy 4.1:** The County shall act within its powers and financial abilities to collect, update, refine, and disseminate information on local groundwater conditions.

The following Santa Barbara County Comprehensive Plan Agricultural Element goal and policy related to groundwater use would potentially influence implementation of the GSP:

- **Goal 1:** Santa Barbara County shall assure and enhance the continuation of agriculture as a major viable production industry in Santa Barbara Country. Agriculture shall be encouraged. Where conditions allow, (taking into account environmental impacts) expansion and intensification shall be supported.
  - **Policy 1F:** The quality and availability of water, air, and soil resources shall be protected through provisions including but not limited to, the stability of Urban/Rural Boundary Lines, maintenance of buffer areas around agricultural areas, and the promotion of conservation practices.

Santa Barbara County Comprehensive Plan's Influence on Water Demand and Groundwater Sustainability Plan's Goals

Review of relevant *Santa Barbara County Comprehensive Plan* goals and policies reveals that the County's goals and policies relative to future land use development and conservation complement the use and conservation of groundwater resources goals anticipated to be included in the CBGSA GSP. The Comprehensive Plan explicitly states as a goal ensuring that adequate quality and quantity of groundwater will be available for present and future county residents, as well as the elimination of prolonged overdraft of any groundwater basins through land use planning decisions and water resources planning.

The county is expected to grow from 453,500 to 521, 700 residents between 2017 and 2050 (Santa Barbara County Association of Governments, 2019). These growth estimates are County-wide, and the General Plan does not specify how much growth, if any, is expected to occur within the Basin. Ensuring sustainable management of the Basin through implementation of the GSP will be critical in terms of supporting projected population growth in the county while maintaining sustainable groundwater levels in the Basin.

GSP's Influence on Santa Barbara County Comprehensive Plan's Goals and Policies

Successful implementation of the GSP will help to ensure that the Cuyama Basin's groundwater supply is managed in a sustainable manner. Given the amount of population growth projected in the county in the coming years, it is possible that changes in groundwater management by the GSP will result in changes to the pace, location and type of development that will occur in the county in the future. It is anticipated that GSP implementation will be consistent with the Comprehensive Plan's goals related to sustainable land use development in the county.

San Luis Obispo County General Plan

The *San Luis Obispo County General Plan* describes official County policy on the location of land uses and their orderly growth and development. It is the foundation upon which all land use decisions are based, guides action the County takes to assure a vital economy, ensures a sufficient and adequate housing supply, and protects agricultural and natural resources (County of San Luis Obispo, 2015).

Relevant San Luis Obispo General Plan Principles and Policies

The following San Luis Obispo General Plan Land Use Element principles and policies related to groundwater use would potentially influence implementation of the GSP:

- **Principle 1:** Preserve open space, scenic natural beauty and natural resources. Conserve energy resources. Protect agricultural land and resources.
    - **Policy 1.2:** Keep the amount, location and rate of growth allowed by the Land Use Element within the sustainable capacity of resources, public services and facilities.
    - **Policy 1.3:** Preserve and sustain important water resources, watersheds and riparian habitats.

The following San Luis Obispo General Plan Conservation and Open Space Element goals and policies related to groundwater use would potentially influence implementation of the GSP:

- **Goal WR 1:** The county will have a reliable and secure regional water supply.
    - **Policy WR 1.2:** Conserve Water Resources. Water conservation is acknowledged to be the primary method to serve the county's increasing population. Water conservation programs should be implemented countywide before more expensive and environmentally costly forms of new water are secured.

- **Policy WR 1.3:** New Water Supply. Development of new water supplies should focus on efficient use of our existing resources. Use of reclaimed water, interagency cooperative projects, desalination of contaminated groundwater supplies, and groundwater recharge projects should be considered prior to using imported sources of water or seawater desalination, or dams and on-stream reservoirs.
- **Policy WR 1.7:** Agricultural Operations. Groundwater management strategies will give priority to agricultural operations. Protect agricultural water supplies from competition by incompatible development through land use controls.
- **Policy WR 1.12:** Impacts of New Development. Accurately assess and mitigate the impacts of new development on water supply. At a minimum, comply with the provisions of Senate Bills 610 and 221.
- **Policy WR 1.14:** Avoid Net Increase in Water Use. Avoid a net increase in non-agricultural water use in groundwater basins that are recommended or certified as Level of Severity II or III for water supply. Place limitations on further land divisions in these areas until plans are in place and funded to ensure that the safe yield will not be exceeded.

- **Goal WR 2:** The County will collaboratively manage groundwater resources to ensure sustainable supplies for all beneficial uses.
  - **Policy WR 2.1:** Groundwater quality assessments Prepare groundwater quality assessments, including recommended monitoring, and management measures.
  - **Policy WR 2.2:** Groundwater Basin Reporting Programs. Support monitoring and reporting programs for groundwater basins in the region.
  - **Policy WR 2.3:** Well Permits. Require all well permits to be consistent with the adopted groundwater management plans.
  - **Policy WR 2.4:** Groundwater Recharge. Where conditions are appropriate, promote groundwater recharge with high-quality water.
  - **Policy WR 2.5:** Groundwater Banking Programs. Encourage groundwater-banking programs.
- **Goal WR 3:** Excellent water quality will be maintained for the health of the people and natural communities.
  - **Policy WR 3.2:** Protect Watersheds. Protect watersheds, groundwater and aquifer recharge areas, and natural drainage systems from potential adverse impacts of development projects.
  - **Policy WR 3.3:** Improve Groundwater Quality. Protect and improve groundwater quality from point and non-point source pollution, including nitrate contamination; MTBE and other industrial, agricultural, and commercial sources of contamination; naturally occurring mineralization, boron, radionuclides, geothermal contamination; and seawater intrusion and salts.
  - **Policy WR 3.4:** Water Quality Restoration. Pursue opportunities to participate in programs or projects for water quality restoration and remediation with agencies and organizations such as the Regional Water Quality Control Board (RWQCB), California Department of Fish and Wildlife

(CDFW), National Marine Fisheries Service (NMFS), and Resource Conservation Districts (RCDs) in areas where water quality is impaired.

- **Goal 4:** Per capita water use in the county will decline by 20% by 2020.
  - **Policy WR 4.1:** Reduce Water Use. Employ water conservation programs to achieve an overall 20% reduction in per capita residential and commercial water use in the unincorporated area by 2020. Continue to improve agricultural water use efficiency consistent with Policy AGP 10 in the Agricultural Element.
  - **Policy WR 4.2:** Water Pricing Structures. Support water-pricing structures to encourage conservation by individual water users and seek to expand the use of conservation rate structures in areas with Levels of Severity II and III for water supply.
  - **Policy WR 4.3:** Water conservation The County will be a leader in water conservation efforts.
  - **Policy WR 4.5:** Water for Recharge. Promote the use of supplemental water such as reclaimed sewage effluent and water from existing impoundments to prevent overdraft of groundwater. Consider new ways to recharge underground basins and to expand the use of reclaimed water. Encourage the eventual abandonment of ocean outfalls.
  - **Policy WR 4.6:** Graywater. Encourage the use of graywater systems, rainwater catchments, and other water reuse methods in new development and renovation projects, consistent with state and local water quality regulations.
  - **Policy WR 4.7:** Low Impact Development. Require Low Impact Development (LID) practices in all discretionary and land division projects and public projects to reduce, treat, infiltrate, and manage urban runoff.
  - **Policy WR 4.8:** Efficient Irrigation. Support efforts of the resource conservation districts, California Polytechnic State University, the University of California Cooperative Extension, and others to research, develop, and implement more efficient irrigation techniques.
- **Goal 5:** The best possible tools and methods available will be used to manage water resources.
  - **Policy WR 5.1:** Watershed Approach. The County will consider watersheds and groundwater basins in its approach to managing water resources in order to include ecological values and economic factors in water resources development.

The following San Luis Obispo General Plan Agriculture Element goals and policies related to groundwater use would potentially influence implementation of the GSP:

- **Policy AGP10a:** Encourage water conservation through feasible and appropriate "best management practices." Emphasize efficient water application techniques; the use of properly designed irrigation systems; and the control of runoff from croplands, rangelands, and agricultural roads.
- **Policy AGP10b:** Encourage the U.C. Cooperative Extension to continue its public information and research program describing water conservation techniques that may be appropriate for agricultural practices in this county. Encourage landowners to participate in programs that conserve water.

- **Policy AGP11b:** Do not approve proposed general plan amendments or re-zonings that result in increased residential density or urban expansion if the subsequent development would adversely affect: (1) water supplies and quality, or (2) groundwater recharge capability needed for agricultural use.
- **Policy AGP11c:** Do not approve facilities to move groundwater from areas of overdraft to any other area, as determined by the Resource Management System in the Land Use Element.

San Luis Obispo County General Plan's Influence on Water Demand and Groundwater Sustainability Plan

The semi-arid climate in the county is subject to limited amounts of rainfall and recharge of groundwater basins and surface reservoirs. A focus of the County General Plan is that future development should take place recognizing that the dependable supply of some county groundwater basins is already being exceeded. If mining of groundwater continues in those areas without allowing aquifers to recharge, water supply and water quality problems will eventually result, which may be costly to correct and could become irreversible.

The General Plan explicitly encourages preservation of the county's natural resources, and states that future growth should be accommodated only while ensuring that this growth occurs within the sustainable capacity of these resources.

The county was expected to grow between 0.44 and 1 percent per year from 2013 through 2018, an increase of approximately 12,000 persons over the five-year period and is expected to grow by over 41,000 from 2010 to 2030 (County of San Luis Obispo, 2014). These growth estimates are County-wide, and the General Plan does not specify how much growth, if any, is expected to occur within the Basin. Ensuring sustainable management of the basin through implementation of the GSP will be critical in terms of supporting projected population growth in the county while maintaining sustainable groundwater levels in the basin.

GSP's Influence on San Luis Obispo County General Plan's Goals and Policies

Successful implementation of the GSP will help to ensure that the Cuyama Basin's groundwater supply is managed in a sustainable manner. Given the amount of population growth projected in the county in the coming years, it is possible that changes in groundwater management by the GSP will impact the location and type of development that will occur in the Basin in the future. It is anticipated that GSP implementation will reinforce the General Plan's goals related to sustainable land use development in the county.

Ventura County General Plan

The Ventura County General Plan guides decision making and provides direction for growth and development. The 2040 General Plan consists of the following:

- County-wide Goals, Policies and Programs containing eleven chapters (Introduction, Land Use and Community, Housing Element, Circulation Transportation and Mobility element, Public Facilities and Infrastructure, Conservation and Open space, Hazards and Safety, Agricultural, Water Resource, Economic Viability and Area Plan.)
- Four appendices (Plan Area and Existing Community Land Use Maps, Climate Change, Count of Ventura Measure (SAOR) Save Open Space and Agricultural Resource Initiative – 2050 and Guidelines for Orderly Development.)
- Several Area Plans which contain specific goals, policies and programs for specific geographical areas of the county

A few of these chapters and guiding principles which could potentially influence the GSP are described below.

Relevant Ventura County General Plan Principles and Policies

The following Ventura County General Plan Water Resource Element Chapter 9 goals and policies related to groundwater use would potentially influence implementation of the GSP:

- Goal 1: To effectively manage water supply by adequately planning for the development, conservation, and protection of water resources for present and future generations.
  - Policy 1: The County should encourage water suppliers, groundwater management agencies, and groundwater sustainability agencies to inventory and monitor the quantity and quality of the county's water resources,
  - Policy 2: The County shall consider the location of a discretionary project within a watershed to determine whether or not it could negatively impact a water source.
  - Policy 3: The County shall support the use of, conveyance of, and seek to secure water from varied sources that contribute to a diverse water supply portfolio.
  - Policy 4: The County shall continue to support the conveyance of, and seek to secure water from, state sources.
  - Policy 5: The County shall participate in regional committees to coordinate planning efforts for water and land use that is consistent with the Urban Water Management Planning Act, Sustainable Groundwater Management Act, the local Integrated Regional Water Management Plan, and the Countywide National Pollutant Discharge Elimination System Permit (stormwater and runoff management and reuse)
  - Policy 6: The County shall encourage the continued cooperation among water suppliers in the county, through entities such as the Association of Water Agencies of Ventura County and the Watersheds Coalition of Ventura County, to ensure immediate and long-term water needs are met efficiently.
  - Policy 7: The County shall encourage continued cooperation among water suppliers in the county.

- Policy 8: The County shall encourage the consolidation of water suppliers where necessary to ensure all residents are receiving water of adequate quality and quantity.
- Policy 9: Where technically feasible, the County shall support the use of groundwater basins for water storage.
- Policy 10: The County shall continue to support and participate with the Watersheds Coalition of Ventura County in implementing and regularly updating the Integrated Regional Water Management Plan.
- Policy 11: The County shall require all discretionary development to demonstrate an adequate long-term supply of water.
- Policy 12: The County shall evaluate the potential for discretionary development to cause deposition and discharge of sediment, debris, waste and other pollutants into surface runoff, drainage systems, surface water bodies, and groundwater.
- Policy 13: The County shall require that all County-owned water pumps use 100 percent renewable sourced electricity for water pumping, when feasible, and shall encourage private entities to use 100 percent renewable-sourced electricity when feasible.
- Policy 14: The County shall require that discretionary development for new golf courses shall be subject to conditions of approval that prohibit landscape irrigation with water from groundwater basins or inland surface waters.

- Goal 2: To implement practices and designs that improve and protect water resources.
  - Policy 1: The County shall cooperate with Federal, State and local agencies in identifying and eliminating or minimizing all sources of existing and potential point and non-point sources of pollution to ground and surface waters.
  - Policy 2: The County shall evaluate the potential for discretionary development to cause deposition and discharge of sediment, debris, waste, and other contaminants into surface runoff, drainage systems, surface water bodies, and groundwater.
  - Policy 3: The County shall require that discretionary development not significantly impact the quality or quantity of water resources within watersheds, groundwater recharge areas or groundwater basins.
  - Policy 4: The County shall require discretionary development for out-of-river mining below the historic or predicted high groundwater level in the Del Norte/El Rio (Oxnard Forebay Basin) to demonstrate that exaction activities will not interfere with or affect water quality and quantity pursuant to the County's Initial Study Assessment Guidelines.

- Goal 3: To promote efficient use of water resources through water conservation, protection, and restoration.

- Policy 1: The County shall encourage the use of non-potable water, such as tertiary treated wastewater and household graywater, for industrial, agricultural, environmental, and landscaping needs consistent with appropriate regulations.
- Policy 2: The County shall require the use of water conservation techniques for discretionary development, as appropriate.
- Policy 3: The County shall require discretionary development to incorporate low impact development design features and best management practices, including integration of stormwater capture facilities, consistent with County's Stormwater Permit.
- Policy 4: The County shall strive for efficient use of potable water in County buildings and facilities through conservation measures, and technological advancements.

- Goal 4: To maintain and restore the chemical, physical, and biological integrity and quantity of groundwater resources.

  - Policy 1: The County shall work with water suppliers, water users, groundwater management agencies, and groundwater sustainability agencies to implement the Sustainable Groundwater Management Act (SGMA).
  - Policy 2: In areas identified as important recharge areas by the County or the applicable Groundwater Sustainability Agency, the County shall condition discretionary development to limit impervious surfaces where feasible and shall require mitigation in cases where there is the potential for discharge of harmful pollutants within important groundwater recharge areas.
  - Policy 3: The County shall support groundwater recharge and multi-benefit projects consistent with the Sustainable Groundwater Management Act and the Integrated Regional Water Management Plan to ensure the long-term sustainability of groundwater.
  - Policy 4: The County shall encourage the use of in-stream water flow and recycled water for groundwater recharge while balancing the needs of urban and agricultural uses, and healthy ecosystems, including in-stream waterflows needed for endangered species protection.
  - Policy 5: The County shall require that discretionary development shall not significantly impact the quantity or quality of water resources within watersheds, groundwater recharge areas or groundwater basins.
  - Policy 6: The County shall require discretionary development for out-of-river mining below the historic or predicted high groundwater level in the Del Norte/El Rio (Oxnard Forebay Basin) to demonstrate that extraction activities will not interfere with or affect groundwater quality and quantity pursuant to the County's Initial Study Assessment Guidelines.
  - Policy 7: The County shall require that discretionary development be subject to conditions of approval requiring proper drilling and construction of new oil, gas, and water wells and removal and plugging of all abandoned wells on-site.

- Policy 8: The County shall require all new water wells located within Groundwater Sustainability Agency (GSA) boundaries to be compliant with GSAs and adopted Groundwater Sustainability Plans (GSPs)
- Policy 9: The County shall prohibit new water wells in the Oxnard Plain Pressure Basin if the new water wells would increase seawater intrusion in the Oxnard or Mugu aquifers.

- Goal 5: To protect and, where feasible, enhance watersheds and aquifer recharge areas through integration of multiple facets of watershed-based approaches.
  - Policy 1: The County shall work with water suppliers, Groundwater Sustainability Agencies (GSAs), wastewater utilities, and stormwater management entities to manage and enhance the shift toward integrated management of surface and groundwater, stormwater treatment and use, recycled water and conservation, and desalination.
  - Policy 2: The County shall continue to seek funding and support coordination of watershed planning and watershed-level project implementation to protect and enhance local watersheds.
- Goal 6: To sustain the agricultural sector by ensuring an adequate water supply through water efficiency and conservation.
  - Policy 1: The County should support the appropriate agencies in their efforts to effectively manage and enhance water quantity and quality to ensure long-term, adequate availability of high quality and economically viable water for agricultural uses, consistent with water use efficiency programs.
  - Policy 2: The County should support programs designed to increase agricultural water use efficiency and secure long-term water supplies for agriculture.
  - Policy 3: The County should encourage the use of reclaimed irrigation water and treated urban wastewater for agricultural irrigation in accordance with federal and state requirements in order to conserve untreated groundwater and potable water supplies.
- Goal 7: To consider the water needs of the natural environment with other water uses in the county.
  - Policy 1: The County shall encourage the appropriate agencies to effectively manage water quantity and quality to address long-term adequate availability of water for environmental purposes, including maintenance of existing groundwater-dependent habitats and in-stream flows needed for riparian habitats and species protection.

Ventura County Plan's Influence on Water Demand and Groundwater Sustainability Plan's Goals

Review of relevant Ventura County General Plan goals and policies reveals that the County's goals and policies relative to future land use development and conservation complement the use and conservation of groundwater resources goals included in the CBGSA GSP. The General Plan explicitly states as a goal ensuring that adequate quality and quantity of groundwater will be available for present and future county residents, as well as accommodating anticipated future growth and development while maintaining a safe and healthful environment by preserving valuable natural resources, including groundwater.

The county is expected to decline from 837,845 to 722,411 residents between 2021 and 2050 (Caltrans, 2022). These estimates are County-wide, and the General Plan does not specify how much population decline, if any, is expected to occur within the Basin. Ensuring sustainable management of the basin through implementation of the GSP will be critical in terms of supporting forecasted population in the county while maintaining sustainable groundwater levels in the Basin.

GSP's Influence on Ventura County General Plan's Goals and Policies

Successful implementation of the GSP will help to ensure that the Cuyama Basin's groundwater supply is managed in a sustainable manner. Given the amount of population growth projected in the county in the coming years, it is possible that changes in groundwater management by the GSP will result in changes to the pace, location and type of development that will occur in the county in the future. It is anticipated that GSP implementation will reinforce the General Plan's goals related to sustainable land use development in the county.

Kern County General Plan

Because of the close interrelationship between water supplies, land use, conservation, and open space issues, the Land Use, Conservation, and Open Space Element sections of the Kern County General Plan are the most relevant elements for development of the GSP. These elements provide for a variety of land uses for future economic growth while also assuring the conservation of Kern County's agricultural, natural, and resource attributes (County of Kern, 2009).

Relevant Kern County General Plan Goals and Policies

The following Land Use, Conservation, and Open Space Element goals and policies related to groundwater use would potentially influence implementation of the GSP:

- Goal 1.4.5: Ensure that adequate supplies of quality water (appropriate for intended use) are available to residential, industrial, and agricultural users in Kern County.
    - Policy 1.4.2: The efficient and cost-effective delivery of public services and facilities will be promoted by designating areas for urban development which occur in or adjacent to areas with adequate public service and facility capacity.
    - Policy 1.4.2.a: Ensure that water quality standards are met for existing users and future development.
- Goal 1.6.6: Promote the conservation of water quantity and quality in Kern County.

- Goal 1.6.7: Minimize land use conflicts between residential and resource, commercial, and industrial land uses.
  - Policy 1.6.11: Provide for an orderly outward expansion of new urban development so that it maintains continuity of existing development, allows for the incremental expansion of infrastructure and public service, minimizes impacts on natural environmental resources, and provides a high-quality environment for residents and businesses.
  - Policy 1.9.10: To encourage effective groundwater resource management for the long-term economic benefit of the county, the following shall be considered:
  - Policy 1.9.10.a: Promote groundwater recharge activities in various zone districts.
  - Policy 1.9.10.c: Support the development of groundwater management plans.
  - Policy 1.9.10.d: Support the development of future sources of additional surface water and groundwater, including conjunctive use, recycled water, conservation, additional storage of surface water and groundwater and desalination.
- Goal 1.10.1: Ensure that the county can accommodate anticipated future growth and development while maintaining a safe and healthful environment and a prosperous economy by preserving valuable natural resources, guiding development away from hazardous areas, and assuring the provision of adequate public services.
  - Policy 1.10.6.39: Encourage the development of the county's groundwater supply to sustain and ensure water quality and quantity for existing users, planned growth, and maintenance of the natural environment.
  - Policy 1.10.6.40: Encourage utilization of community water systems rather than the reliance on individual wells.
  - Policy 1.10.6.41: Review development proposals to ensure adequate water is available to accommodate projected growth.

Kern County General Plan's Influence on Water Demand and Groundwater Sustainability Plan's Goals

Review of relevant Kern County General Plan goals and policies reveals that the County's goals and policies relative to future land use development and conservation complement the use and conservation of groundwater resources goals that are anticipated to be included in the CBGSA GSP. The General Plan explicitly encourages development of the county's groundwater supply to ensure that existing users have access to high quality water, and states that future growth should be accommodated only while ensuring that adequate high-quality water supplies are available to existing and future users.

GSP's Influence on Kern County General Plan's Goals and Policies

Successful implementation of the GSP will help to ensure that the Cuyama Basin's groundwater supply is managed in a sustainable manner. Given the small portion of the Cuyama Basin that lies in Kern County, it is anticipated that GSP implementation will have little to no effects on the General Plan's goals related to sustainable land use development in the county.

1.2.7 Plan Elements from CWC Section 10727.4

The plan elements from California Water Code Section 10727.4 require GSPs to address or coordinate the addressing of the components listed in Table 1-2. As noted in the table, several components of California Water Code Section 10727.4 address issues that are not within the CBGSA's authority and are coordinated with local agencies.

Table 1-2: Plan Elements from CWC Section 10727.4

Element	Location
(a) Control of saline water intrusion	Not applicable
(b) Wellhead protection areas and recharge areas.	To be coordinated with counties
(c) Migration of contaminated groundwater.	Coordinated with Regional Water Quality Control Board (RWQCB)
(d) A well abandonment and well destruction program.	To be coordinated with counties
(e) Replenishment of groundwater extractions.	Chapter 7, Projects and Management Actions
(f) Activities implementing, opportunities for, and removing impediments to, conjunctive use or underground storage.	Chapter 7, Projects and Management Actions
(g) Well construction policies.	To be coordinated with counties
(h) Measures addressing groundwater contamination cleanup, groundwater recharge, in-lieu use, diversions to storage, conservation, water recycling, conveyance, and extraction projects.	Chapter 7, Projects and Management Actions, and coordinated with RWQCB
(i) Efficient water management practices, as defined in Section 10902, for the delivery of water and water conservation methods to improve the efficiency of water use.	Coordinated with Cuyama Basin Water District
(j) Efforts to develop relationships with state and federal regulatory agencies.	Chapter 8, Plan Implementation
(k) Processes to review land use plans and efforts to coordinate with land use planning agencies to assess activities that potentially create risks to groundwater quality or quantity.	To be coordinated with counties
(l) Impacts on groundwater dependent ecosystems.	Chapter 2, Basin Settings, Section 2.2. Groundwater Conditions

1.3 Notice and Communication

In accordance with the SGMA regulations in Section 354.10, Notice and Communication, this section provides the following information:

- Description of the beneficial uses and users of groundwater in the Basin, including the land uses and property interests potentially affected by the use of groundwater in the Basin, the types of parties representing those interests, and the nature of consultation with those parties.
- List of public meetings at which the GSP was discussed or considered by the CBGSA.
- Comments regarding the GSP received by the CBGSA and a summary of any responses made by the CBGSA (Appendix D).
- Explanation of the CBGSAs decision-making process.
- Identification of opportunities for public engagement and a discussion of how public input and response will be used.
- Description of how the CBGSA encourages the active involvement of diverse social, cultural, and economic elements of the population within the Basin.
- Methods the CBGSA used to inform the public about progress implementing the GSP, including the status of projects and actions.

1.3.1 Description of Beneficial Uses and Users of Groundwater

Beneficial uses and users of groundwater in the Basin include the following interests (as listed in California Water Code Section 10723.2):

- Holders of overlying groundwater rights, including agricultural users and domestic well owners. There are approximately 262 agricultural and domestic wells identified to date in the Basin.
- Public water systems/municipal well operators are CCSD, the Cuyama Mutual Water Company, and the Ventucopa Water Supply Company.
- Disadvantaged communities: there are three disadvantaged and severely disadvantaged communities in the Cuyama Basin: Cuyama, New Cuyama, and Ventucopa. The census block groups for the Santa Barbara and San Luis Obispo County portions of the Basin are considered disadvantaged.
- Local land use planning agencies are San Luis Obispo, Santa Barbara, Ventura, and Kern counties.
- Entities that monitor and report groundwater elevations are CCSD, San Luis Obispo County, SBCWA, and Ventura County.
- Environmental users of groundwater, including groundwater dependent ecosystems (GDEs)

Potential interests (listed in California Water Code Section 10723.2) that are not present in the Cuyama Basin include the following:

- Surface water users, if there is a hydrologic connection between surface and groundwater bodies
- Federal government, including, the military and managers of federal lands

- California Native American tribes

The types of parties representing Cuyama Basin interests and the nature of consultations with these parties are summarized below.

Standing Advisory Committee

The SAC was established in September 2017 to encourage active involvement from diverse social, cultural, and economic elements of the population within the Basin. The SAC membership reflects this diversity. The members represent large and small landowners and growers from different geographic locations in the Basin, longtime residents of New Cuyama including Hispanic community members, and a manager of an environmentally-centric non-profit organization. SAC's role is described in Section 1.3.4.

Technical Forum

A technical forum was established to allow for technical input from interested parties within the Cuyama Basin. The forum had no decision-making authority. For the original 2020 GSP, monthly conference calls were held with representatives from the following organizations to review and seek input on technical matters:

- CBWD and consultants EKI Environment & Water, Inc. (EKI) and Provost & Pritchard Consulting Group (Provost & Pritchard)
- CCSD and consultants Dudek
- Grapevine Capital Partners, North Fork Vineyard and consultants Cleath-Harris Geologists
- San Luis Obispo County
- Santa Barbara Pistachio Company
- SBCWA

For the 2025 GSP Update, monthly conference calls were again held with the representatives listed above, along with the representatives from the following organizations:

- Bolthouse Farms and Grimmway Farms, and their consultants GSI Water Solutions, Inc.
- Sunrise Olive Ranch, and consultants Stetson Engineers
- Coalition of Landowners for Commonsense Groundwater Solution, and consultants Montgomery & Associates
- Various Cuyama Basin landowners, and consultants Aquilogic, Inc.

Additional Consultations

The GSP team conducted additional consultations regarding GSP matters via email, telephone, or via in-person meetings with representatives from the following groups:

- Bolthouse Farms
- Community representatives from the Family Resource Center and Center
- Duncan Family Farms
- DWR
- Grimmway Farms
- Individual landowners in the Cuyama Basin
- Kern County
- Santa Barbara County Fire Department, New Cuyama Station
- Santa Barbara County Public Works Department
- Santa Barbara IRWM Program
- United States Department of Agriculture's Forest Service Mount Pinos Ranger District, Los Padres National Forest
- University of California at Santa Barbara
- USGS
- Ventura County
- Wellntel Network

The following agencies and organizations were notified by mail about GSA-hosted community workshops:

- Cachuma Resource Conservation District in Santa Maria, California
- California Department of Fish and Wildlife, Headquarters in Sacramento, California
- California Natural Resources Agency in Sacramento, California
- California Wildlife Conservation Board in Sacramento, California
- Kern County, Cooperative Extension in Bakersfield, California
- Leadership Council for Justice and Accountability in Bakersfield, California
- Los Padres Forest Watch in Santa Barbara, California
- Morro Coast Audubon Society in Morro Bay, California
- San Luis Obispo County, Cooperative Extension in San Luis Obispo, California
- United States Department of Agriculture's Natural Resource Conservation Service in Fresno, California
- United States Fish and Wildlife Service in Ventura, California
- United States Fish and Wildlife Service, Attention Friends of California Condors Wild and Free in Ventura, California

- United States Forest Service, Bitter Creek National Wildlife Refuge, Refuge Manager, Debora Kirkland in Ventura, California
- United States Forest Service, Los Padres National Forest, Headquarters in Goleta, California
- Ventura County Audubon Society Chapter in Ventura, California
- Ventura County, Cooperative Extension in Ventura, California

The CBGSA developed a stakeholder engagement strategy to ensure that the interests of all beneficial uses and users of groundwater in the Basin were considered. Multi-organization planning processes can be complex. It can be challenging for community members to understand required decision-making steps, and where and how stakeholder issues and concerns are considered. Groundwater management as a practice is also complex. Educating and engaging groundwater stakeholders and the community about complex issues while simultaneously meeting deadlines established by SGMA, required an organized stakeholder engagement strategy.

An additional challenge to the engagement strategy is that the Basin area is rural and has no news media outlets serving the area. The combined population per the 2010 Census of the three disadvantaged communities is 666 (Ventucopa 92, Cuyama 57, and New Cuyama 517). The engagement strategy relied primarily on mail and email communications about community workshop and GSA meetings. Mailings were sent to 675 parcel owners. Additionally, the CBGSA sent 185 emails to stakeholders, engaged with counters who distributed notices, and word of mouth.

In January 2018, and to inform development of stakeholder engagement strategy, the CBGSA conducted 22 phone interviews with members of the CBGSA Board of Directors, SAC, CBGSA staff, staff from each of the four counties, and community representatives from the New Cuyama Family Resource Center and the Blue Sky Center, which are both located in New Cuyama. Several common themes emerged, which were used to form the basis for constructive stakeholder engagement and planning for the GSP. The prevailing ideas expressed included the following outreach and planning objectives:

- Provide a fair, balanced, and transparent public process that builds trust and understanding towards the common goal of a GSP that can best benefit everyone in the Basin.
- Provide a public meeting environment that is inclusive of all perspectives and all stakeholders.
- Provide education on a range of topics, at key milestones throughout the planning process, beginning with education about SGMA and what a GSP includes.
- Provide education and outreach specifically inclusive of smaller farmers/ranchers and the Hispanic community.
- Develop a GSP that is fair for all stakeholders in the Basin.

The stakeholder engagement strategy was developed to support the themes listed above, and in March 2018, the strategy was approved by the CBGSA Board. The strategy can be found online at: http://cuyamabasin.org/assets/pdf/CBGSP-Engagement-Strategy_May2018.pdf.

1.3.2 List of Public Meetings Where the GSP was Discussed

Below is a list of the public meetings where the GSP was discussed. The following includes the public meetings held from June 2017 through July 2024.

CBGSA Board Meetings

In 2017, meetings were held on June 30, August 2, September 6, September 27, October 4, October 9, November 1, and December 6.

In 2018, meetings were held on January 3, January 10, April 4, May 2, July 11, August 1, September 5, October 3, and November 7.

In 2019, meetings were held on January 9, February 6, April 3, May 1, June 5, July 10, August 7, and December 4.

In 2020, meetings were held on March 4, May 6, June 3, June 25, August 13, and November 4.

In 2021, meetings were held on January 13, March 3, May 5, July 7, August 18, September 1, and November 3.

In 2022, meetings were held on January 5, March 2, May 4, July 6, September 7, November 2, November 15, and December 12.

In 2023, meetings were held on January 18, March 29, May 3, July 12, September 6, November 1, and December 22.

In 2024, meetings were held on January 10, March 6, May 1, May 23, July 10, July 31, September 4, and November 6.

Joint Meetings of CBGSA Board and Standing Advisory Committee

In 2018, joint meetings were held on February 7, March 7, June 6, September 5, and December 3.

In 2019, joint meetings were held on March 6 and May 1, and November 6.

CBGSA Standing Advisory Committee Meetings

In 2017, standing Advisory Committee meetings were held on October 16, and November 30.

In 2018, standing Advisory Committee meetings were held on January 4, February 1, March 1, March 29, April 26, May 31, June 28, July 26, August 30, September 27, November 1, and November 29.

In 2019, standing Advisory Committee meetings were held on January 8, January 31, February 28, and March 28, April 25, May 30 June 27, and November 6.

In 2020, standing Advisory Committee meetings were held on February 27, April 30, May 28, June 25, August 13, and October 29.

In 2021, standing Advisory Committee meetings were held on January 7, February 25, April 29, July 1, August 11, August 26, and October 28.

In 2022, standing Advisory Committee meetings were held on January 4, February 24, April 28, June 30, September 1, and October 27.

In 2023, standing Advisory Committee meetings were held on January 5, March 23, April 27, July 6, August 31, October 12, and October 26.

In 2024, standing Advisory Committee meetings were held on January 4, February 29, April 25, July 1, July 25, August 29, and October 31.

Community Workshops

In 2018, community workshops conducted in both English and Spanish were held on March 7, June 6, September 5, and December 3.

In 2019, community workshops were also conducted in English and in Spanish on March 6, May 1, and November 6.

In 2023, a community workshop was conducted in English and in Spanish on October 12.

In 2024, community workshops was conducted in English and in Spanish on July 18 and October 10.

1.3.3 Comments Regarding the GSP Received by the CBGSA, Response Summary

Public comments received and CBGSA responses provided during the development of the Original 2020 GSP are in Appendix D.

1.3.4 GSA Decision Making Process

On June 30, 2017, the CBGSA Board of Directors met for the first time. The 11-member board is the designated decision-making entity for GSP development and is subject to the Brown Act.[1] According to the requirements of the act, all meetings were noticed 72 hours in advance, were open to the public and included a public comment period. Board membership and meeting agendas, minutes, and materials are available online at http://cuyamabasin.org/cuyama-gsa-board.html. Meeting agendas were also posted at the meeting location, the Family Resource Center, in New Cuyama.

The Board of Director votes are made on the basis of one vote for each Director, with Directors representing CBWD weighted at 6.7 percent and Directors representing other entities weighted at 11.1 percent. A weighted vote total of at least 75 percent is required for approval of the following:

- Annual budget
- GSP for the Basin and any substantive amendment
- Any stipulation to resolve litigation
- Adding new Board members
- Establishing and levying any fee, charge or assessment
- Adopting or amending bylaws
- Selecting a consultant to prepare the GSP

A weighted vote total of at least 50 percent is required for approval of all other decisions.

In September 2017, the CBGSA Board appointed the seven-member SAC to provide advice and input to the CBGSA Board on GSP development and implementation, and to assist with stakeholder engagement throughout the Cuyama Basin. In March 2018, the CBGSA Board expanded the SAC membership to nine members, including representatives from the Hispanic community in the Basin. One member resigned in March 2019, and the CBGSA Board of Directors is currently considering a replacement process. According to the requirements of the Brown Act, all SAC meetings were noticed 72 hours in advance and were open to the public. SAC membership, agendas, minutes, and meeting materials are available at http://cuyamabasin.org/standing-advisory-committee.html.

The CBGSA decision-making process included developing an agenda for each meeting of the CBGSA Board and for each SAC meeting. The CBGSA Executive Director developed the agendas in concert with the technical team, outreach team, and the respective chairs of the CBGSA Board and SAC. Agenda items were either educational, informational, or required direction or decision. Agenda items were presented to the SAC, and then the SAC chair would provide an overview of SAC discussion and recommendations at

[1] http://ag.ca.gov/publications/2003_Intro_BrownAct.pdf

the subsequent CBGSA Board meeting. Figure 1-25 depicts the overall topics and decision process for developing the Original GSP.

Figure 1-25: Topics and Decision Process for GSP Development

A similar process was used in the implementation of the GSP, revising and resubmitting the original GSP to DWR in 2022, and in the development of this Updated GSP. An example of the updated scheduling and decision scheduling is shown in Figure 1-26.

Figure 1-26: Topics and Decision Process for Updated GSP Development

1.3.5 Opportunities for Public Engagement and How Public Input was Used.

Community input was encouraged and received at CBGSA Board meetings, SAC meetings, and community workshops. This GSP was shaped by community input, SAC input, and CBGSA Board direction and decisions.

Opportunities for Public Engagement

Regular opportunities for public engagement were available throughout GSP development. The CBGSA Board, SAC, and CBGSA staff encouraged public input throughout the development of the GSP in the following ways described below.

Meetings and Direct Engagement

- Public meetings and community workshops (detailed in Section 1.3.2)
- Direct contact with CBGSA staff. The public was encouraged to contact the CBGSA staff by phone, email, or mail with questions and comments. CBGSA contact information was distributed at all meetings and is available on the CBGSA website at http://cuyamabasin.org/contact-us.html.

- An informal briefing was hosted by the technical team at The Place, a restaurant in Ventucopa. The technical team met with interested growers and residents to update them and answer questions about the GSP.

Original 2020 GSP Section Review and Comment Periods

When draft sections of the GSP section became available for review and comment, the CBGSA Board, SAC members, stakeholders were notified. A list of the dates drafts were available online are listed below. Draft GSP sections are available online at: http://cuyamabasin.org/resources.html#gsp.

- February 21, 2019: Chapter 5, Sustainability
- February 21, 2019: Chapter 2, Water Budget
- November 28, 2018: Chapter 2, Groundwater Conditions Draft
- November 28, 2018: Chapter 2, Groundwater Conditions Draft: Appendix X Hydrographs
- November 28, 2018: Chapter 2, Groundwater Conditions Draft: Appendix Y – Groundwater Contours
- November 28, 2018: Chapter 2, Groundwater Conditions Draft: Appendix Z – Subsidence White Paper
- November 16, 2018: Chapter 6, Data Management System Chapter Draft
- October 3, 2018: Chapter 2, Updated Hydrogeologic Conceptual Model Draft
- September 24, 2018: Chapter 4, Monitoring Networks Section Draft
- September 24, 2018: Chapter 4, Monitoring Networks Section - Appendices
- September 21, 2018: Chapter 2, Updated Hydrogeologic Conceptual Model Draft
- August 24, 2018: Chapter 2, Groundwater Conditions Draft
- August 24, 2018: Chapter 2, Groundwater Conditions Draft: Appendix X – Hydrographs
- August 24, 2018: Chapter 2, Groundwater Conditions Draft: Appendix Y – Groundwater Contours
- August 24, 2018: Chapter 2, Groundwater Conditions Draft: Appendix Z – Subsidence White Paper
- July 27, 2018: Draft Undesirable Results Narrative
- July 27, 2018: Management Framework Matrix
- June 22, 2018: Draft Hydrogeologic Conceptual Model
- April 20, 2018: Draft Description of Plan Area

2025 GSP Update Section Review and Comment Periods

When draft sections of the 2025 GSP Update became available for review and comment, the CBGSA Board, SAC members, stakeholders were notified. A list of the dates drafts were available online are listed below. Draft GSP sections are available online at: http://cuyamabasin.org/resources.html#gsp.

- January 18, 2024: Chapter 1, Agency Information and Plan Area Draft (Notice and Communication Subsection excluded)
- January 18, 2024: Chapter 4, Monitoring Network
- May 23, 2024: Chapter 3, Undesirable Results
- May 23, 2024: Chapter 5, Sustainable Management Criteria
- July 10, 2024: Chapter 2, Basin Settings
- July 10, 2024: Chapter 6, Data Management System
- August 23, 2024: Chapter 7, Projects and Management Actions
- August 23, 2024: Chapter 8, Plan Implementation
- August 23, 2024: Executive Summary
- August 23, 2024: Draft 2025 GSP Update

How Public Input and Response was Used in the Development of the GSP

Public input was used to help shape the GSP development. The input was also used to develop context and content for CBGSA meetings, SAC meetings, community workshops, CBGSA newsletters, and for content posted to the CBGSA website.

CBGSA-hosted public meetings were designed to encourage input, discussion, and questions from both the CBGSA Board of Directors and SAC members as well as public audience members. The minutes of CBGSA Board and SAC meetings reflect the questions and comments raised by members and the general public. For each community workshop, public comments were summarized and provided to the CBGSA staff and technical team, the CBGSA Board of Directors, and SAC for further consideration.

Examples of how public input helped shape the GSP are described below.

During the development of the GSP, community input was valuable in identifying and closing groundwater data gaps. Residents and agricultural businesses provided additional data about groundwater levels, historical pumping, and cropping patterns.

During discussion of projects and management actions, several community members and CBGSA Board members expressed concern about unreliable community water supplies in New Cuyama, Cuyama, and Ventucopa. The GSP's list of projects was revised to include construction of new wells for these communities.

Community input also shaped other actions carried forward for further analysis in the GSP. Two projects to improve water resources in the basin came from public input: cloud seeding and rangeland management. The technical team evaluated each approach and discussed benefits and impacts with the CBGSA Board, SAC, and the community. Cloud seeding as a project is included in the GSP for further evaluation. Rangeland management was not carried forward in the GSP due to concerns about the potential impacts of vegetation management, and institutional concerns about coordination with the United States Forest Service.

Appendix D includes a summary of public comments and responses.

1.3.6 How GSA Encourages Active Involvement

Establishment of the SAC in September 2017 was intended to encourage active involvement from diverse social, cultural, and economic elements of the population in the Basin. All meetings of the CGBSA Board and SAC were open to the public and included a public comment period. Community members participated in the public meetings. Community workshops were held in both English and Spanish, provided time for discussion of each topic presented, and provided comment forms for written comments. Workshop materials were also available in English and Spanish. The quarterly CBGSA newsletter was available in English and Spanish and described GSP planning status and opportunities for participation. Notices for community workshops were available in both English and Spanish. Distribution channels included email, hand-delivered postings throughout the Cuyama Valley, and postcard mailings to parcel owners within Basin boundaries. A website (www.cuyamabasin.org) was designed and made available early in the GSP process to assist in keeping stakeholders informed and up to date.

1.3.7 Method of Informing the Public

To inform the public about GSP progress and to seek public input, the following methods were used:

- Notice of public meetings, including CBGSA Board meetings, SAC meetings, and community workshops (in both English and Spanish)
- Website (www.cuyamabasin.org)
- Email distribution via a stakeholder email list was maintained throughout the process and grew to 185 contacts
- Postcards were mailed to 675 parcel owners in the Basin to announce community workshops and provide a link to the website to follow the progress of GSP development
- A quarterly, four-page CBGSA newsletter was mailed to all New Cuyama, CA post office box holders as a part of the Cuyama Recreation District Newsletter. The newsletter was also distributed via the stakeholder email list.
- Volunteers at the Family Resource Center distributed community workshop notices to locations throughout the Cuyama Basin.

- A member of the SAC posted community workshop notices in some of the finger areas in the west part of the Cuyama Basin.

The development of the mailing list and email list was informed by SGMA Section 10723.2, which calls for consideration of interests for all beneficial uses and users of groundwater. The initial email list of approximately 80 stakeholders grew to 185 stakeholders by March 2019. Additionally, a conventional mailing list was used that included 675 parcel owners in the Cuyama Basin identified by each of the four counties and the 17 agencies and organizations listed above in Section 1.3.1.

1.4 References

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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, 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 in the 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 flow 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 diagram** – 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) 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 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)

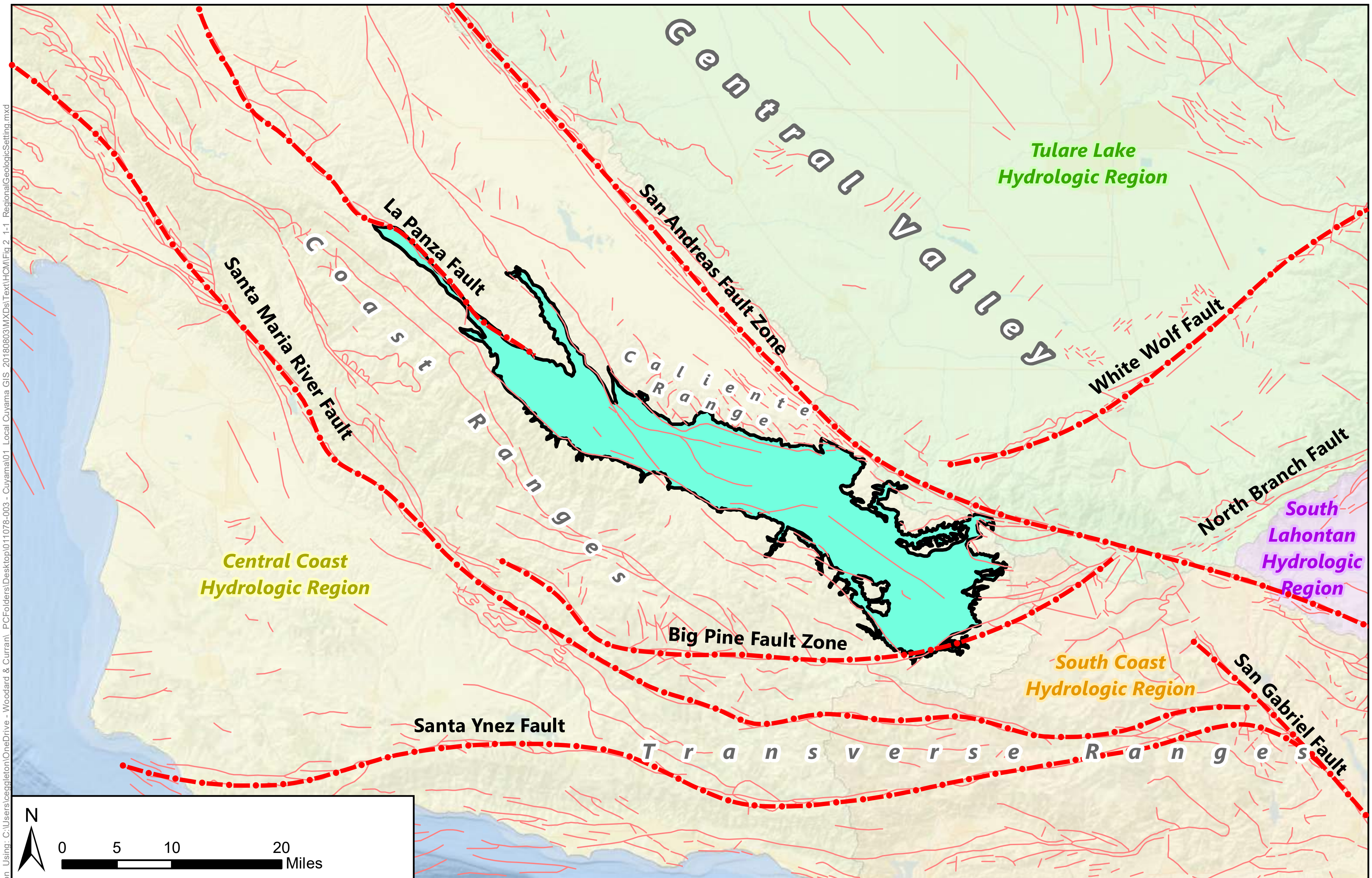


Figure 2-1: Regional Geologic Setting

Cuyama Basin Groundwater Sustainability Agency

Cuyama Valley Groundwater Basin Groundwater Sustainability Plan

December 2019

WOODARD & CURRAN

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>

Figure Exported: 10/18/2018 By: ceggleton Using: C:\Users\ceggleton\OneDrive - Woodard & Curran\ PCFolders\Desktop\011078-003 - Cuyama\01 Local Cuyama GIS 20180803\MXDs\Text\HCM\Fig 2_1-1 RegionalGeologicSetting.mxd

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 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 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 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.

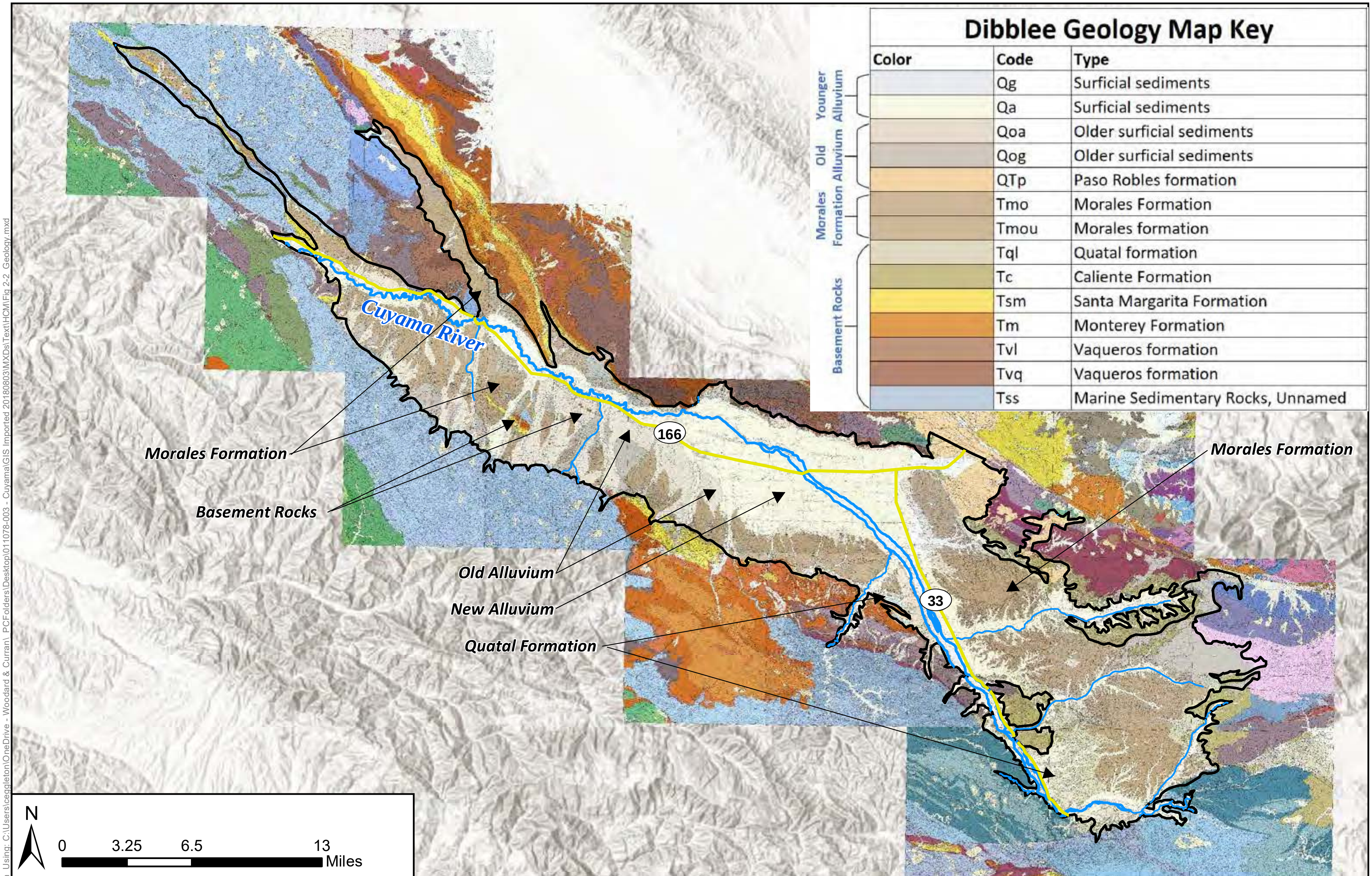


Figure 2-2: Geologic Map

Cuyama Basin Groundwater Sustainability Agency

Cuyama Valley Groundwater Basin Groundwater Sustainability Plan

December 2019

WOODARD & CURRAN

Legend

- Cuyama Basin
- Cuyama River
- Streams
- Highways

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

Figure Exported: 8/21/2018 By: ceggleton Using: C:\Users\ceggleton\OneDrive - Woodard & Curran\ PCFolders\Desktop\011078-003 - Cuyama\GIS Imported 20180803\MXDs\Text\HCM\Fig 2-2_Geology.mxd

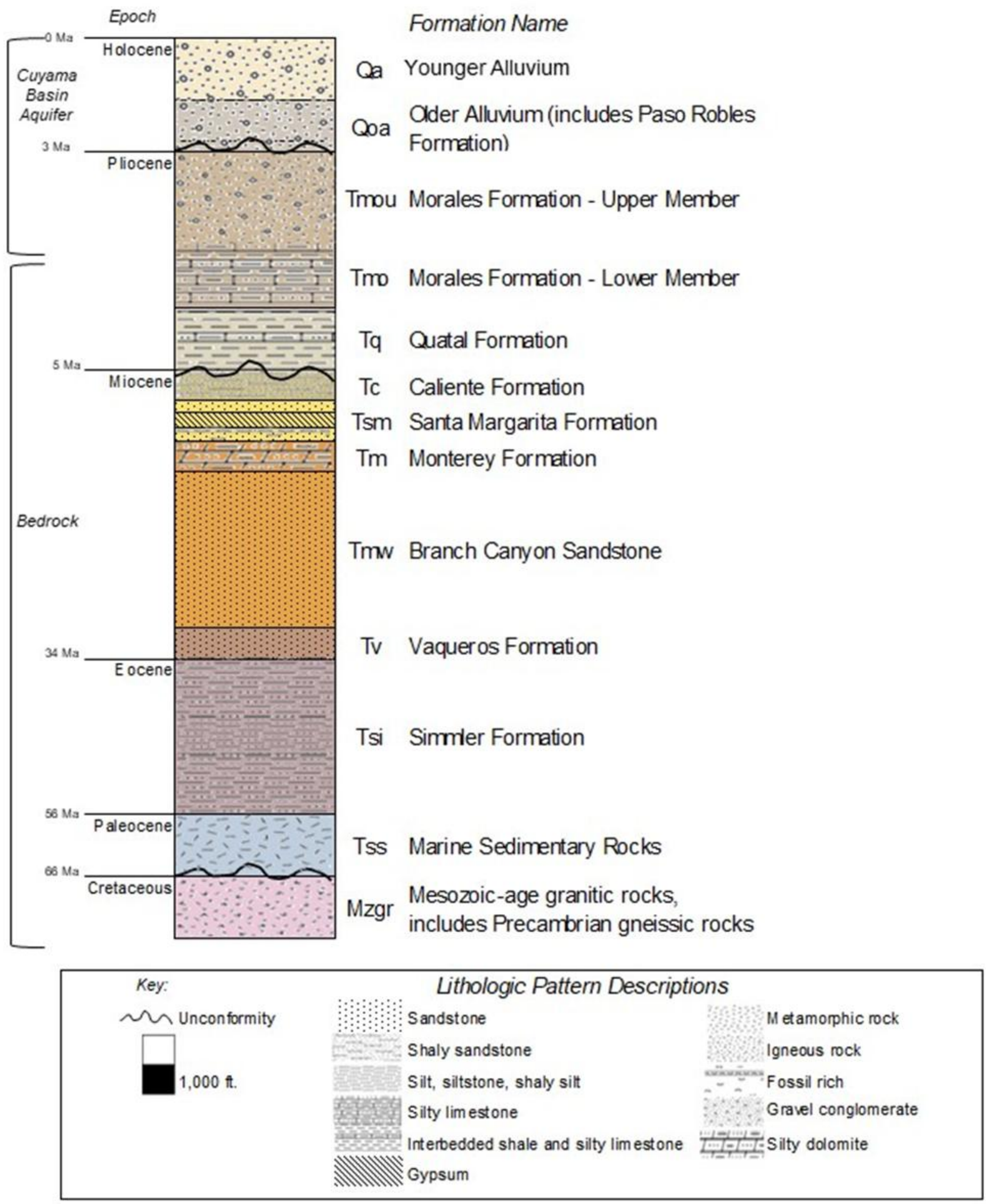
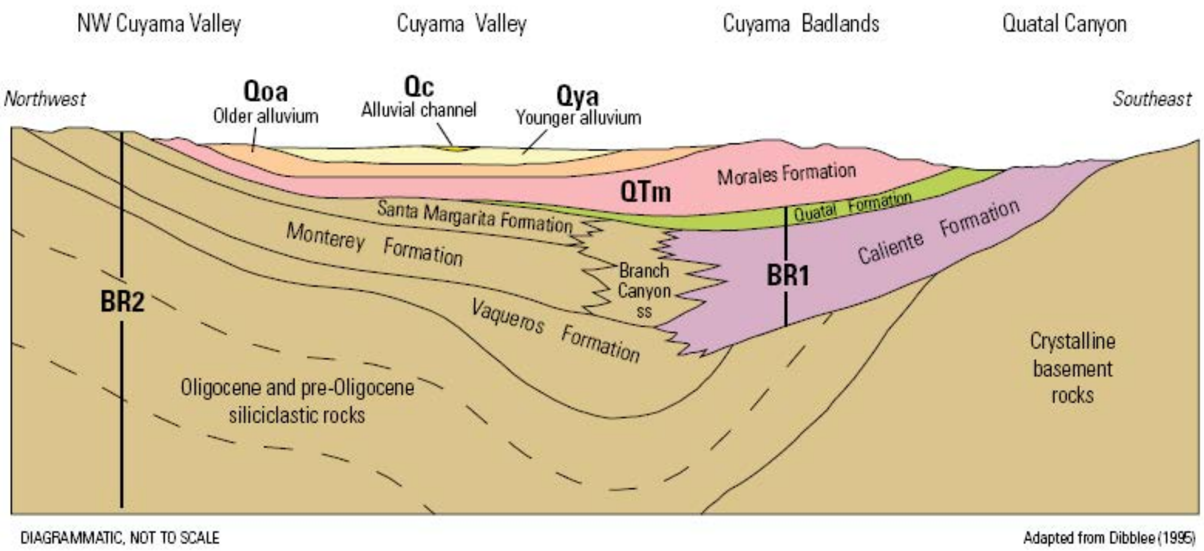


Figure 2-3: Generalized Stratigraphic Column of the Cuyama Valley

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 (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.



Source: USGS, 2013a.

Figure 2-4: Generalized Stratigraphic Diagram

Recent and Younger Alluvium

The youngest deposit in the Basin is the Recent and Young Alluvium. 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 ranging 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 to possibly as much as 1,100 feet in the east (Singer and Swarzenski, 1970). Recent and Younger Alluvium are primarily Holocene in age, but the Younger Alluvium can date back to the Pleistocene (USGS, 2013c).

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 Alluvium.

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 Alluvium deposits and contain a higher clay content. The Older Alluvium 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 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). The 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 (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 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 in the eastern half of the Valley, along the Basin edge in the Caliente Range and in a footwall block of the Pine Mountain 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 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 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).

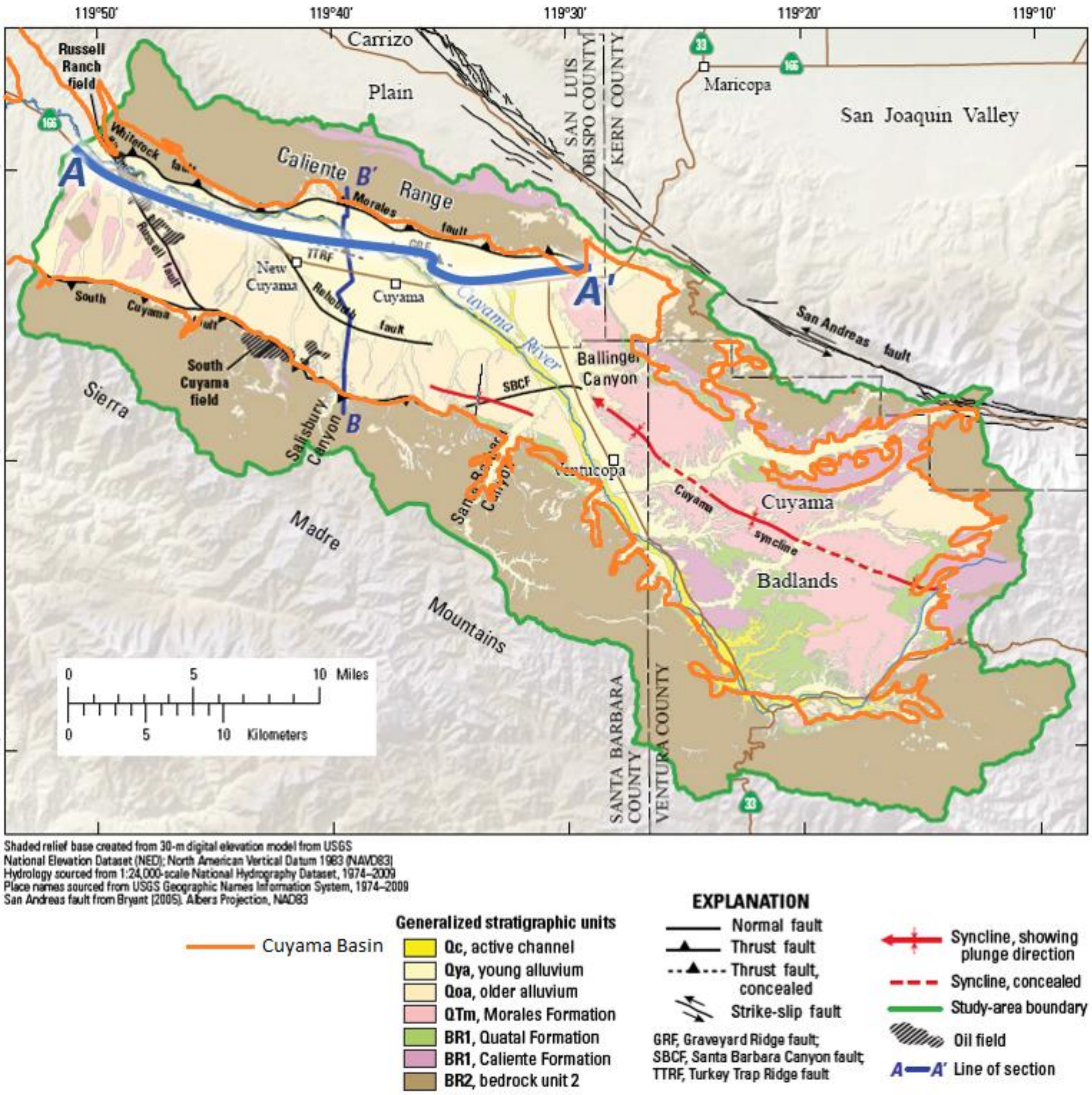
Marine Sedimentary Rocks

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 Madre ranges and the hanging walls of the South Cuyama, La Panza, and Ozena faults (Davis et al., 1988).

Formations Older than Marine Sedimentary Rocks

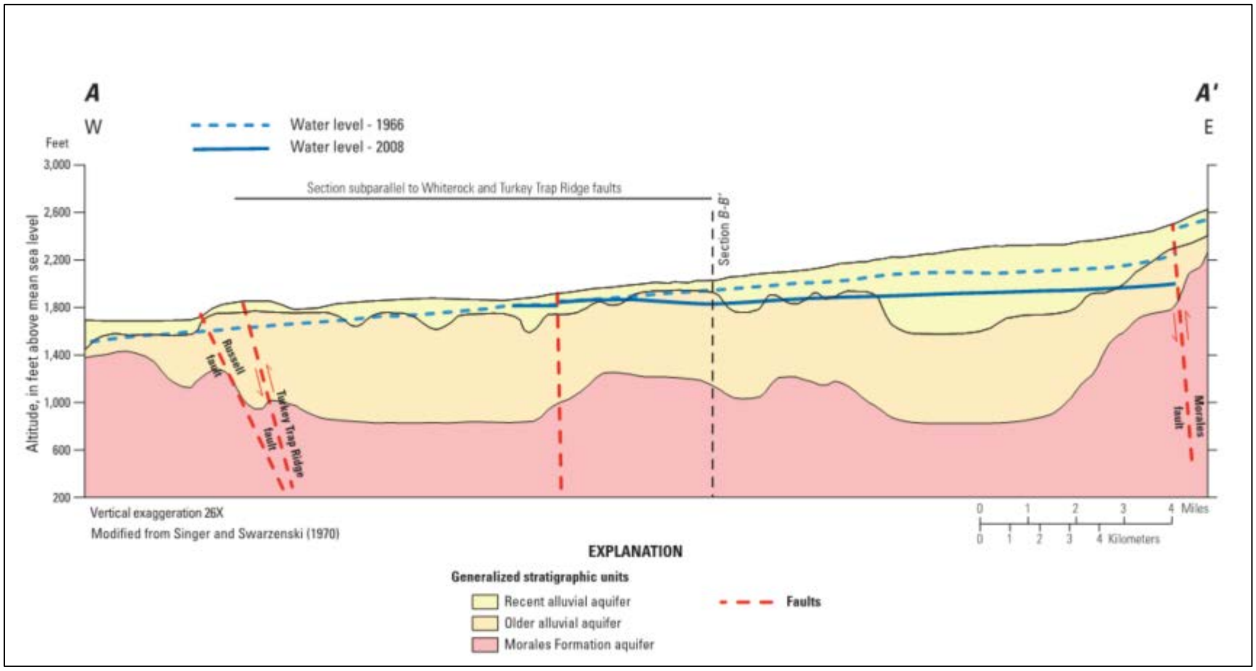
The crystalline rocks of the Cuyama Valley are composed of Mesozoic-age granitic rocks and Precambrian-age gneissic rocks (Davis et al., 1988). Cretaceous granitic rocks are exposed in the La Panza Range and near the San Andreas Fault, 12 to 18 miles southeast of the Cuyama Valley (USGS, 2013b). Precambrian 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 (2013a). 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. Cross section B-B' shows layering of the aquifers and the locations where the Rehoboth and Graveyard Ridge fault cross the cross section.



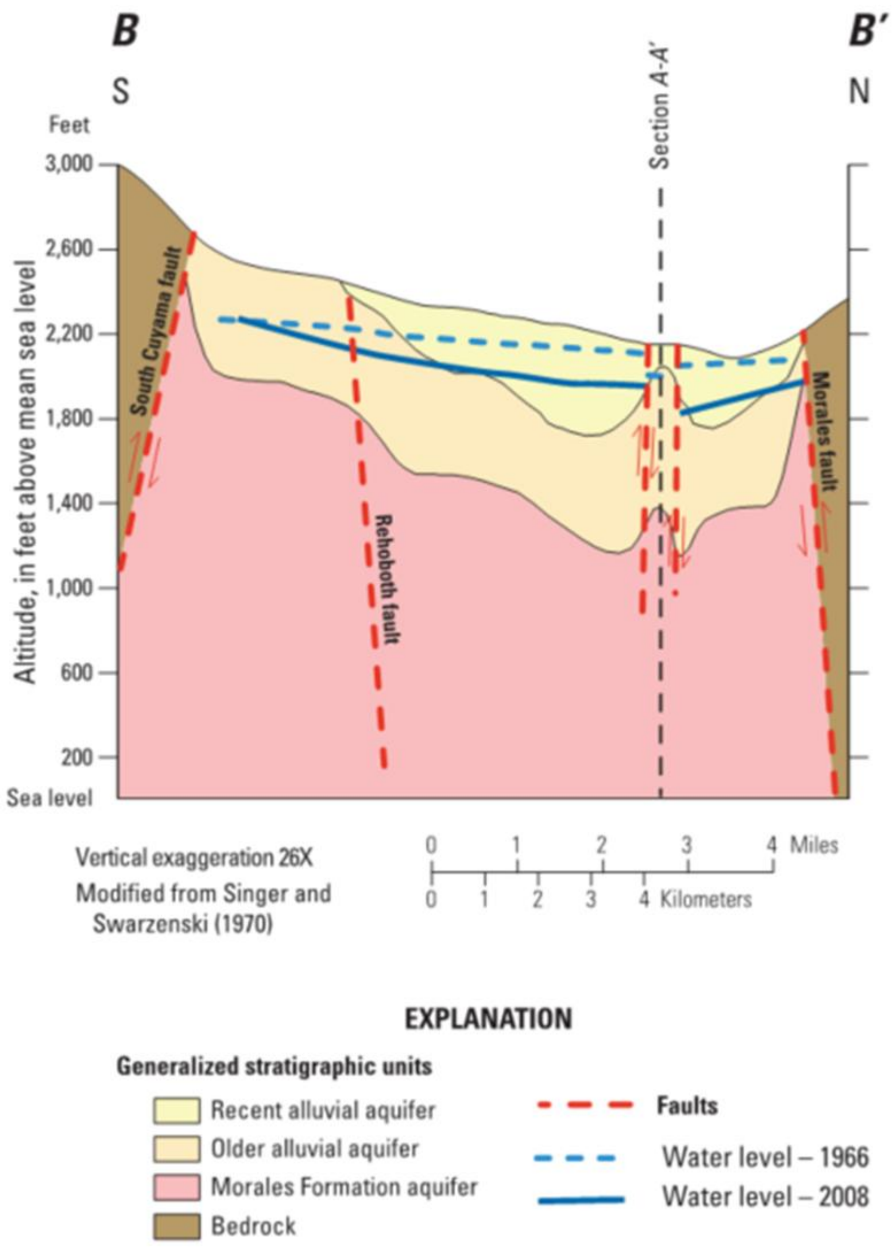
Source: USGS, 2015.

Figure 2-5: Location of USGS 2015 Cross Sections



Source: USGS, 2015

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



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. Outcrops of basement rocks are shown on available geologic maps (and 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 (N50ºW) and plunges to the northwest (13ºNW) (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, a 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.

Syncline in the Southwestern 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 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 Faults in the area, as mapped by 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 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). The NW-striking 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 fault in the same document (USGS, 2013a). Water bearing units on the western (upthrown) side of the Russell Fault become thinner to the west and become thicker to the east 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" (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). 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 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 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, 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).

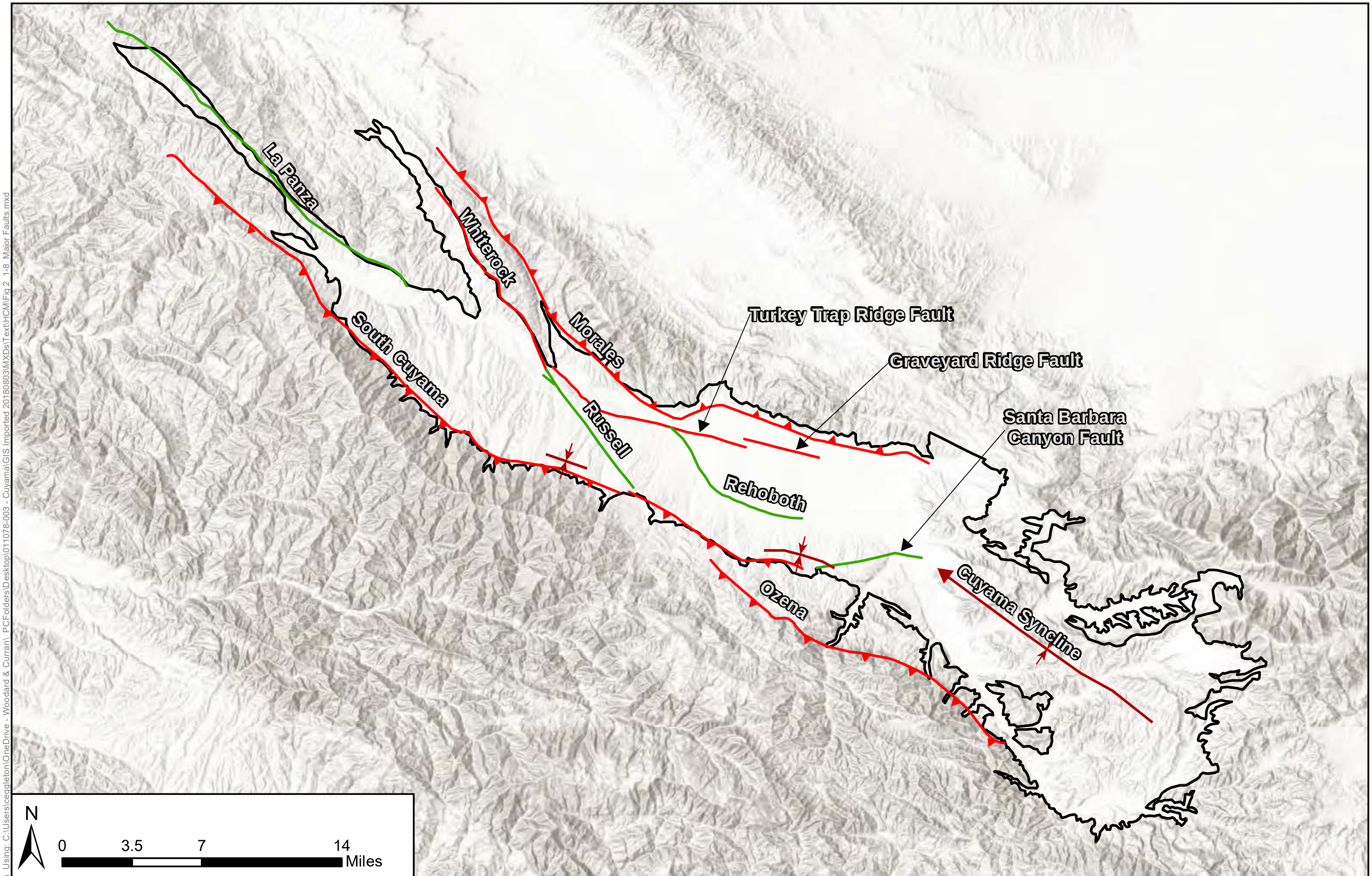


Figure 2-8: Major Faults

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Legend

Fault Types

- Normal
- Syncline
- Thrust
- Thrust Fault, Concealed

Cuyama Basin

Rehoboth Fault

The Rehoboth Fault is a normal, subsurface fault that bisects the central portion of the Basin. The fault is approximately 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 Fault ceased prior to the deposition of the Older and Younger Alluvium (USGS, 2013a).

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

Whiterock Fault

The Whiterock 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 buried (Calhoun, 1985). The fault dips northeast and is late Oligocene to early Miocene in age (Davis et al., 1988). The Whiterock 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 Fault and tectonically overrides the Russell Fault (Nevins, 1982; Calhoun, 1985). The fault cuts the Morales Formation south of the Cuyama River but does not affect the Younger or Older Alluvium (DeLong et al., 2011; Nevins, 1982).

Turkey Trap Ridge Fault and Graveyard Ridge Fault

The Turkey Trap Ridge Fault and the Graveyard Ridge 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 Fault is 11 miles long and located southwest of the Graveyard Ridge Fault; the Graveyard Ridge Fault is 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).

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

Santa Barbara Canyon Fault

The Santa Barbara Canyon Fault is a normal, subsurface fault with a northeast strike near the opening of the Santa Barbara Canyon. The fault offsets 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). Groundwater elevations in the Ventucopa area have been reported 110 feet higher than water levels to the north (Singer and Swarzenski, 1970). In 2013, the USGS concluded that the Santa Barbara Canyon Fault was a barrier to groundwater flow, "Relatively small amount of vertical offset in the Santa Barbara Canyon 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 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 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.[5] 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 elevations 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. 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.

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[5] 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 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 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, Relased in June 2012, Purchased from AAPG as GeoTIFF 28 March 2018.

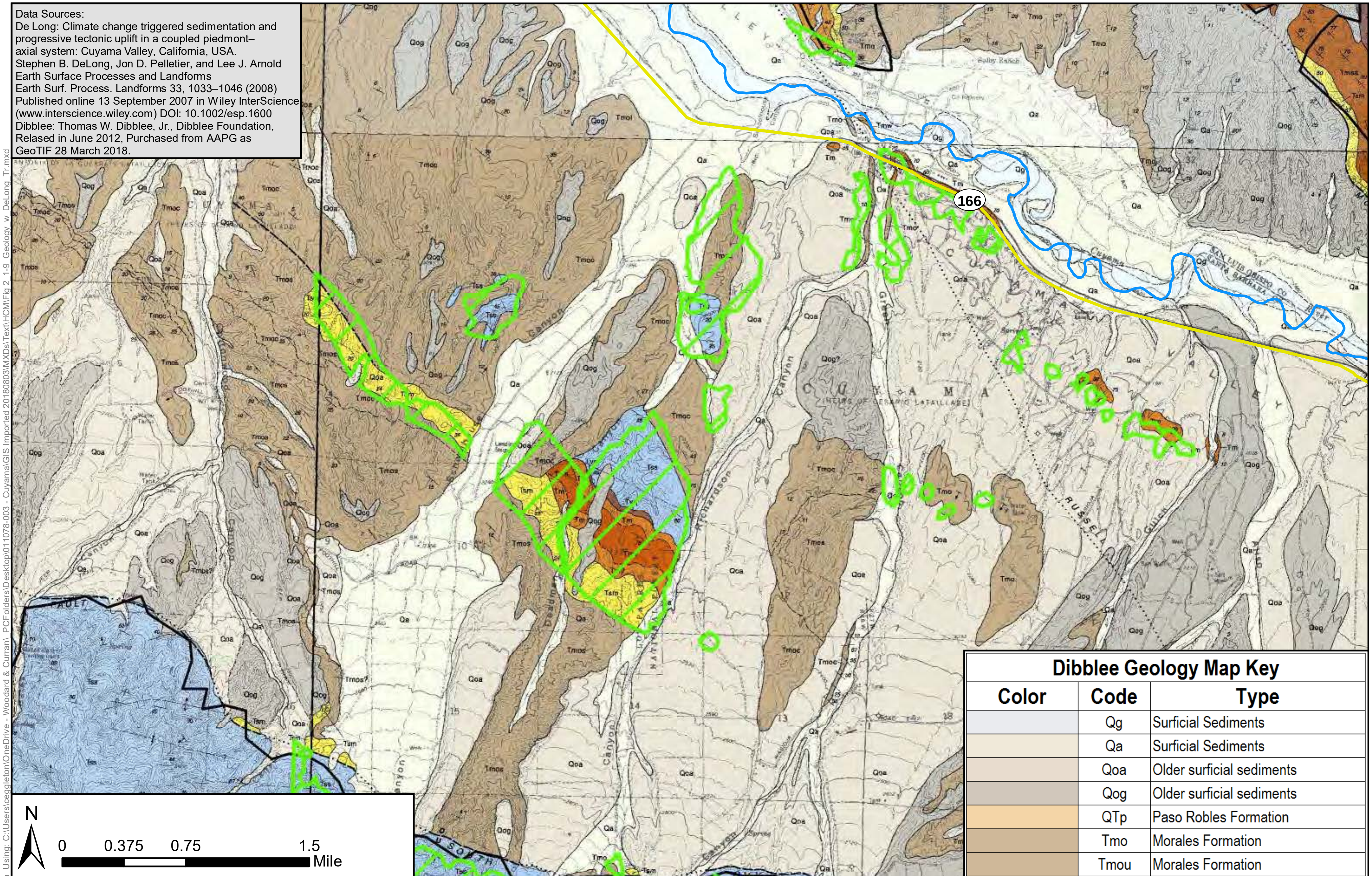

Figure 2-9: Geology with De Long "Tr" Overlay

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December 2019

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Legend

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

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 Exported: 8/21/2018 By: ceggleton Using: C:\Users\ceggleton\OneDrive - Woodard & Curran\PCFolders\Desktop\011078-003 - Cuyama\GIS Imported 20180803\MXDs\Text\HCM\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 flown with one line generally parallel to the Cuyama River and the remaining lines perpendicular to the river valley in order to generate a 3-D cross sectional model of the Basin. Figure 2-10 shows the AEM survey flight lines over the Basin.

The 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 the texture of the subsurface materials (coarse vs fine grained). 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 data and were taken into consideration in refining model layering and hydraulic conductivity. Figure 2-11 shows several flight lines in the southeastern portion of the Basin as red lines on an aerial photograph. The figure also shows the 3-D 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. 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.

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 on Line 2 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 inferred by the USGS. 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 of the transects 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 that prevented the collection of induced polarization on Line 2. 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 in 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 about 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 trusting the older Monterrey Formation over the Lower Morales west of the fault. Groundwater appears to be about 50 feet bgs across the profile. The thickness 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 on Line 1 and Line 2 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.

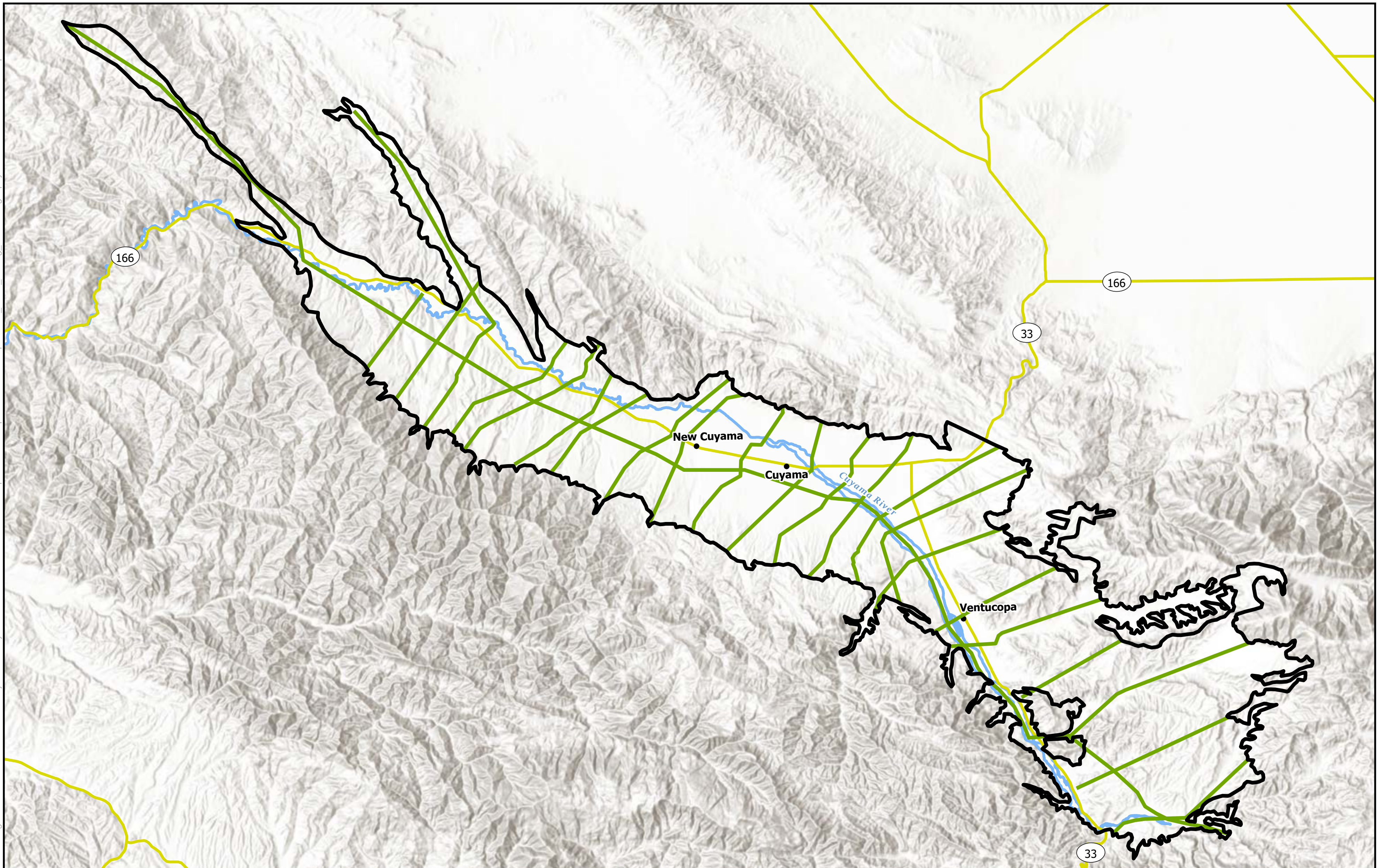


Figure 2-10: Distribution of AEM Flight Lines

Cuyama Valley Groundwater Basin

Legend

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

N

0 1.75 3.5 7 Miles

Map Created: July 2024

Woodard & Curran

Cuyama Basin Groundwater Sustainability Agency

Figure Exported: 7/10/2024 By: ACamille Using: \\woodardcurran.net\shared\Projects\CA Cuyama Basin GSA\0011078.01 GSP\wip\Z_GIS\2_Maps\3_2025 GSP Update\02_Basin_Setting_Overview\geophysical\AEM lines\AEMlines.aprx

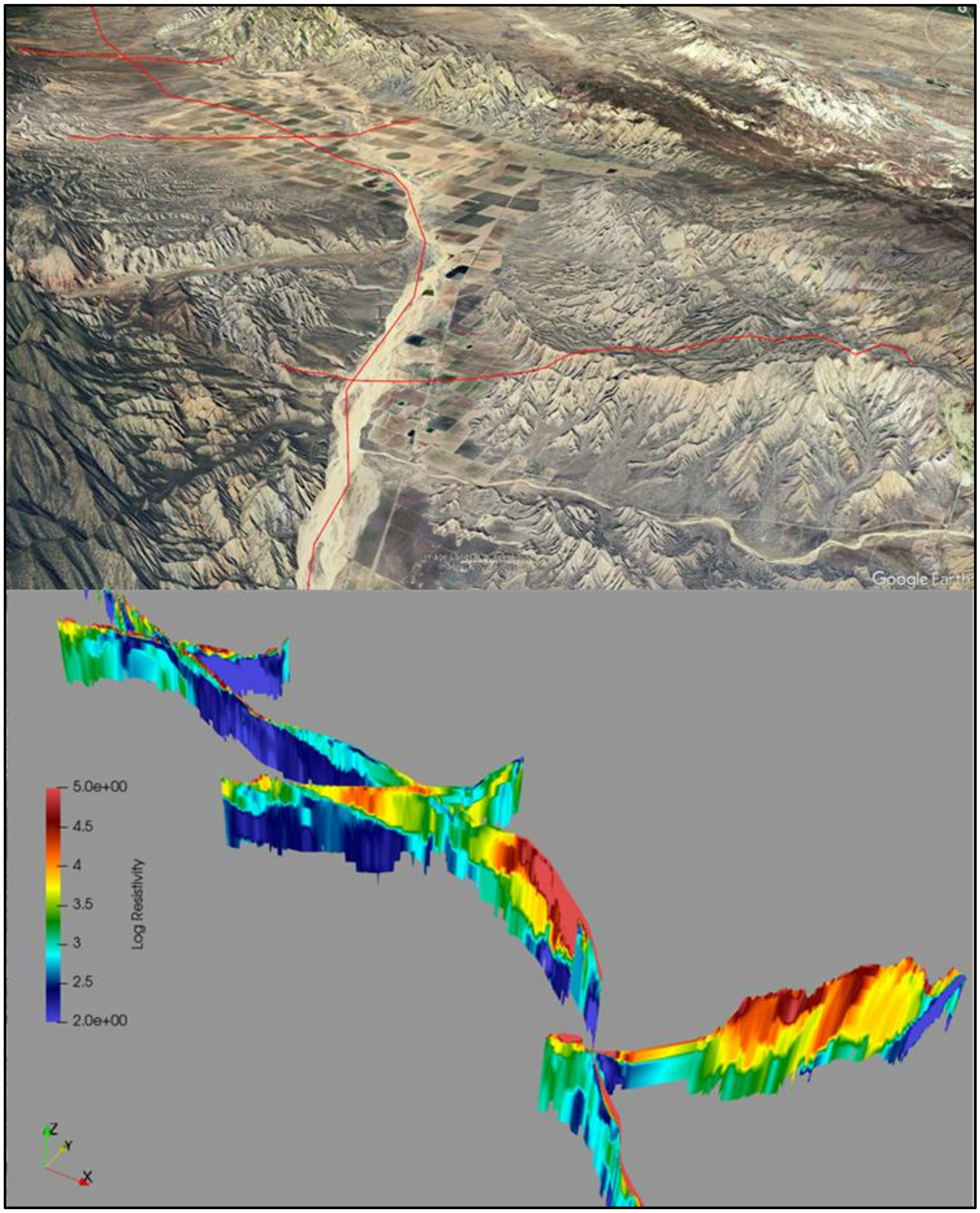


Figure 2-11: DWR AEM Survey Transect

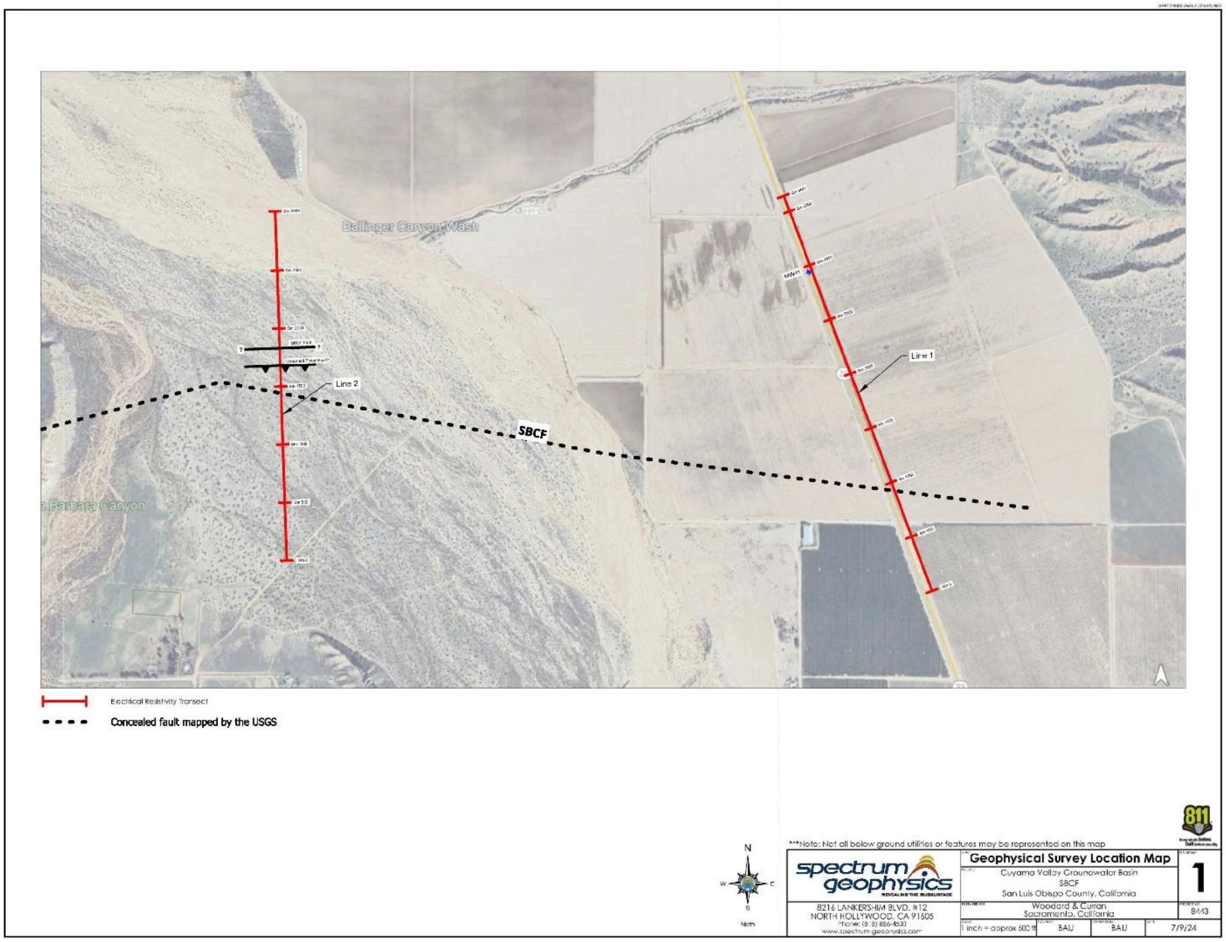


Figure 2-12: Location of Transects for Santa Barbara Canyon Fault

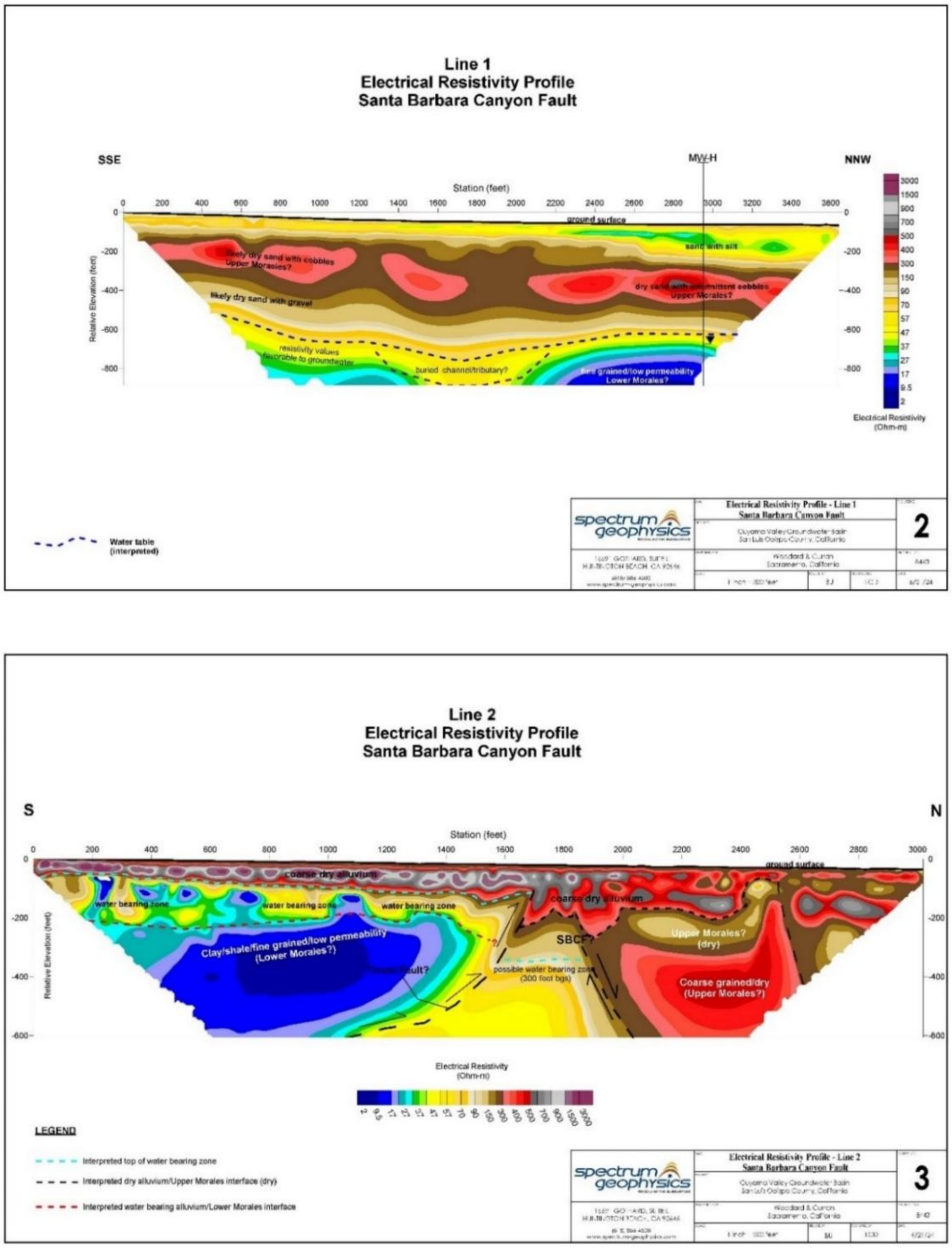
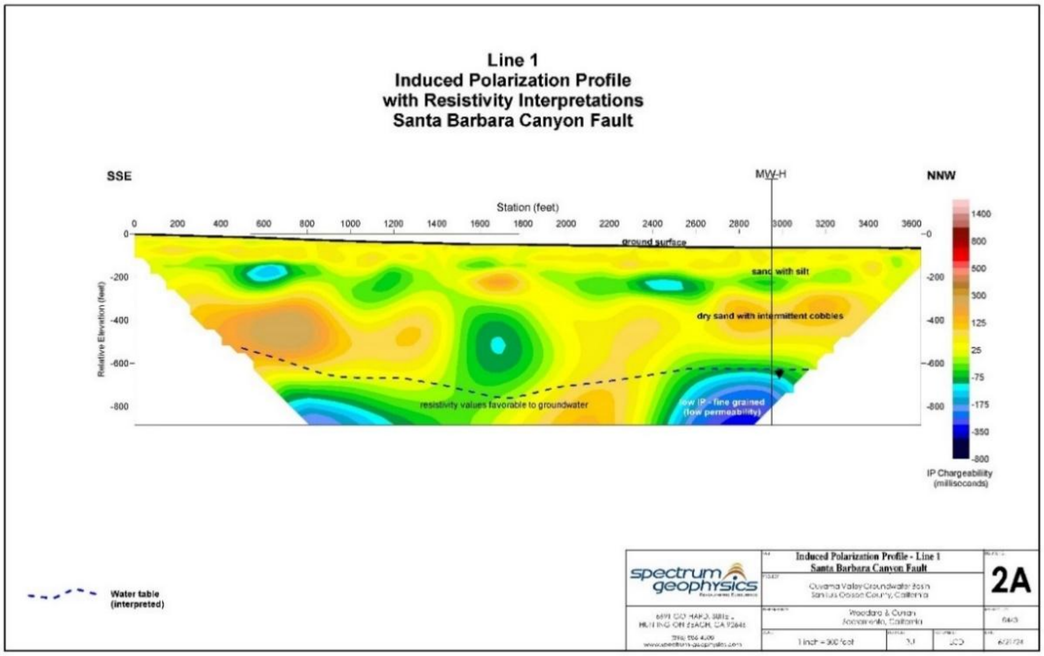


Figure 2-13: Resistivity Profiles for Santa Barbara Canyon Fault



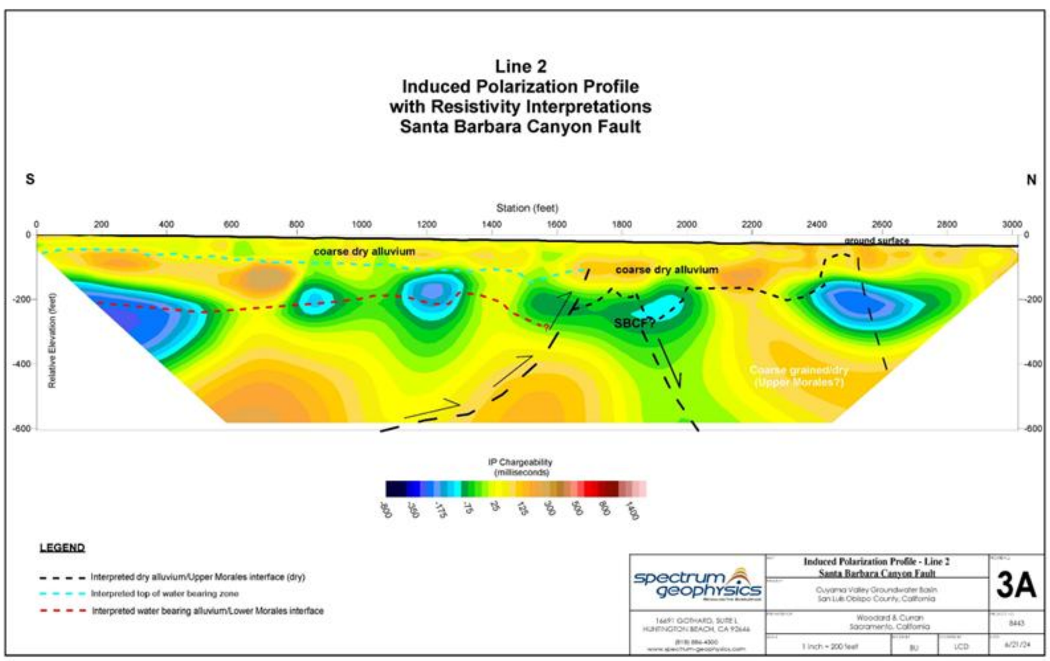


Figure 2-14: Induced Polarization Profiles for Santa Barbara Canyon Fault

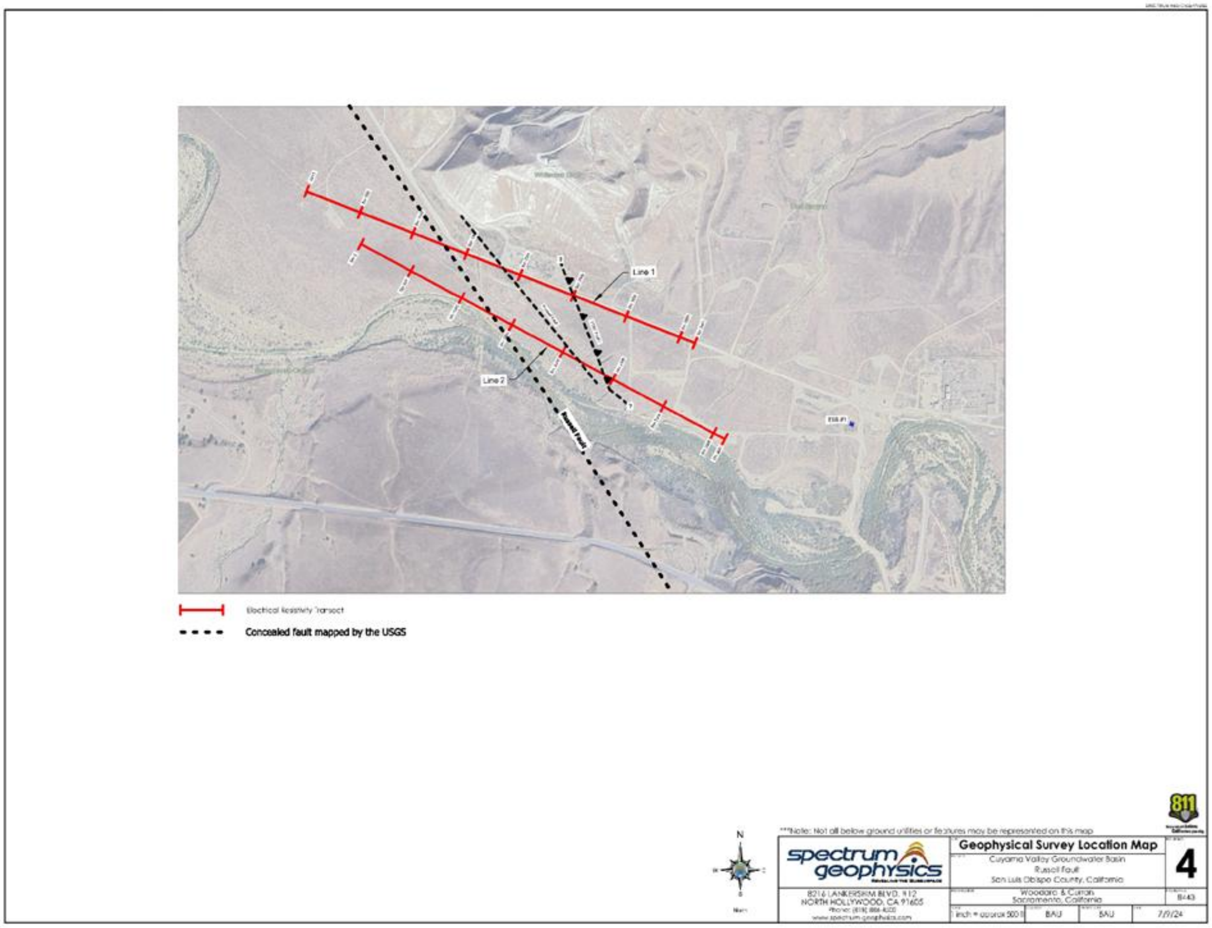


Figure 2-15: Location of Transects for Russell Fault

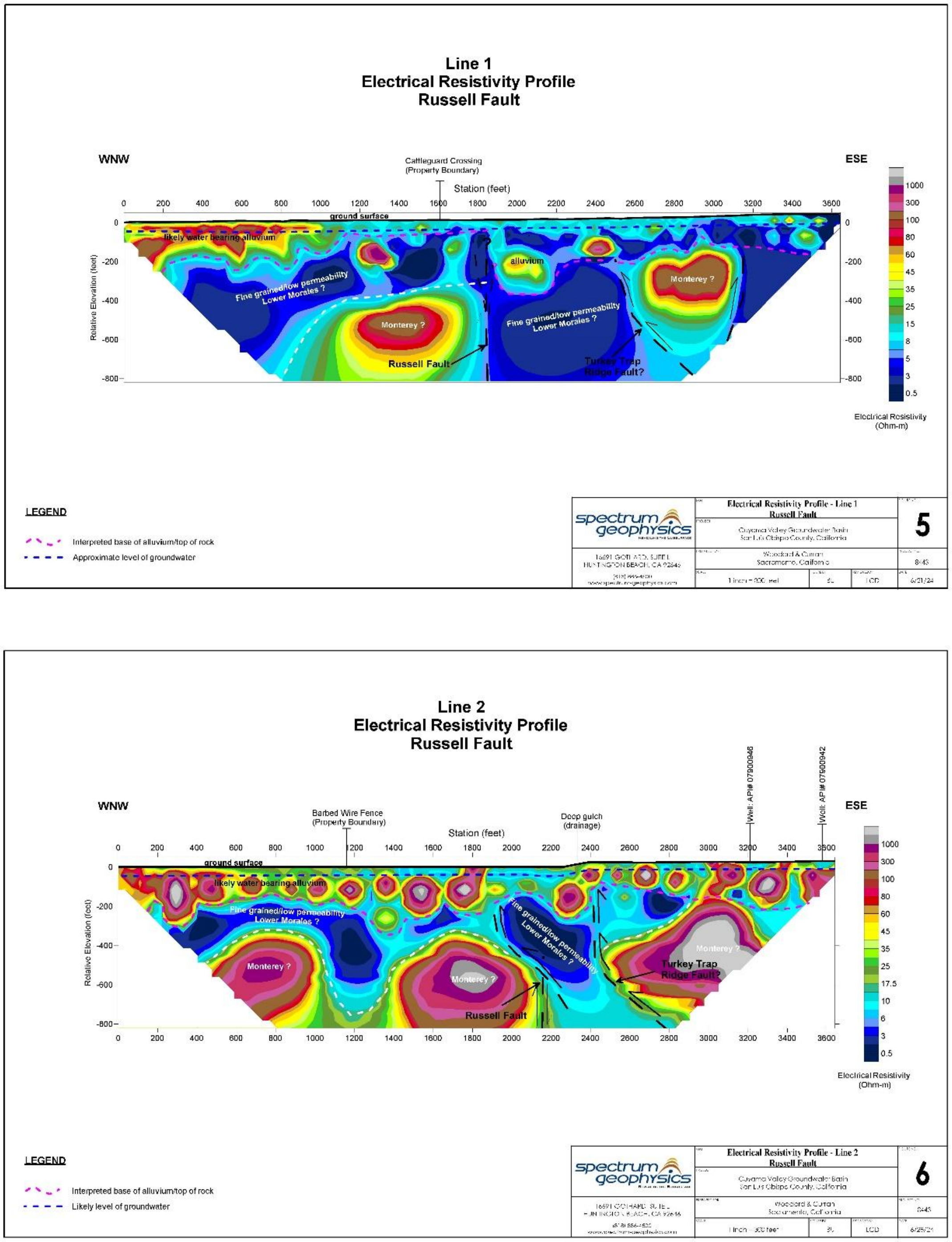


Figure 2-16: Resistivity Profiles for Russell Fault

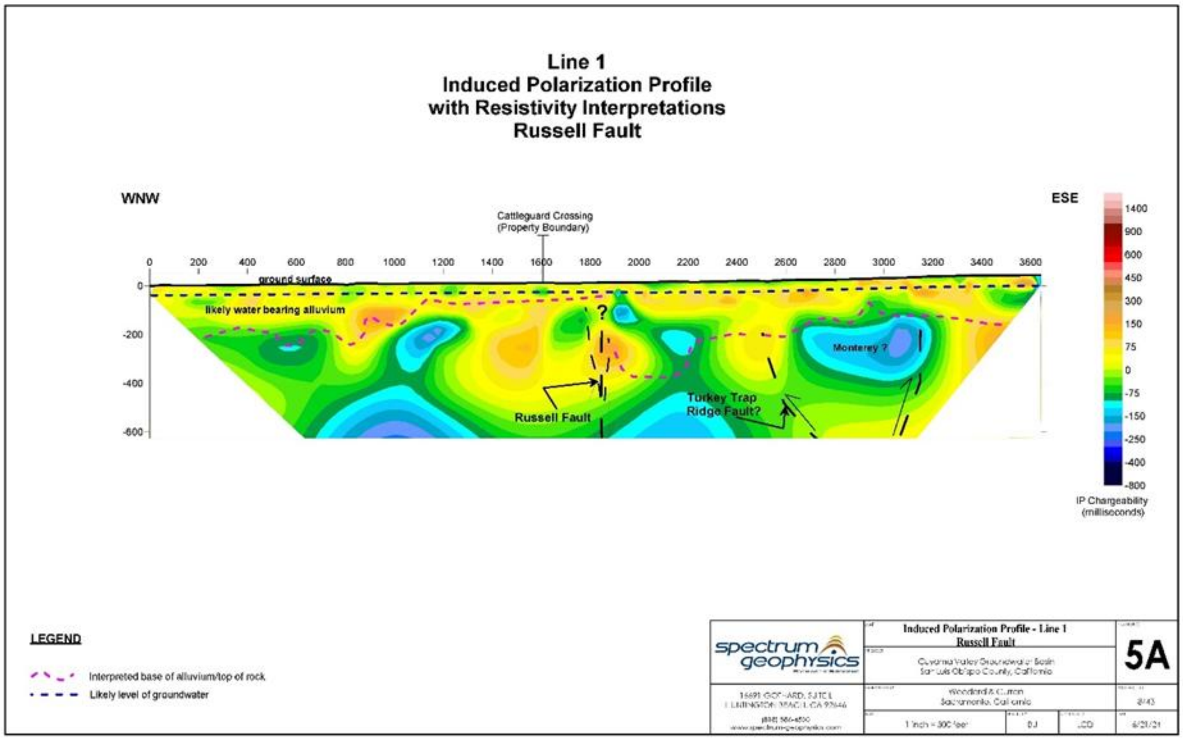


Figure 2-17: Induced Polarization Profile for Russel Fault

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. The Cuyama and Carrizo Plain basins share a 4-mile boundary along the Caliente Range, 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 share less than 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, 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. 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 Younger and Older Alluvium. 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 that is released too slowly or of quality that is too poor for domestic and irrigation uses (USGS, 2013a).

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 Alluvium 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 Younger 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). 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). 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. 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:

- Three multi-completion USGS wells (USGS, 2013c)
- 51 PG&E wells (USGS, 2013c)
- 66 private landowner wells in the central portion of the Basin
- 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 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 *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 USGS study (2011). The CUVHM characterizes the Recent and Younger Alluvium as having the highest hydraulic conductivity of the three aquifer formations (USGS, 2015). Hydraulic conductivity values calculated from field tests are used to characterize these aquifer formation, as described below and summarized in Table 2-1.

Recent and Younger Alluvium

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 32feet per day with a median value of about 10 feet per day. Wells screened in both the Younger and Older Alluvium in the central portion of the Basin had a comparable median value. Field tests are lower than those reported by the USGS (2015). For the Recent and Younger Alluvium, the range is about5 to 85 feet per day (USGS, 2015). Within the Recent and Younger Alluvium, the highest horizontal conductivity estimates are at wells constructed near the Cuyama River. Calculations of vertical hydraulic conductivity range from 0.2 feet per day in tributaries crossing the Alluvium in areas west of the Russell Fault up to 49 feet per day 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 up to about 81 feet per day, with a median hydraulic conductivity of 16 feet per day. Field tests are also higher than those reported by the USGS (2015 and 2011) that range from 0.3 to 28 feet per day. West of the Russell Fault, near the vineyards, hydraulic conductivity reportedly ranges from about 0.8 to 1.8 feet per day with a median value of 1.2 feet per day. Field data show that 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. Estimates range up to 61 feet per day with a median value of 21 feet per day.

Morales Formation

The Upper Morales Formation has the lowest hydraulic conductivity of the aquifer units. In the central portion of the Basin, the hydraulic conductivity at wells only screened in the Morales Formation ranges from 1.6 to 10 feet per day, with a median value of 3.2 feet per day. Two wells were interpreted to be screened only in the Morales Formation west of the Russell Fault. The hydraulic conductivity for these wells ranges from 1.6 to 2 feet per day. The hydraulic conductivity of the Upper Morales Formation decreases with depth. The highest values of hydraulic conductivity in the Morales Formation occur in the central portion of the 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
Private Landowners, Southeast Portion of the Basin[c]	1	Younger Alluvium and Older Alluvium	145 - 407	278

Notes:
[a]Three well locations with four completions each; each well completion is reported as a single well (12 total).
[b]Conductivity estimated using estimates of transmissivity from field tests.
[c]Conductivity estimated using estimates of specific capacity from 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 that applies only to unconfined aquifers, which is the primary aquifer in the Cuyama Basin.[6] The 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. The Recent and Younger Alluvium had the lowest specific yield ranging from 0.02 to 0.14, the Older Alluvium had a slightly higher range of 0.05 to 0.19, and the Morales Formation had 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 of the aquifer varies laterally and vertically but is typically highest in the Younger Alluvium and lowest in the Morales Formation. Wells screened in the Younger Alluvium have a median specific capacity of 60 gallons per minute (gpm) per foot (USGS, 2013c). Wells screened in both the Younger and Older alluvium have a lower median specific capacity of 40 gpm per foot. Wells 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; specific capacities are less in the western portion of the Basin compared to the eastern portion. However, a greater percentage of wells in the western portion are 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 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).

Transmissivity

DWR defines transmissivity as the "aquifer's ability to transmit groundwater through its entire saturated thickness" (DWR, 2003). Using aquifer tests 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 lower than the Younger Alluvium wells, with a median value of 5,000 gpd/foot (USGS, 2013c). Wells screened in both the Younger and Older Alluvium had a median transmissivity of 11,300 gpd/foot (USGS, 2013c). Estimates of transmissivity from two wells screened in both the Older Alluvium and Morales Formation averaged

[6] For confined aquifers, the measurement of "storativity" is used instead of specific yield.

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 are more variable than transmissivity values for the Younger and Older Alluvium. In general, values of transmissivity are highest in the central portion of the Basin and decline to the west as the thicknesses of the Younger and Older Alluvium decreases.

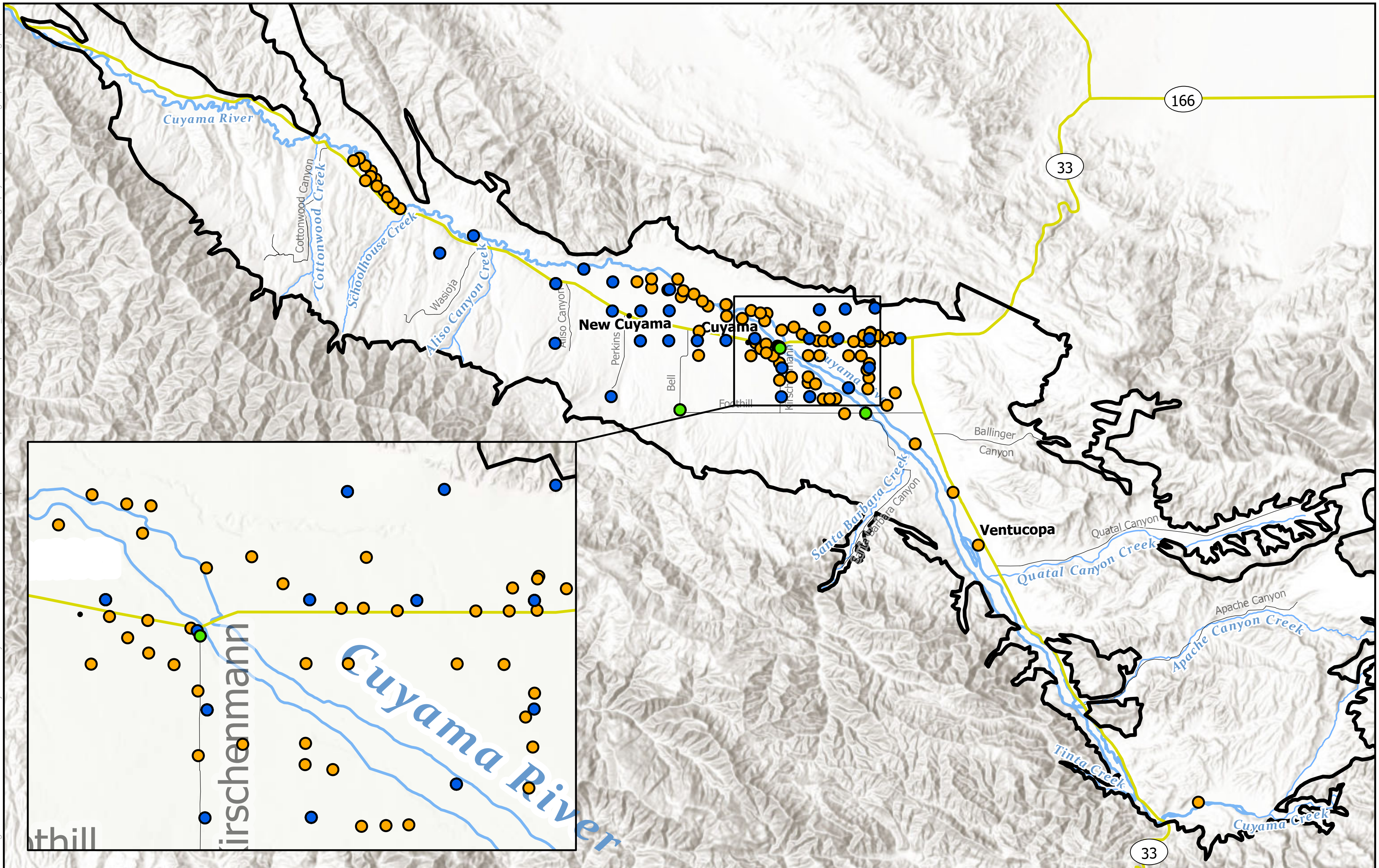


Figure 2-18: Location of Aquifer Testing Wells

Cuyama Valley Groundwater Basin

Legend

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

N

0 1.25 2.5 5 Miles

Map Created: March 2024

Figure Exported: 3/13/2024 By: DHunt Using: \\woodardcurran.net\shared\Projects\CA Cuyama Basin\1078.01 GSP\wip\Z_GIS\2_Maps\3_2025 GSP Update\02_Basin_Setting_Overview\geophysical\aquifer testing\aquifer testing.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, PGE, USGS**

2.1.8 Natural Water Quality Characterization

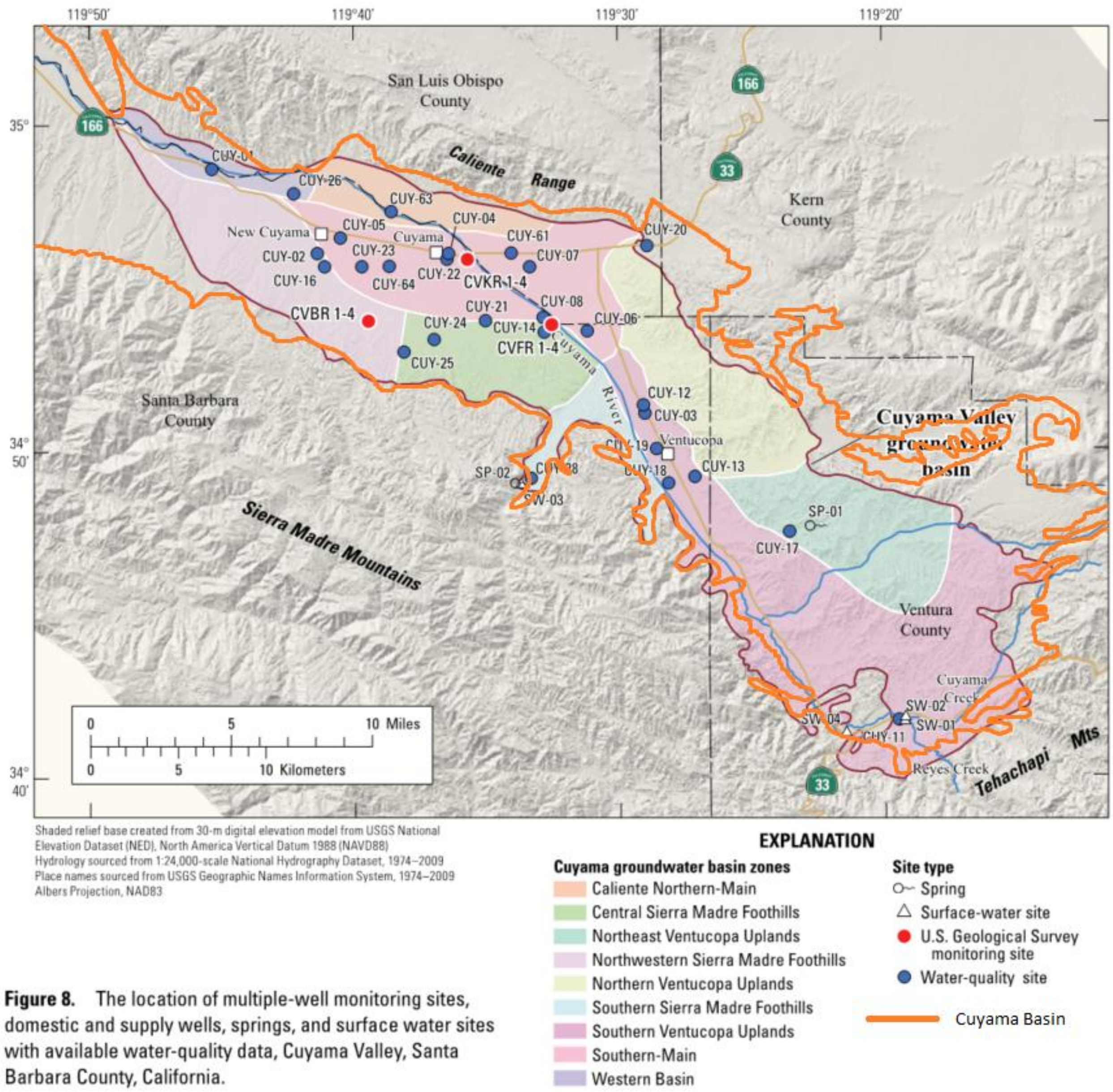
Water quality in the Basin has historically had a high level of TDS and sulfates. High concentrations of other constituents, such as nitrate, arsenic, sodium, boron, and hexavalent chromium are localized (USGS, 2013c). Locations where water quality measurements were taken by the USGS are shown in Figure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

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 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.



Source: USGS, 2013c.

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

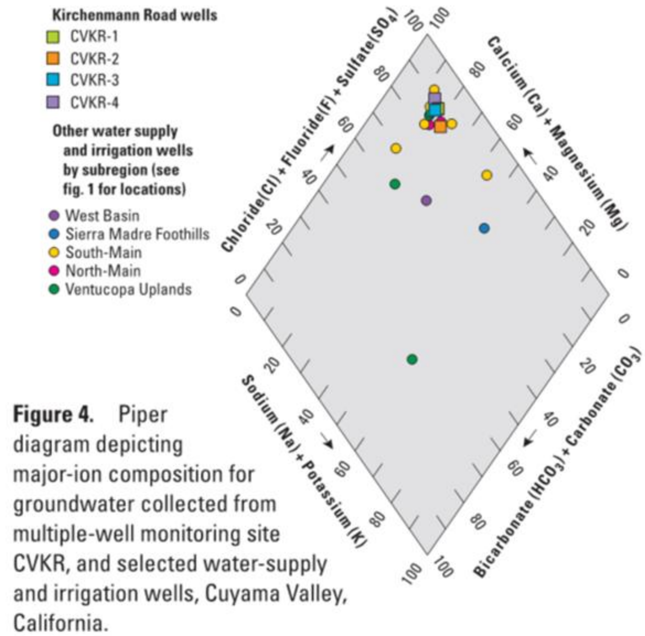


Figure 2-20: Piper Diagram for Well CVKR1-4

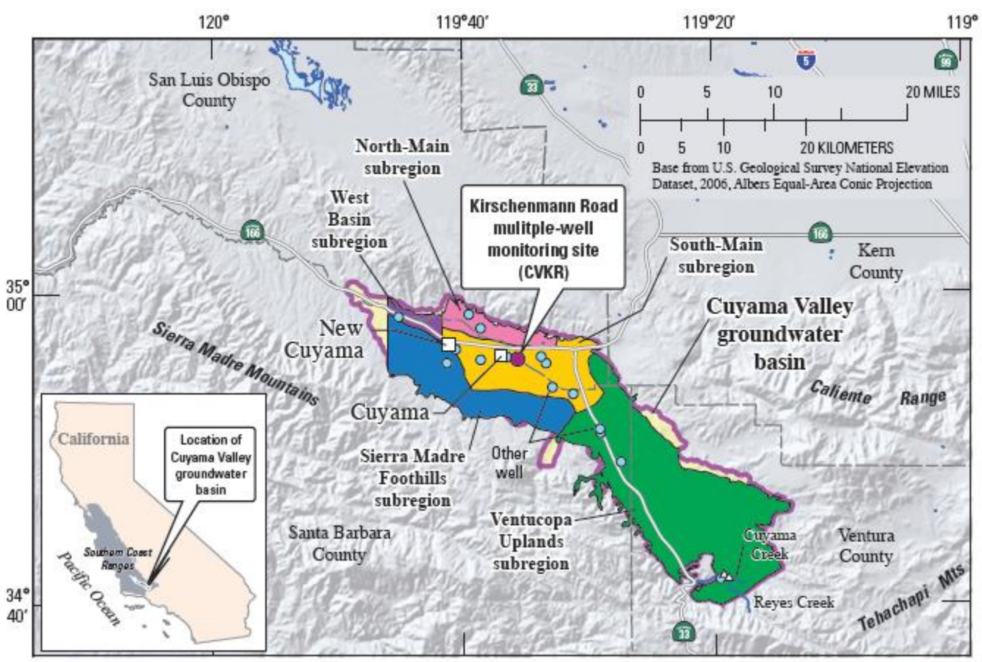


Figure 2-21: Location Map for Samples Used in Figure 2-20

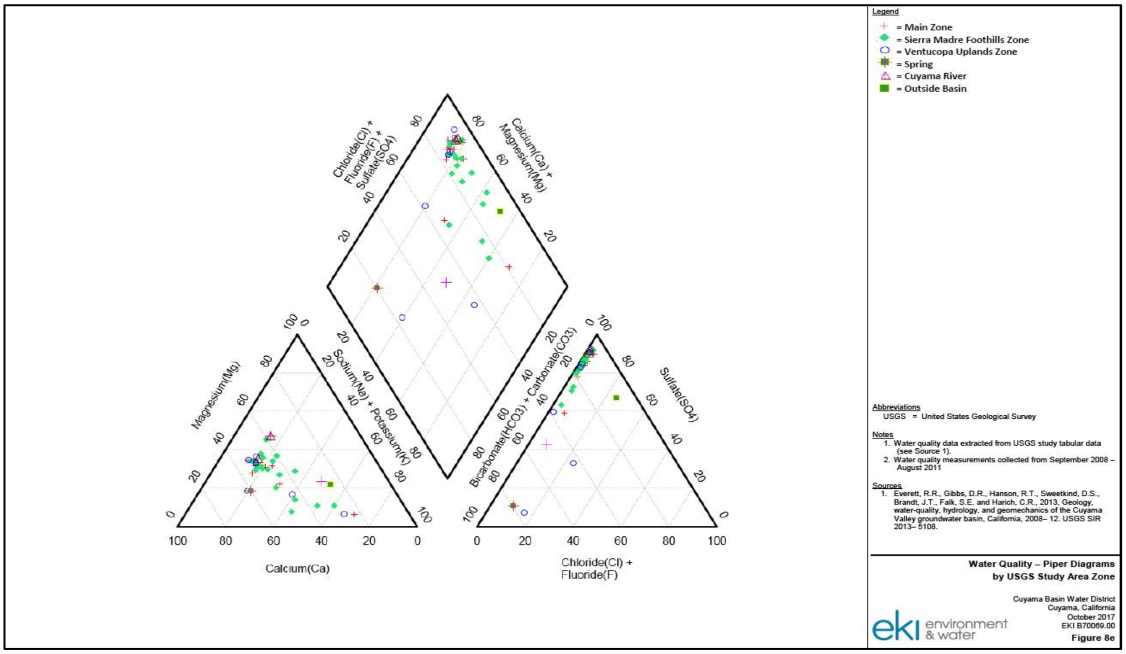


Figure 2-22: Piper Diagram of USGS 2013 Water Quality Sampling

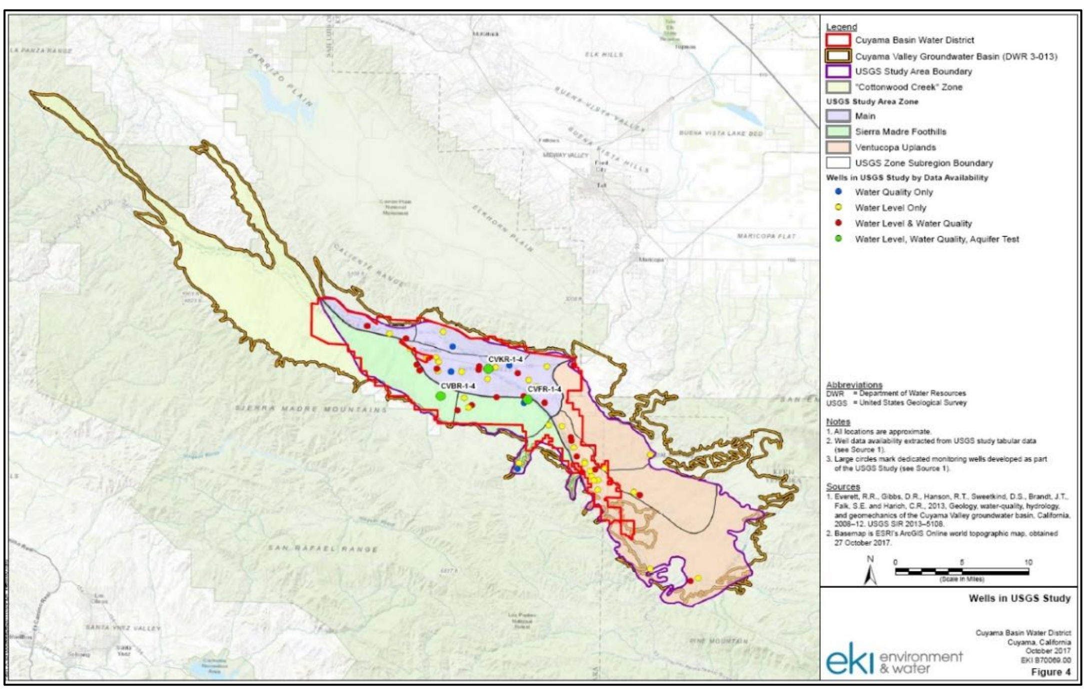


Figure 2-23: Location Map of USGS 2013 Sampling

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.

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 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 2023, 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.

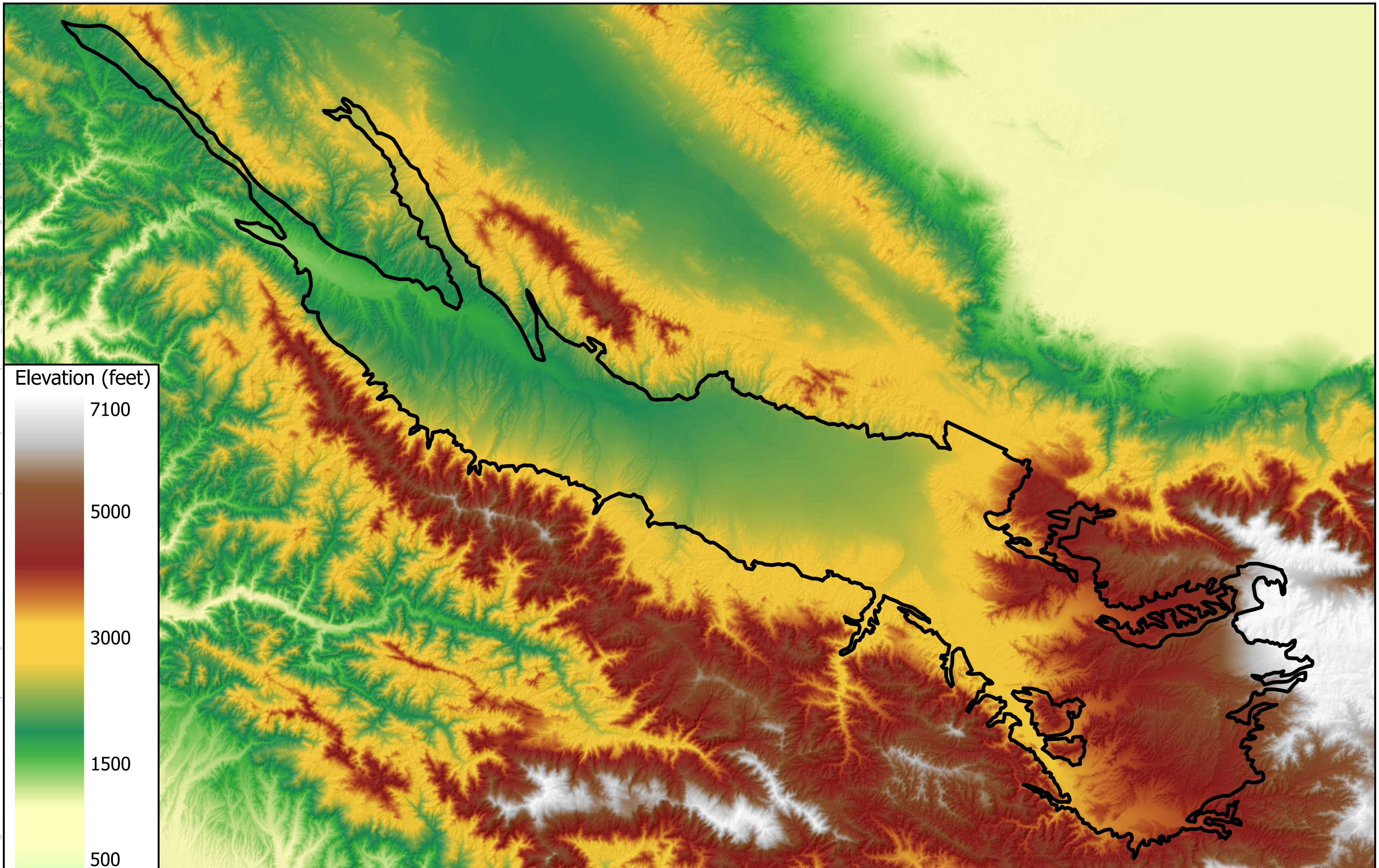


Figure 2-24: Topography

Cuyama Valley
Groundwater Basin

Legend

Cuyama Basin

N

0 1.75 3.5 7 Miles

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Cuyama Basin Groundwater Sustainability Agency

Map Created: February 2024

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Any reliance upon the map or data contained herein shall be at the users' sole risk. **Data sources: CA DWR, Esri, USGS**

Figure Exported: 2/14/2024 By: DHunt Using: \\woodardcurran.net\shared\Projects\CA Cuyama Basin GSA\0011078.01 GSP\wip\Z_GIS\2_Maps\2025 GSP Update\02_Basin_Setting_Overview\geophysical\topology\topology.aprx

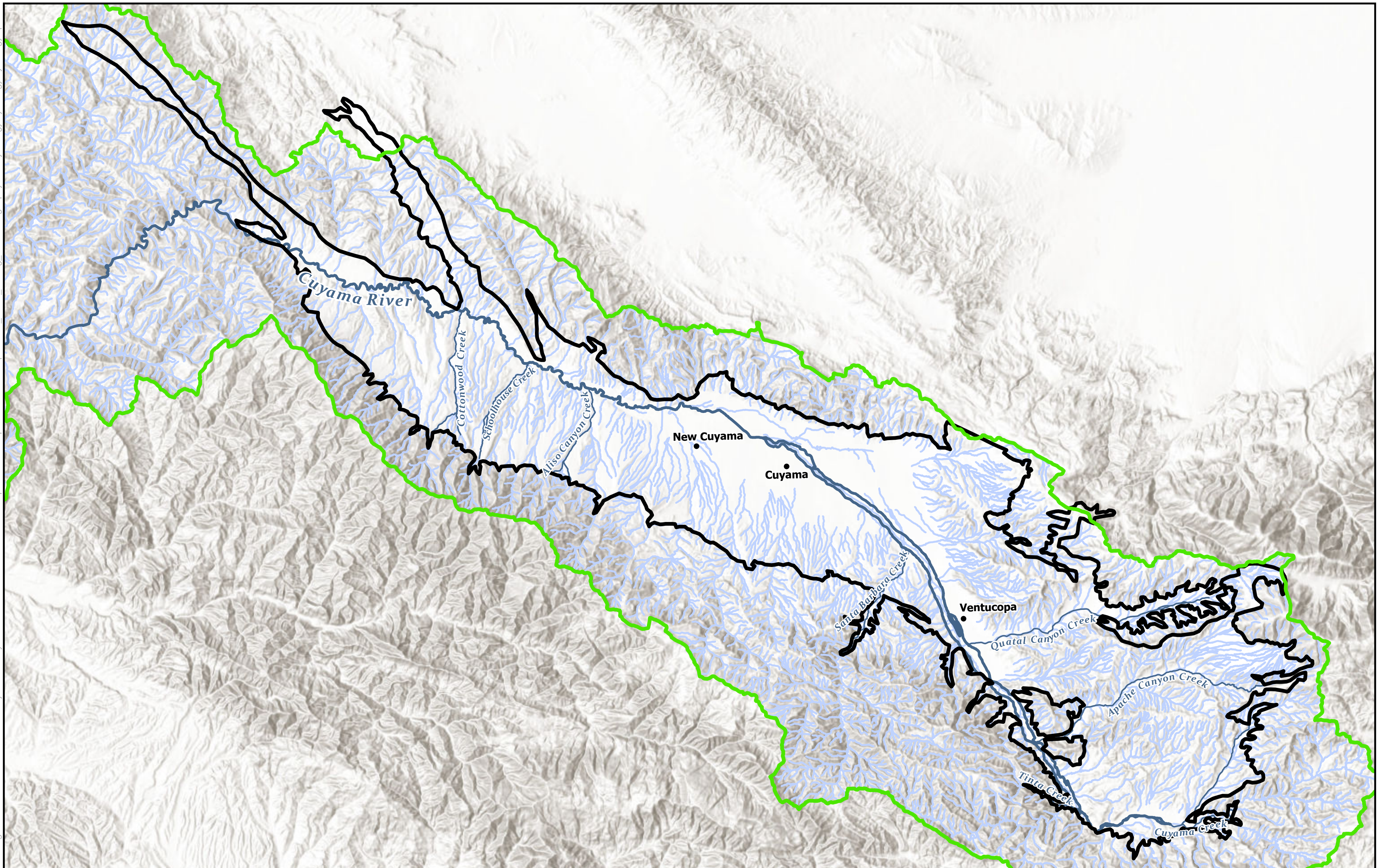

Figure 2-25: Surface Water

Cuyama Valley Groundwater Basin

Legend

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

N

0 1.75 3.5 7 Miles

Map Created: April 2024

Figure Exported: 4/30/2024 By: DHunt Using: \\woodardcurran.net\shared\Projects\CA Cuyama Basin GSA\0011078.01 GSP\wip\Z_GIS\2_Maps\3_2025 GSP Update\02_Basin_Setting_Overview\geophysical\hydrology\hydrology.aprx

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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 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 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.

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.

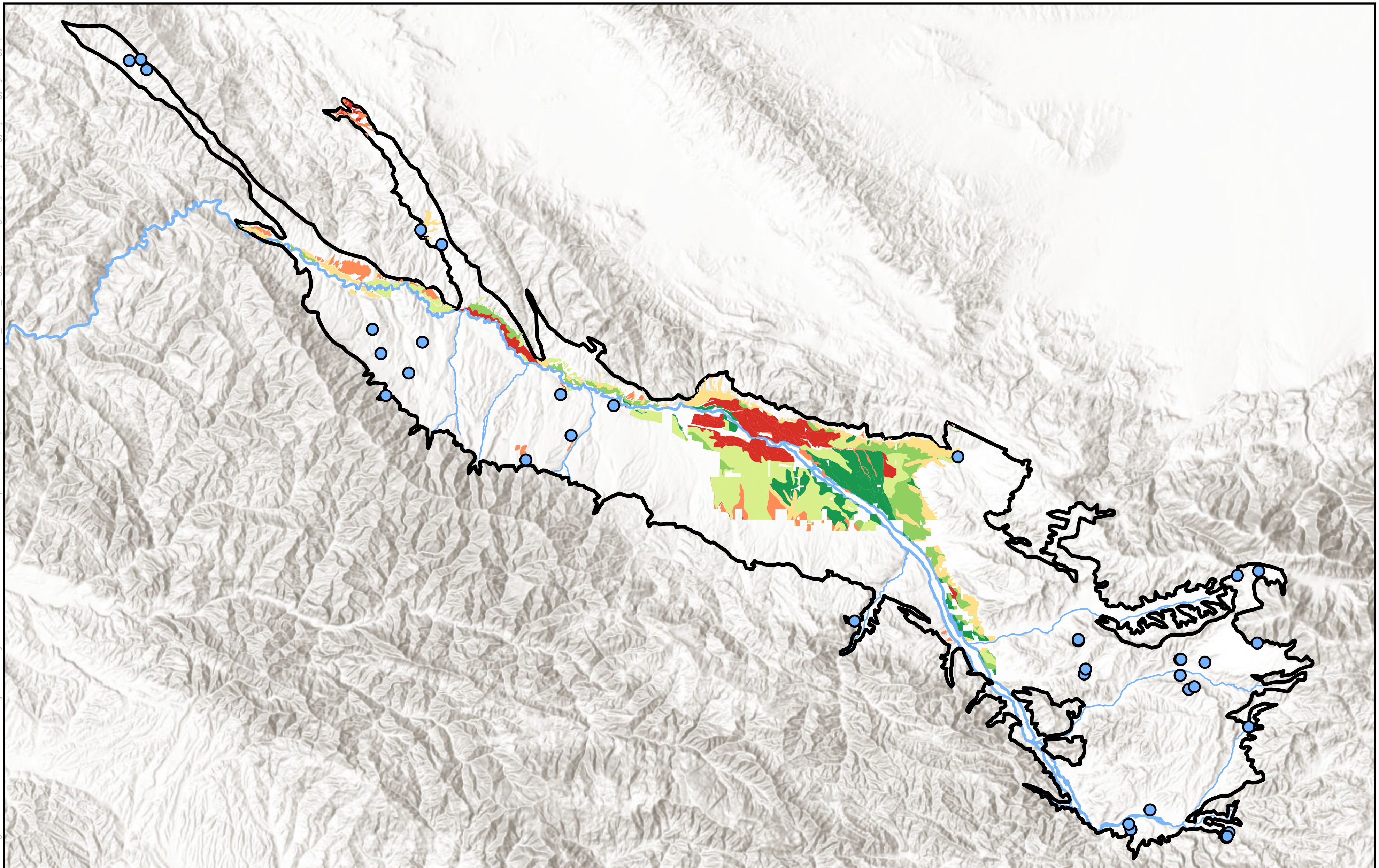

Figure 2-26: Recharge Areas, Springs, and Seeps

Cuyama Valley Groundwater Basin

Legend

Modified SAGBI Score
- Excellent (100 - 85)
- Good (85 - 69)
- Moderately Good (69 - 49)
- Moderately Poor (49 - 29)
- Poor (29 - 15)
- Very Poor (15 - 0)

- NHD Springs and Seeps
- Creek
- Cuyama River
- Cuyama Basin

N

0 1.75 3.5 7 Miles

Map Created: February 2024

Woodard & Curran

Cuyama Basin Groundwater Sustainability Agency

Figure Exported: 2/27/2024 By: DHunt Using: \\woodardcurran.net\shared\Projects\CA Cuyama Basin GSA\0011078.01 GSP\wip\Z. GIS\2. Maps\2025 GSP Update\02_Basin_Setting_Overview\geophysical\hydrology\hydrology\hydrology.aprx

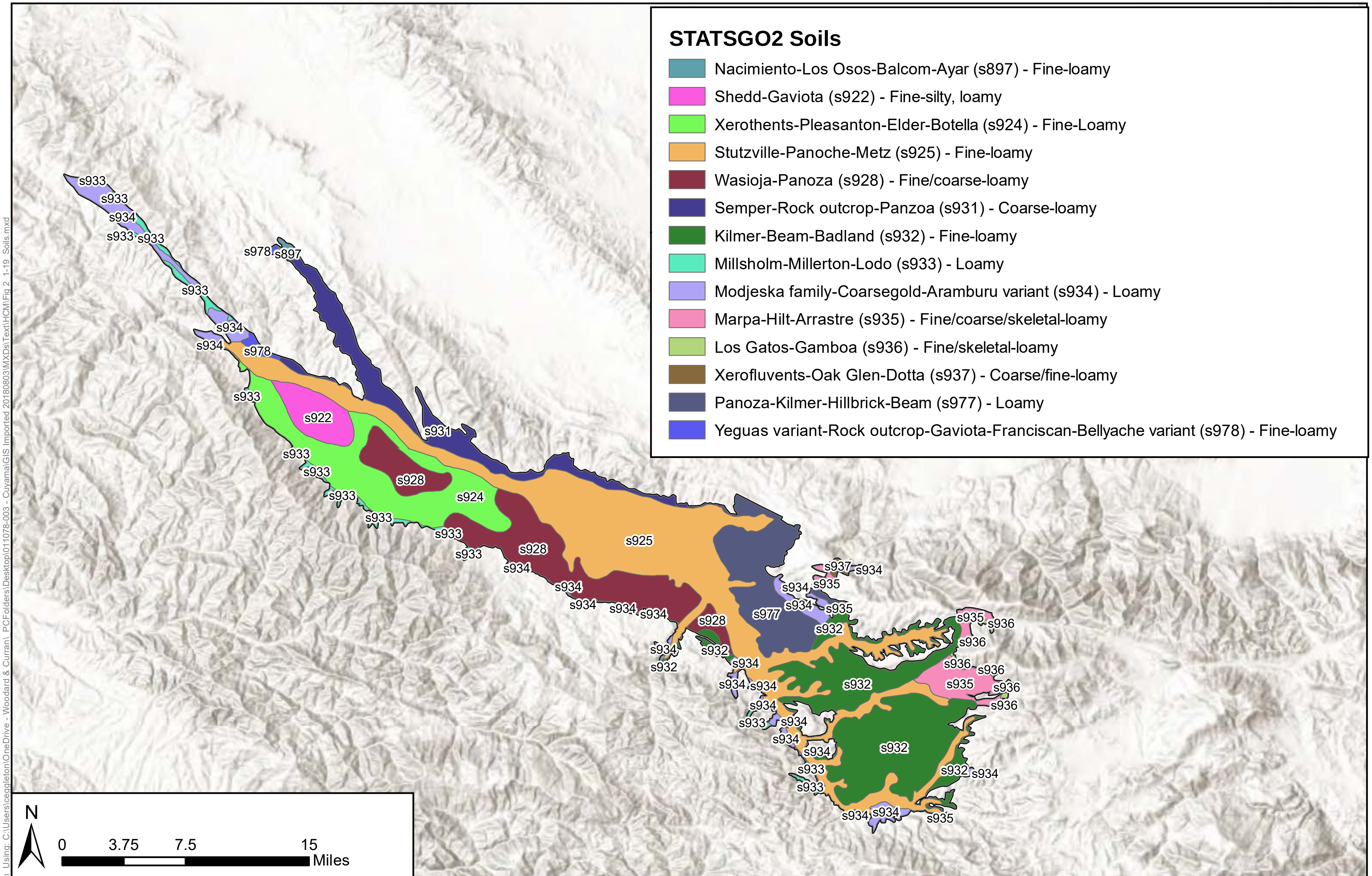

Figure 2-27: Soils

Cuyama Basin Groundwater Sustainability Agency

Cuyama Valley Groundwater Basin Groundwater Sustainability Plan

December 2019

Legend

Cuyama Basin

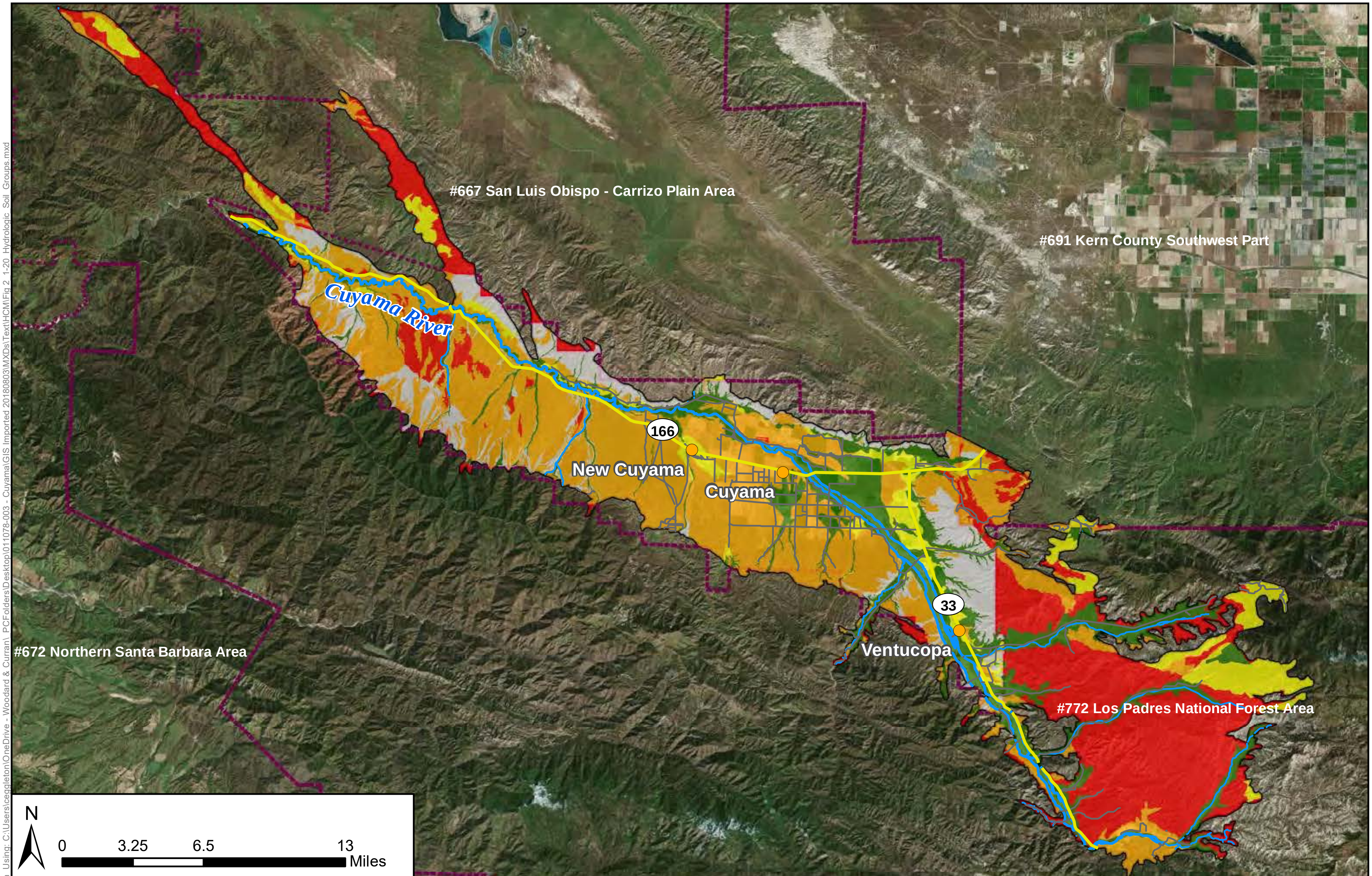

Figure 2-28: Hydrologic Soil Groups

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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 amended GSP. The surface geophysical survey of the subsurface Santa Barbara Canyon Fault confirmed its presence in the Cuyama River channel near its inferred location. The survey also confirmed the fault 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 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. Lastly, the extent of brackish groundwater discovered in the TSS #1 wells east of the Russel Fault is unknown and potential impacts to nearby groundwater is not 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.

2.2.1 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 2-29 shows selected landmarks in the Basin to support the discussion of the location of specific groundwater conditions. 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.

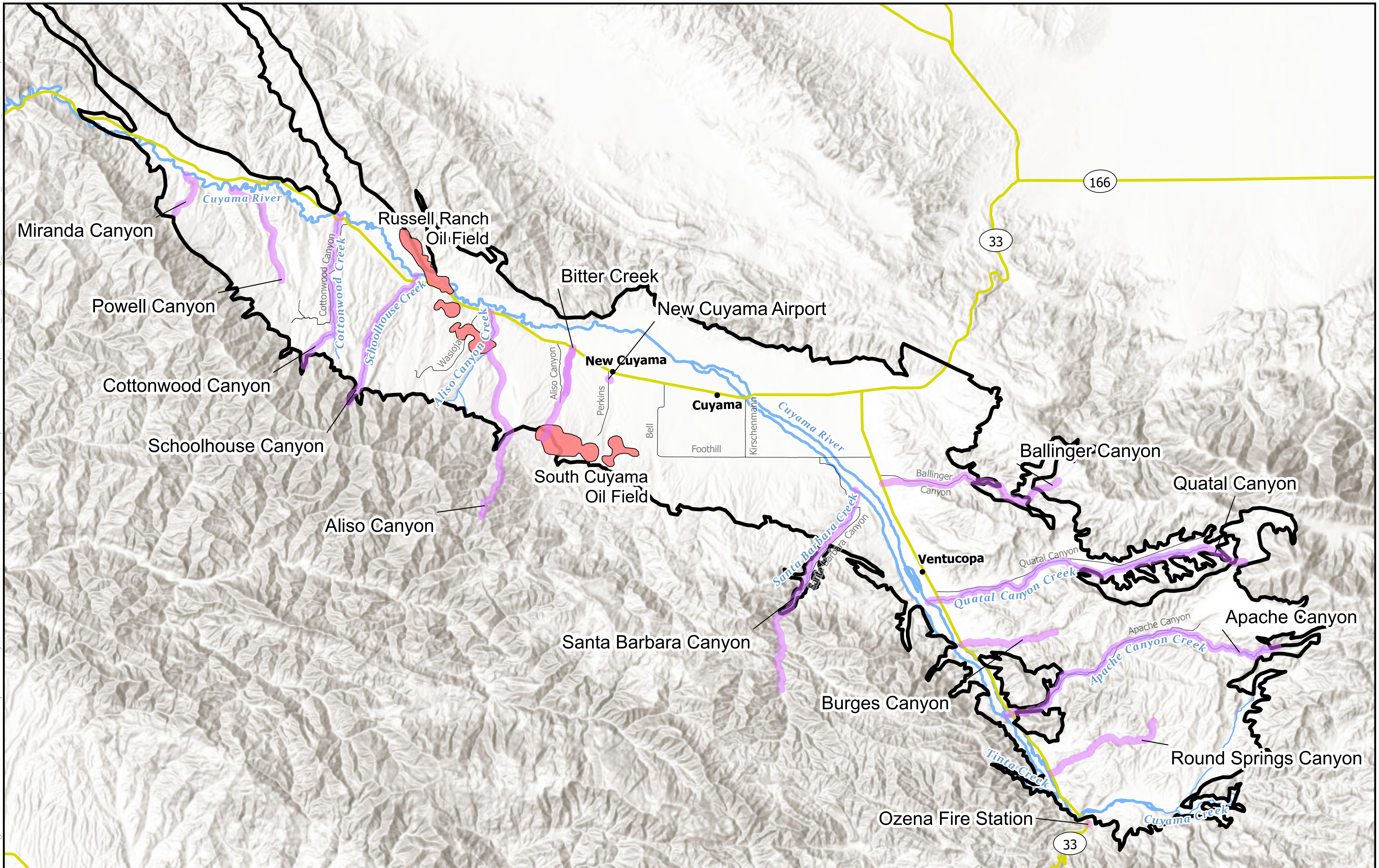

Figure 2-29: Landmarks

Cuyama Valley Groundwater Basin

Legend

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

Map Created: April 2024

Figure Exported: 4/30/2024 By: DHunt Using: \\woodardcurran.net\shared\Projects\CA Cuyama Basin GSA\0011078.01 GSP\wip\Z_GIS\2_Maps\3_2025 GSP Update\02_Basin_Setting_Overview\basin_landmarks\basin_landmarks.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 DOC, CA DWR, Esri, USGS**

2.2.2 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.

2.2.3 Historical Groundwater Elevation Data Processing

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
- 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.[7] 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 Basin and near Ventucopa. Many wells in the USGS database have been typically measured bi-annually,

[7] 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.

with one measurement in the spring, and one measurement in the fall. 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.

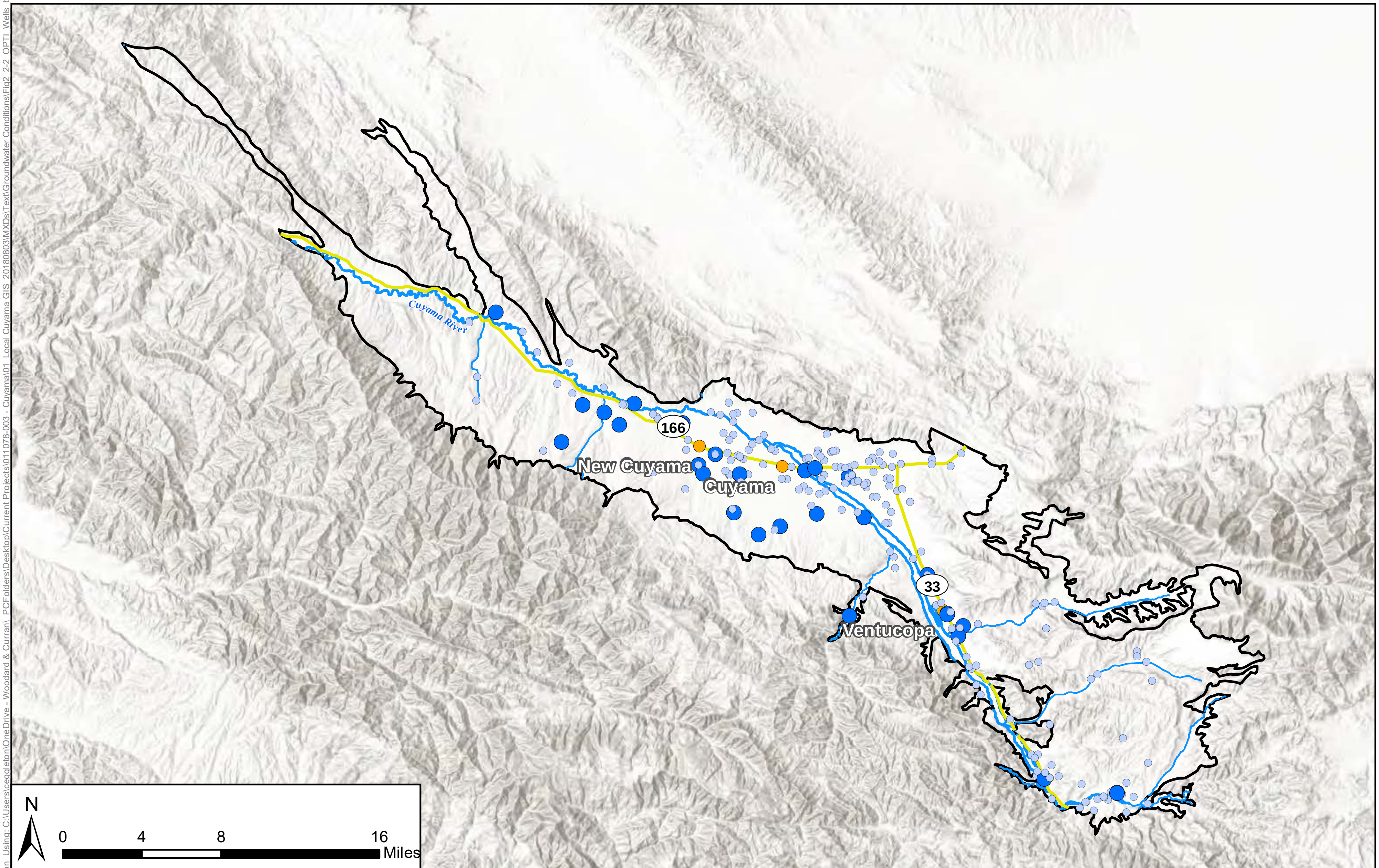

Figure 2-30: Cuyama GW Basin Wells with Monitoring Data Provided by DWR

Cuyama Basin Groundwater Sustainability Agency

Cuyama Valley Groundwater Basin Groundwater Sustainability Plan

December 2019

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Legend

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

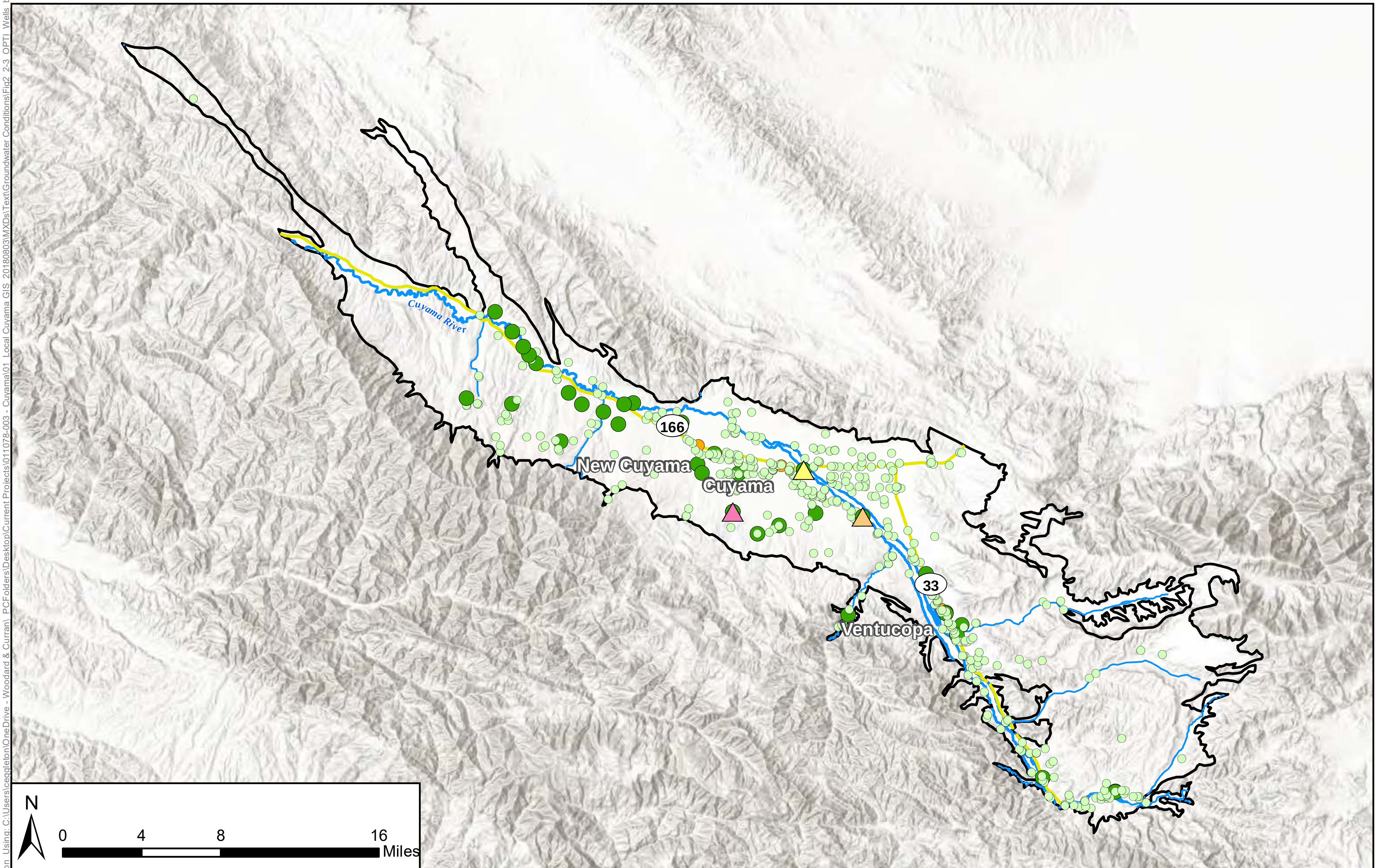

Figure 2-31: Cuyama GW Basin
Wells with Monitoring Data Provided by USGS

Cuyama Basin Groundwater Sustainability Agency

Cuyama Valley Groundwater Basin Groundwater Sustainability Plan

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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

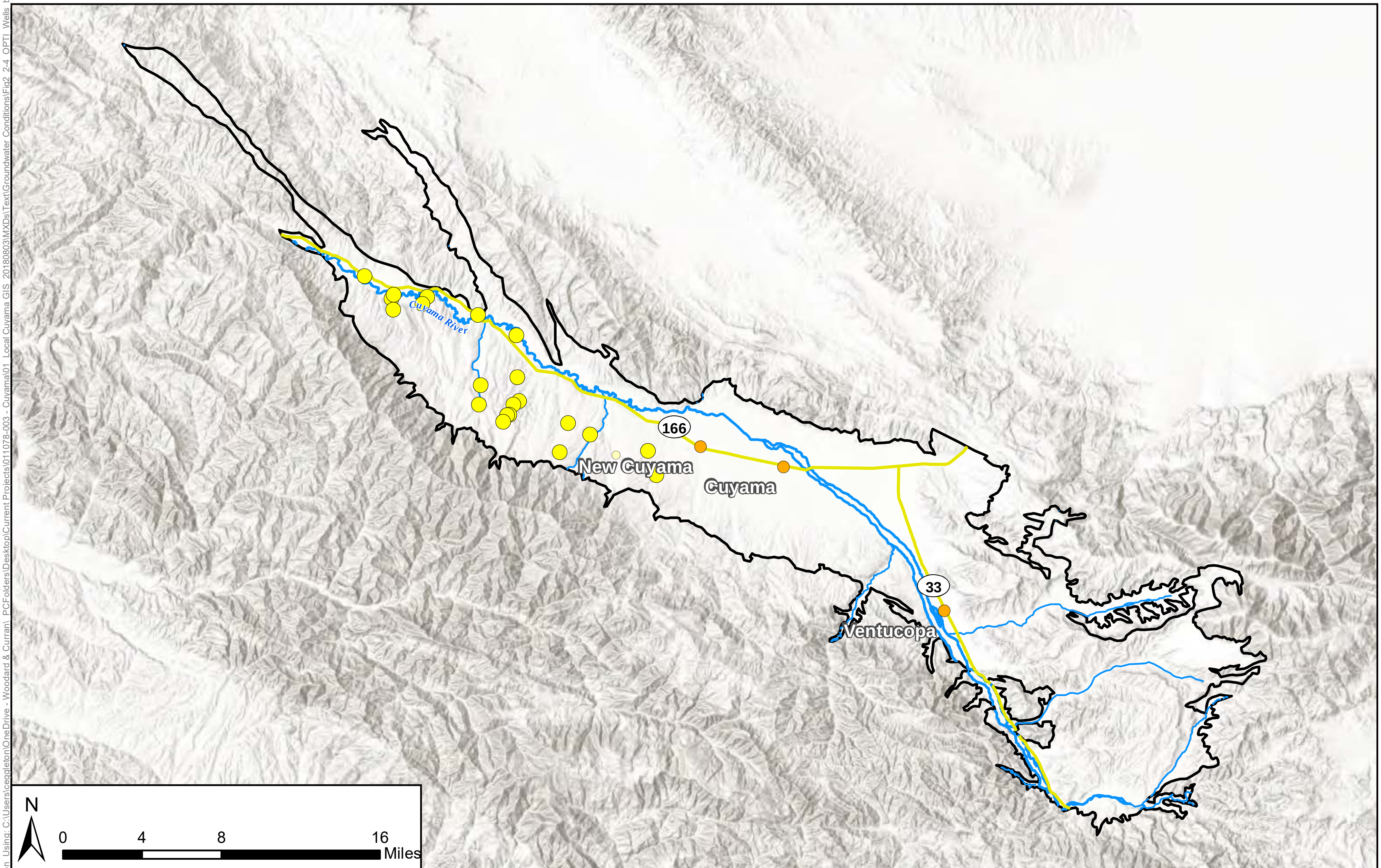

Figure 2-32: Cuyama GW Basin Wells with Monitoring Data Provided by Local Agencies

Cuyama Basin Groundwater Sustainability Agency

Cuyama Valley Groundwater Basin Groundwater Sustainability Plan

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Legend

- Cuyama Basin
- Towns
- Highways
- Cuyama River
- Streams
- County Database Wells Last Measured in 2017-2018
- County Database Wells Last Measured 2016 or Earlier

Figure Exported: 11/13/2018 By: ceggleton Using: C:\Users\ceggleton\OneDrive - Woodard & Curran_PCFolders\Desktop\Current Projects\011078-003 - Cuyama\01_Local Cuyama GIS_20180803\MXDs\Text\Groundwater Conditions\Fig2_2-4_OPTI_Wells_by_Agency

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, west of the Russell Fault. Associated data provided with private landowners varies by source. Some data and measurements were taken annually, while other well owners 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 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 east of the Russell Fault.

Figure 2-35 shows a comparison of data provided by private landowners and data compiled from the DWR, USGS, and 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 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 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 monitoring network 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).

Processing of these data has been refined as additional information 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.

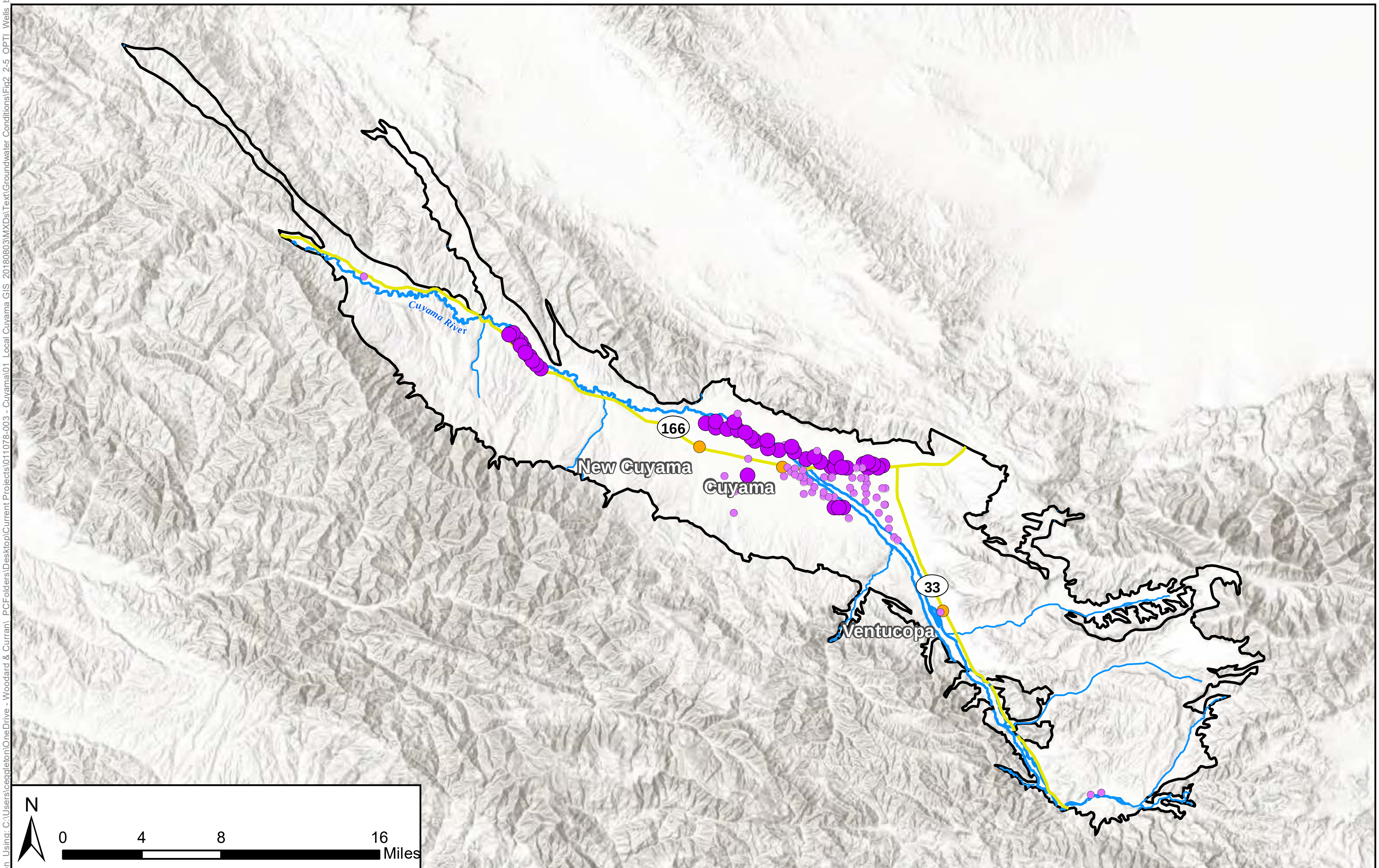


Figure 2-33: Cuyama GW Basin Wells with Monitoring Data Provided by Private Landowners

Cuyama Basin Groundwater Sustainability Agency

Cuyama Valley Groundwater Basin Groundwater Sustainability Plan

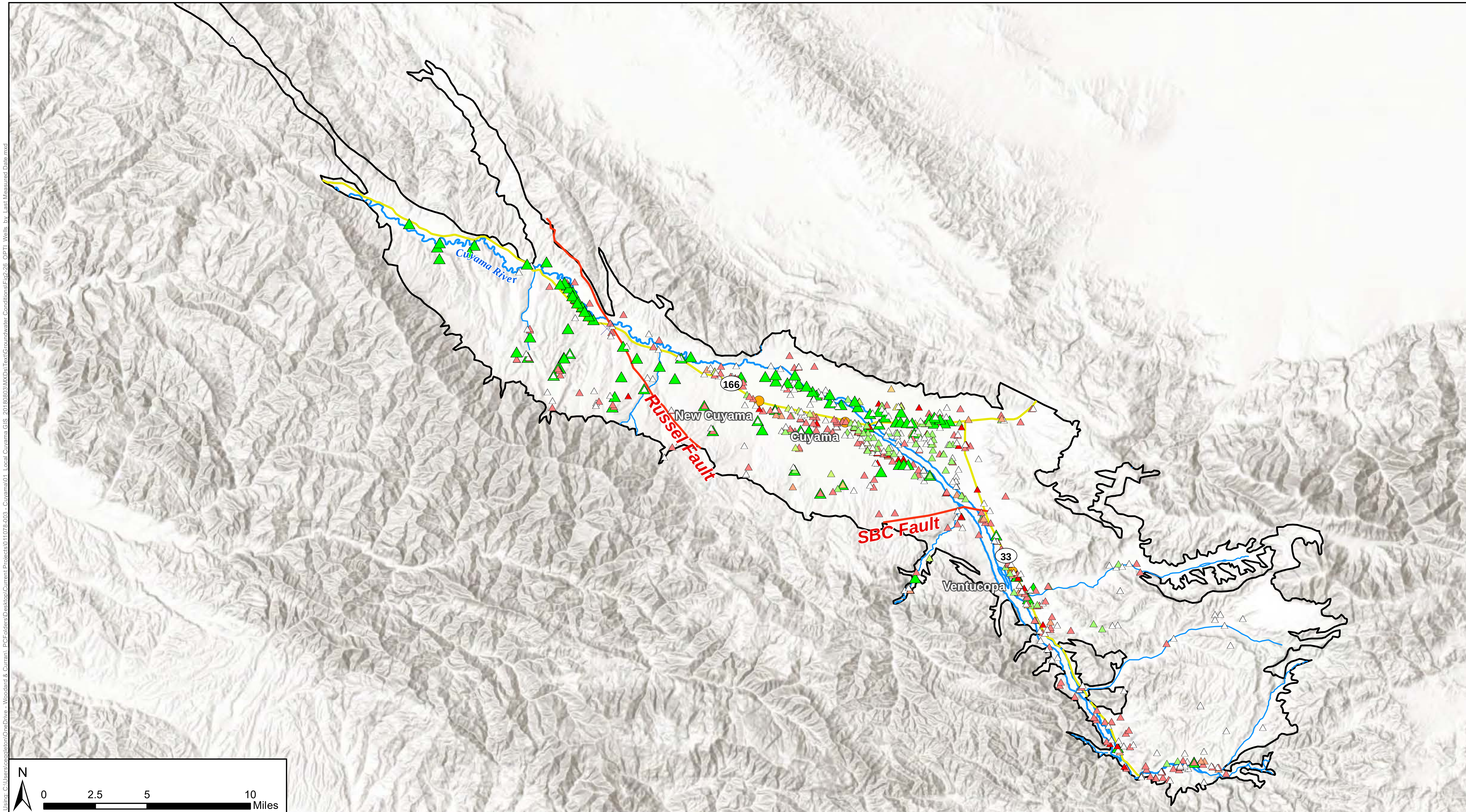
December 2019

WOODARD & CURRAN

Legend

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

Figure Exported: 11/19/2018 By: ceggleton Using: C:\Users\ceggleton\OneDrive - Woodard & Curran_PCFolders\Desktop\Current Projects\011078-003 - Cuyama\01_Local Cuyama GIS_20180803\MXDs\Text\Groundwater Conditions\Fig2_2-5_OPTI_Wells_by_Agency



Legend

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

Most Recent Year with Measurements

- 2017 - 2018
- 2010 - 2016
- 2000 - 2009
- 1990 - 1999
- 1980 - 1989
- 1970 - 1979
- 1960 - 1969
- 1950 - 1959
- Pre-1950
- No Measurment Data

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

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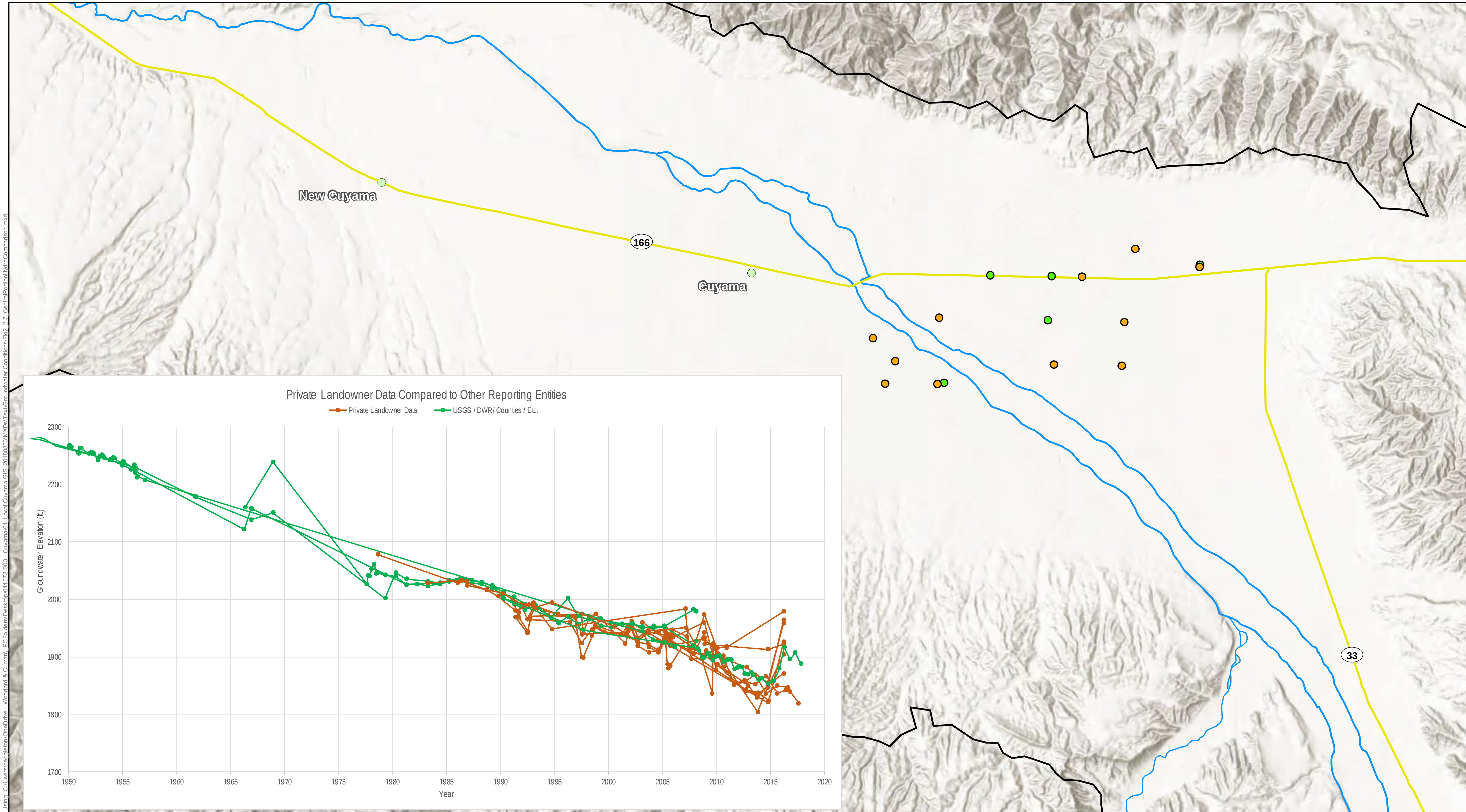


Figure 2-35: Central Cuyama GW Basin Wells and Hydrographs by Data Source

Cuyama Basin Groundwater Sustainability Agency

Cuyama Valley Groundwater Basin Groundwater Sustainability Plan

December 2019

WOODARD & CURRAN

Legend

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

N

0 0.5 1 2 Miles

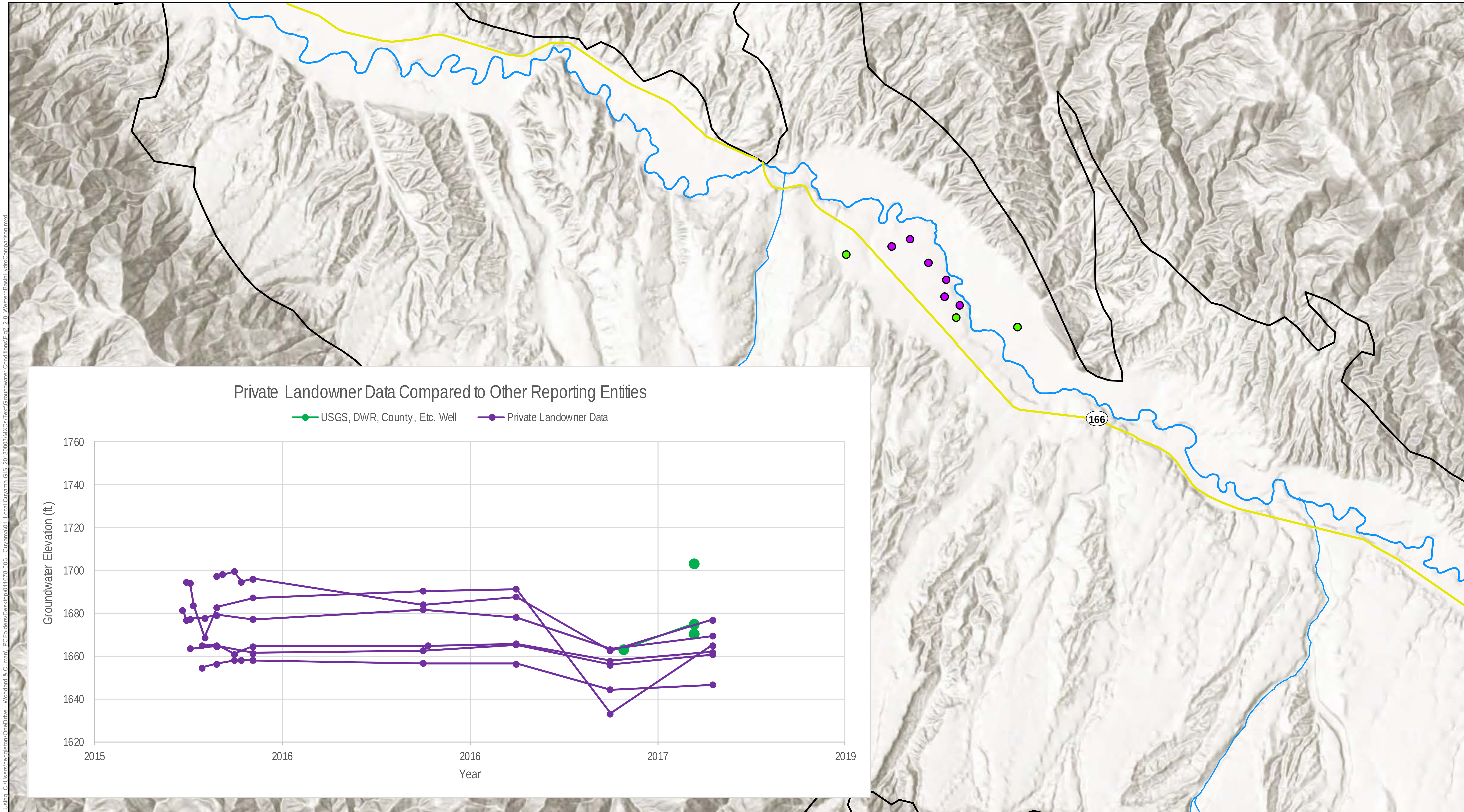


Figure 2-36: Western Cuyama GW Basin Wells and Hydrographs by Data Source

Cuyama Basin Groundwater Sustainability Agency

Cuyama Valley Groundwater Basin Groundwater Sustainability Plan

December 2019

WOODARD & CURRAN

Legend

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

N

0 0.5 1 2 Miles

2.2.5 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.

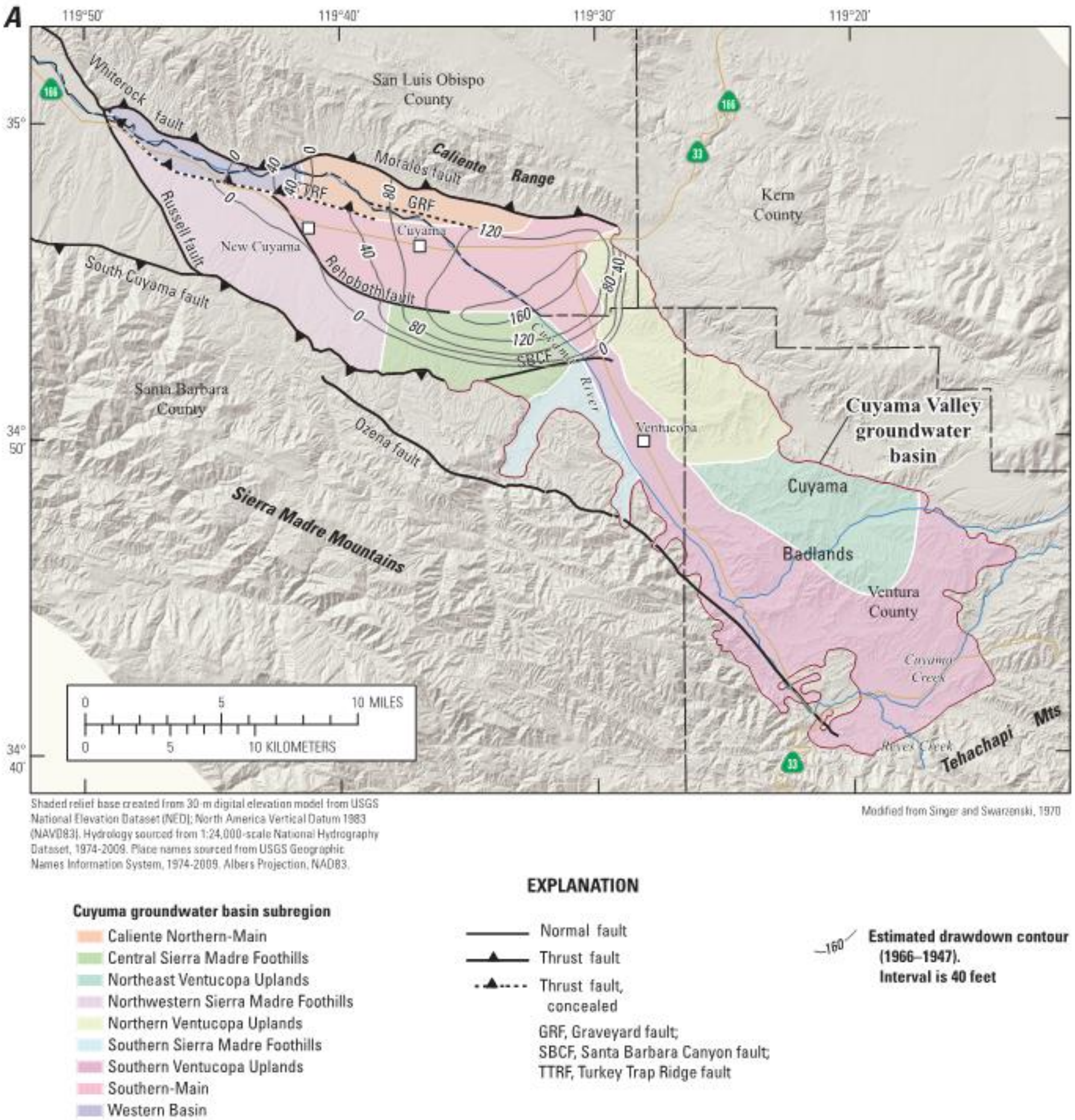
Historical Context – 1947 to 1966 Groundwater Trends

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 on the average of about 27 feet" (USGS, 1956).

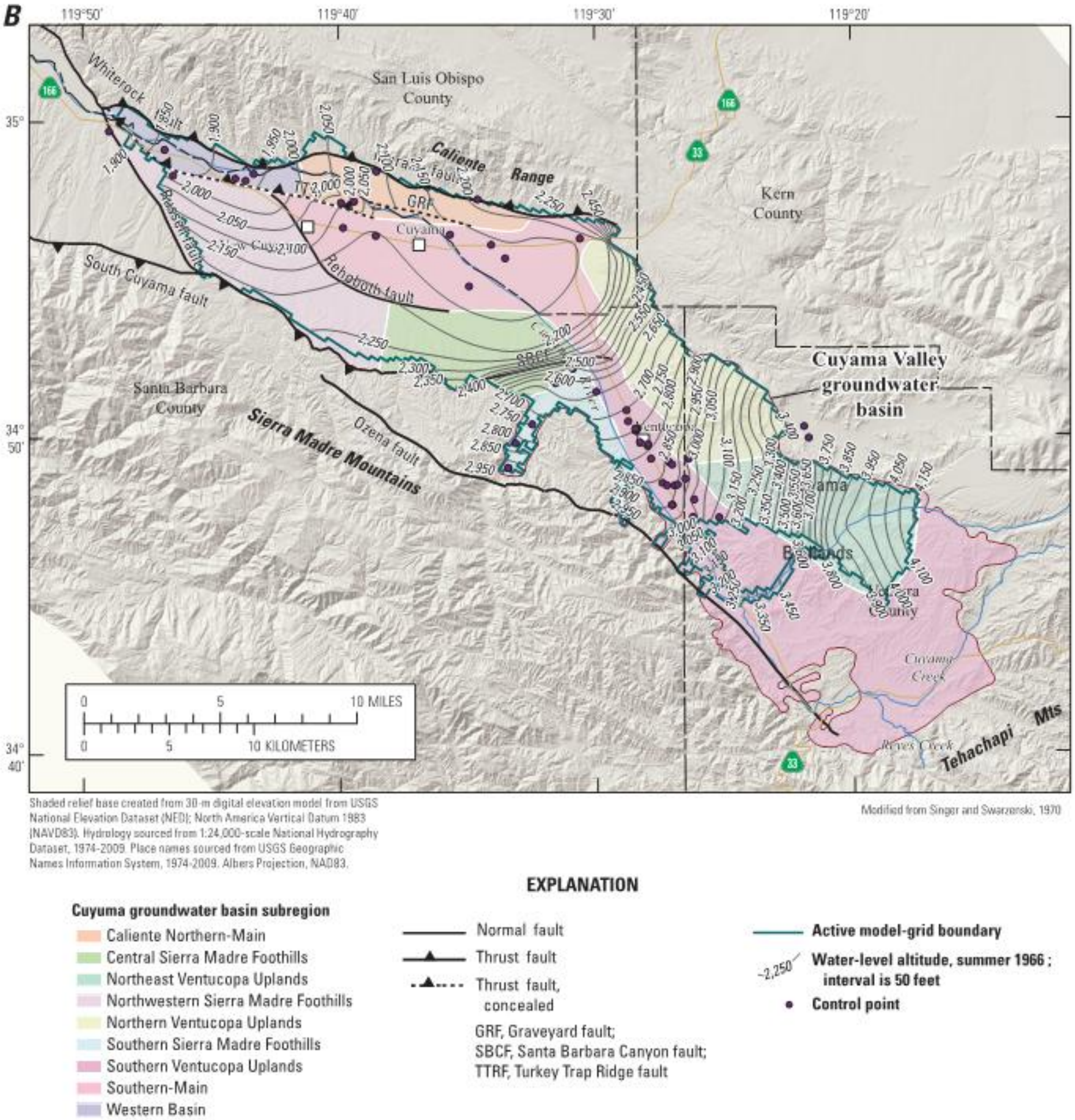
A USGS report titled *Hydrologic Models and Analysis of Water Availability in the Cuyama Valley, California* (USGS, 2015) presents two maps generated by using CUVHM simulated data. Figure 2-37 shows the estimated drawdown in the central portion of the Basin from 1947 to 1966. Figure 2-37shows that estimated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

Figure 2-38 shows the estimated contours of groundwater elevation for summer 1966. These contours show a low area in the central portion of the 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 portion of the Basin, generally matching topography. Few wells are located in this area and groundwater elevation contours were estimated over large distances by the USGS.



Source: USGS, 2015

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



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 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 on the CBGSA's online public Opti DMS.

Groundwater Hydrographs

The DMS contains water level measurements from wells the CBGSA has identified in the Basin. Groundwater hydrographs were developed for a subset of the wells that are part of the monitoring network. These wells are measured more frequently, and the hydrographs provide indicators of groundwater elevation trends throughout the Basin. All historical measurements were compiled and shown in one hydrograph for each well. 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.

Figure 2-39 shows the current monitoring network that has been updated with this GSP submittal. Subsequent maps show different parts of the Basin 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 for each region of the Basin. These wells were selected because they broadly represent Basin conditions in their areas. More information about these conditions is summarized below.

- In the southeast region near Round Springs Canyon, near the Ozena Fire Station (Well 89), groundwater levels have been fluctuating by about 20 feet throughout the measurement period except for larger declines in about 1997 and 2017. On average, groundwater levels have remained stable. 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 declined from the early 1990's to about 2018 when they stabilized for several years. A recent increase in groundwater levels started at the end of 2023. This well is not pumped and the measurements represent static water levels.
- In the central region of the Basin (Well 91), groundwater levels have been declining from 2009 to 2024. The net decline over this period is about 100 feet bgs. This well is not pumped and the measurements represent static water levels.

- Also, in the central region (Well 77), groundwater levels have shown a steady decline since 2009 with seasonal fluctuations during most years. The net decline has been about 100 feet bgs.
- In the western portion of the Basin (Well 118), groundwater levels have been generally stable since 2016 with groundwater levels within about 60 feet of ground surface. These levels increased by 10 feet in recent years. This well is not pumped and the measurements represent static water levels.

Figure 2-41 shows hydrographs for six wells in the western part of the Basin located adjacent to the Cuyama River with water levels within 100 feet of ground surface. Wells 836 and 830 show a similar trend of stable water levels. A slight decline in water levels occurred in late 2022 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 and an overall decline although Well 841 shows some recovery since mid-2022.

Figure 2-42 shows hydrographs for six other wells in the western portion of the Basin that are not adjacent to the Cuyama River. However, only Wells 117 and 106 are dedicated monitoring wells with no pumping. Water levels in Well 117 have been stable other than a sharp increase in early 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 571, groundwater levels were stable from 2016 to about 2020. Through 2022, the fluctuating levels ranged from 120 to 140 feet bgs. In early 2023, the measurements indicate an abrupt increase of about 80 feet. Since then, groundwater levels have declined from 40 to 80 feet bgs but remain notably higher than pre-2022 levels.

Figure 2-43 shows hydrographs for four wells in the west-central part of the Basin at variable distances from the Cuyama River. Wells 114 and 112 are active pumping wells. Well 114 was measured in 1968 but not again until 2016. The absence of data during this period indicates a decline from 30 to about 44 feet bgs. Well 112 has a similar data gap from 1968 to 2016 but shows a net increase in water levels from about 112 feet up to 83 feet bgs. Since 2016, the water level has declined to about 87 feet bgs. Well 568, also an active pumping well, has a data gap from 1967 to about 2009. During this period, water declines had a net decline of 10 feet. Water levels continued to decline until early 2022 when measurements show an abrupt decline of 40 feet. Subsequent water levels indicate the decline recovered just as abruptly, suggesting a possible measurement error. Water levels were steady for the remainder of 2023 at about 40 feet bgs, lower than historical measurements. Well 474 is a monitoring well with a decline in water levels of about 20 feet from 1955 to about 1967. Subsequent measurements show a partial recovery followed by steady conditions until mid-2019 with depth to water of about 185 feet bgs. Since that time, water levels have sharply increased to 135 feet bgs.

Figure 2-44 shows hydrographs for three wells in the north-central portion of the Basin. Wells 72, 74, and 604 are all active pumping wells. Well 72 had fluctuating water levels from about 55 to 80 feet bgs from 1981 to 2008. Since then, the water levels have fluctuated more frequently and show a net decline to about 130 feet bgs. The water level measurements show several significant short-term declines from 2009 to 2021. Water levels in Well 74 have slowly declined from 2008 to 2024 with levels decreasing from 220 to 250 feet bgs. An abrupt short-term decline is indicated by the data in 2009. Water levels in Well 604 had a net decline from 1995 to mid-2017. Since then, the water levels have increased 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 while Wells 608 and 609 are active pumping wells. Water levels in Well 103 have fluctuated above and below 300 feet bgs from 2012 to 2022, likely due to nearby pumping for irrigation. Since that time, water levels have increased to about 240 feet bgs. Wells 608 and 609, both close to the Cuyama River, had net water level declines from 1995 to 2024. At Well 608, water levels have declined from 290 to about 430 feet bgs. At Well 609, water levels have declined from about 280 to about 440 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. Water levels in Well 96 have declined from 1983 to 2024 from about 295 to about 340 feet bgs. Water levels in Well 612, close to the Cuyama River, have declined from 1995 to 2024 from 330 to about 475 feet bgs. Water levels in Well 615 were steady from 1995 to 200 at 360 feet bgs. Since then, water levels have declined to about 520 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. Wells 610, 629, and 633 have net declines since the first measurements in the late 1990’s and mid-2000’s. Depth to water in Wells 629 and 633 are currently about 560 to 570 feet bgs and 630 feet bgs in Well 610. Whereas it ranges from below 550 to about 650 feet bgs in the other wells. Water levels in Well 95 slightly declined from 2009 to 2023 to greater than 600 feet bgs. The well was reportedly rehabilitated and the pump set a new depth. The measurement of roughly 70 feet bgs is assumed to be a measurement error.

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. At Well 85, water levels have fluctuated significantly since 1950 with a net increase from 170 to 160 feet bgs. At Well 100, water levels had a net decline from 130 to 160 feet bgs from 2010 to 2022. In 2023, water levels sharply rose to 70 feet bgs. At Well 101, water levels had a net decline from 70 to about 108 feet bgs from 2008 to 2023. Since then, water levels have increased to 90 feet bgs. At Well 62, water levels declined from about 65 to about 165 feet bgs from in the mid 1990’s to 2023. Since then, water levels have sharply increased to about 115 feet bgs. At Well 89, water levels have fluctuated since 1980 within the range of 20 to 40 feet bgs. The measurements indicate sharp declines in water levels in 1995 and 2016.

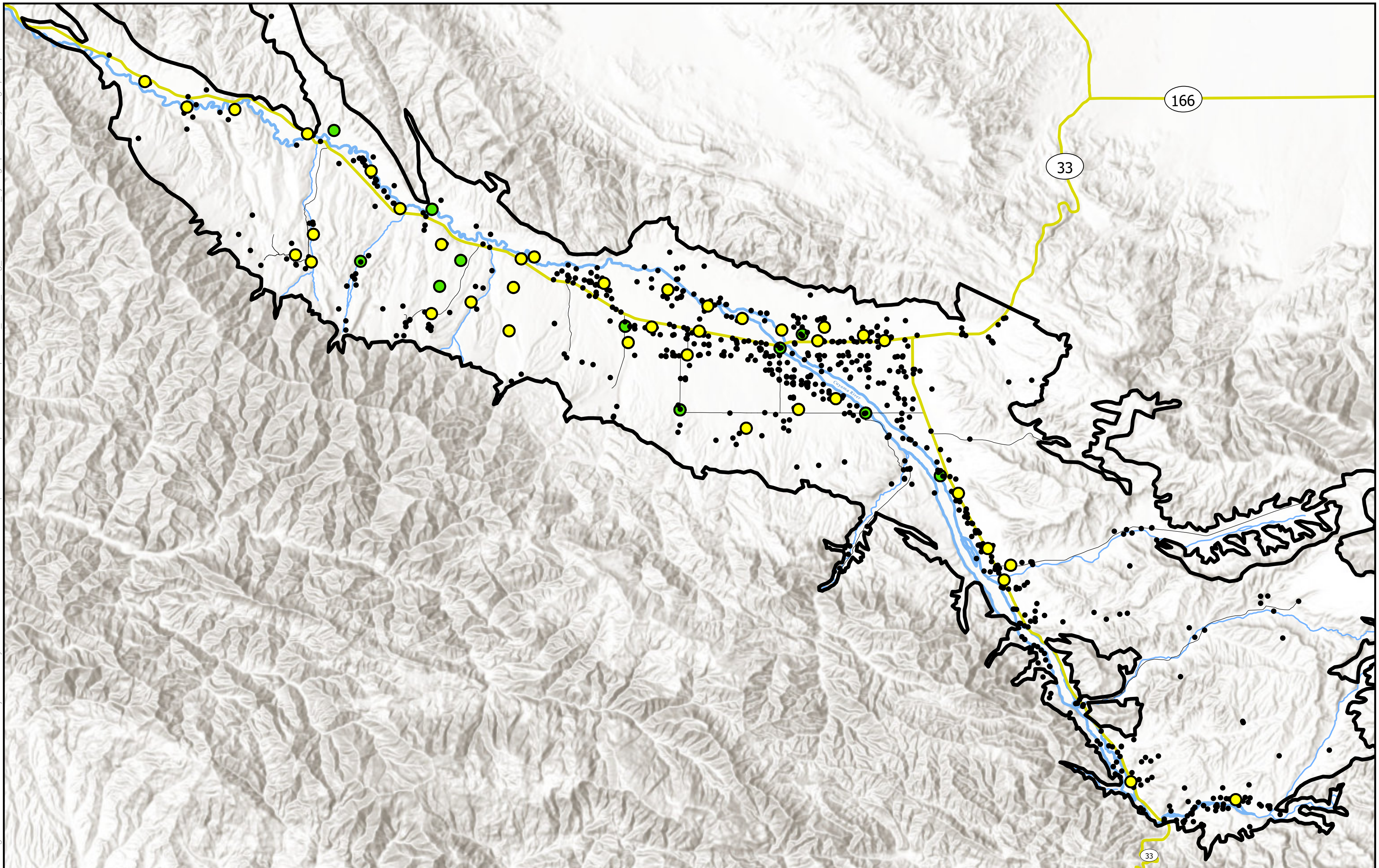


Figure 2-39: Monitoring Well Locations

Cuyama Valley Groundwater Basin

Legend

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

N

Woodard & Curran

Cuyama Basin Groundwater Sustainability Agency

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**

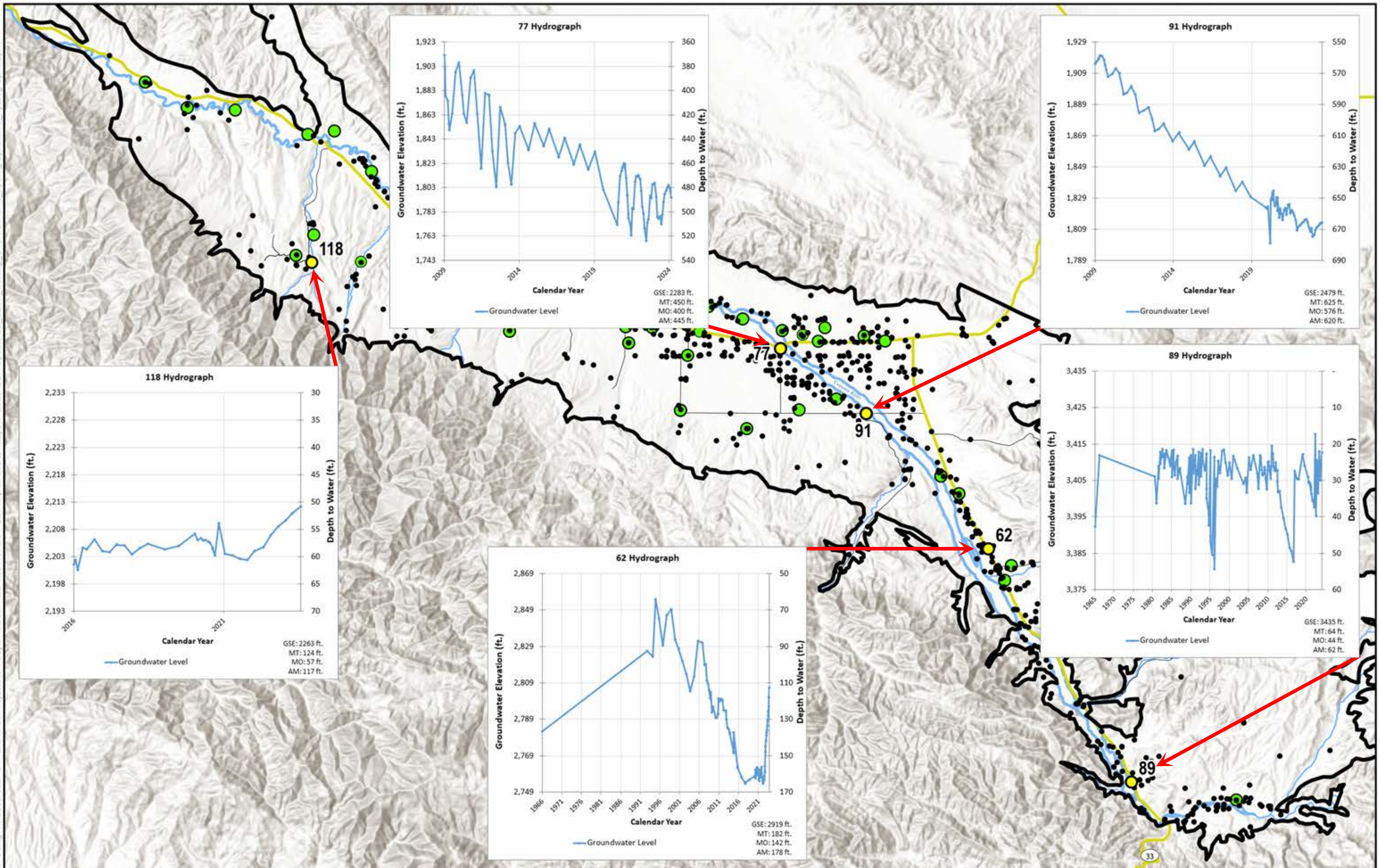


Figure 2-40: Monitoring Well Network Hydrographs

Cuyama Valley Groundwater Basin

Legend

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

N

0 1.25 2.5 5 Miles

Map Created: August 2024

Woodard & Curran

Cuyama Basin Groundwater Sustainability Agency

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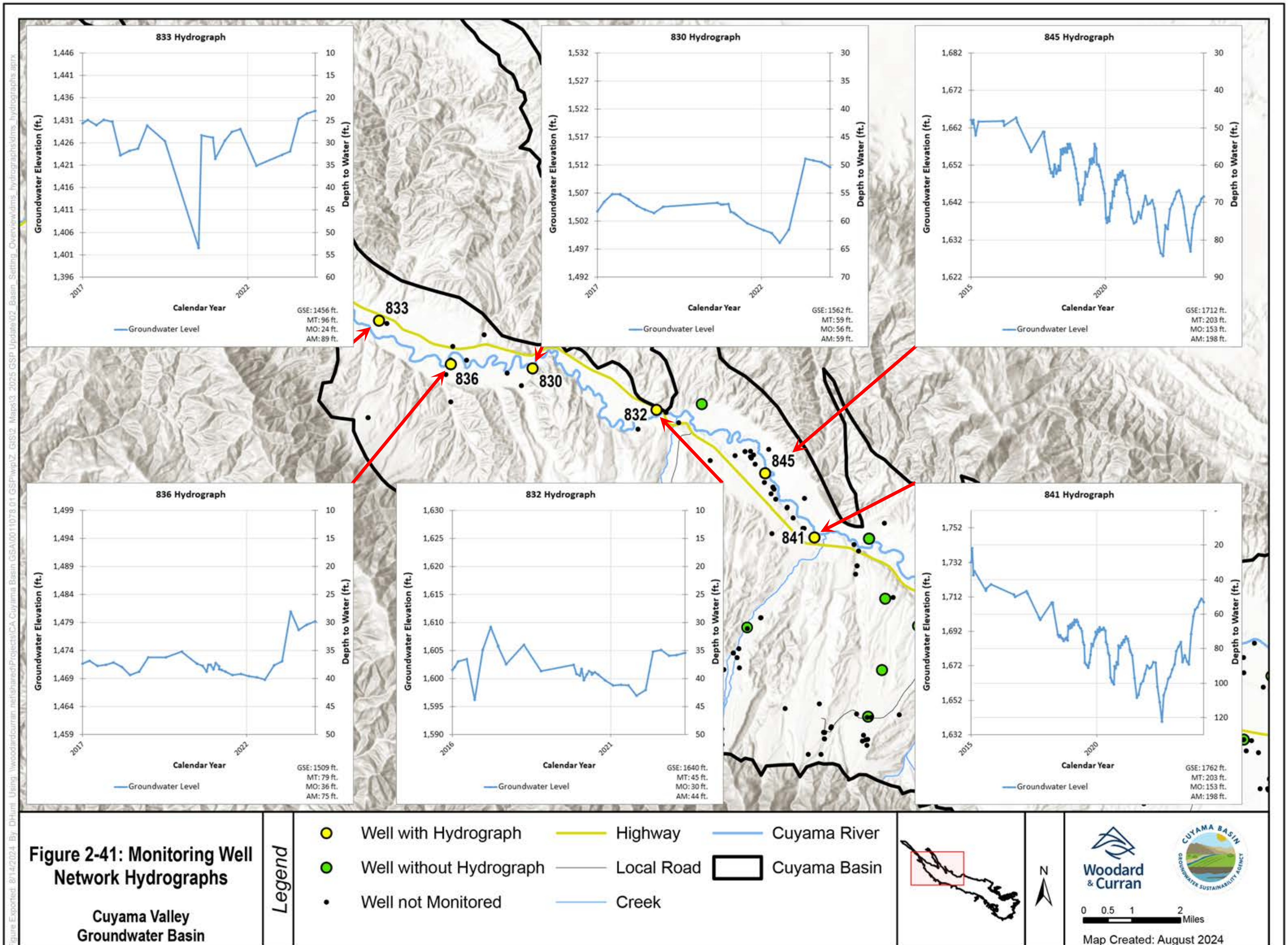

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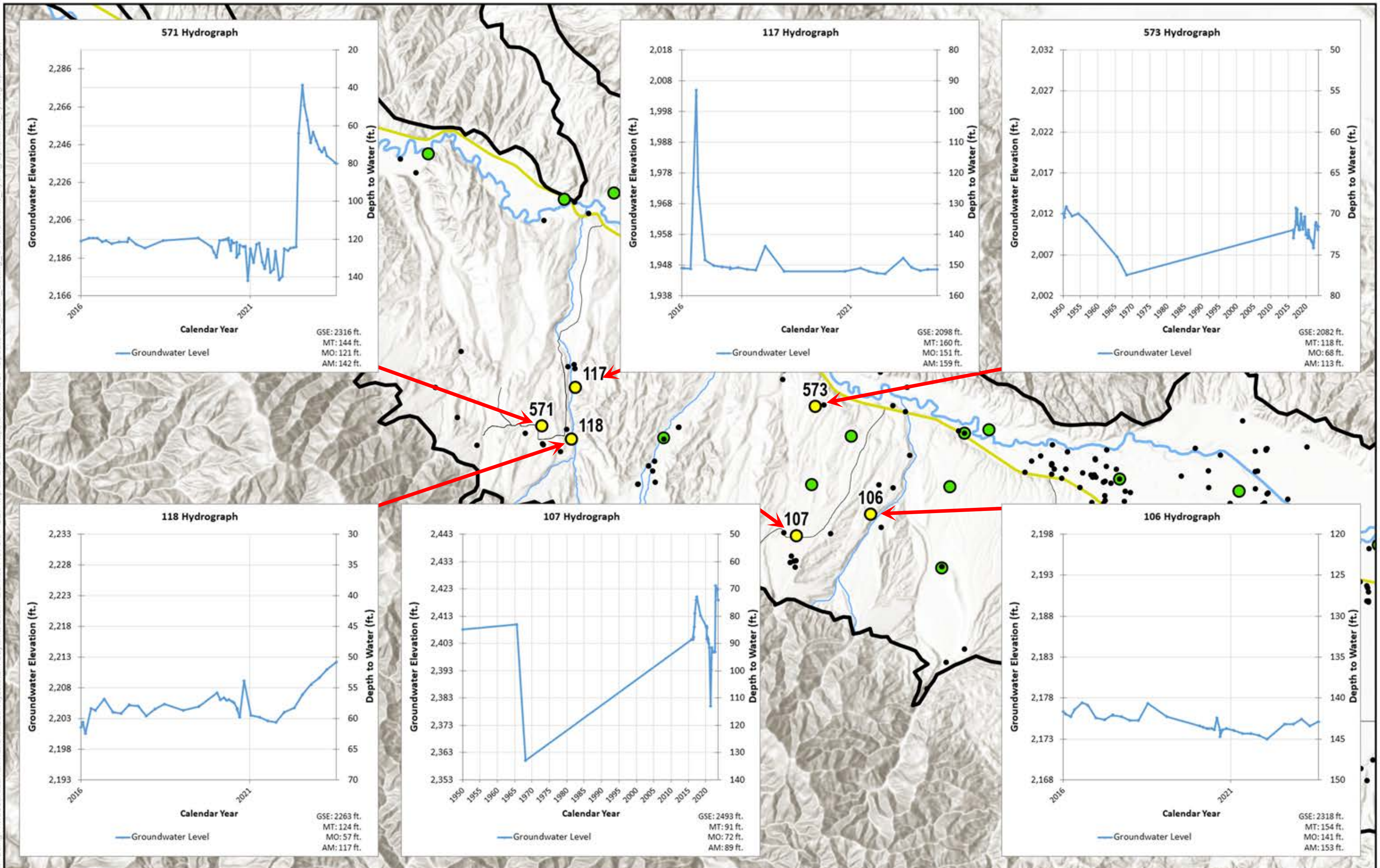

Figure 2-42: Monitoring Well Network Hydrographs

Cuyama Valley Groundwater Basin

Legend

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

N

0 0.5 1 2 Miles

Map Created: August 2024

Woodard & Curran

Cuyama Basin Groundwater Sustainability Agency

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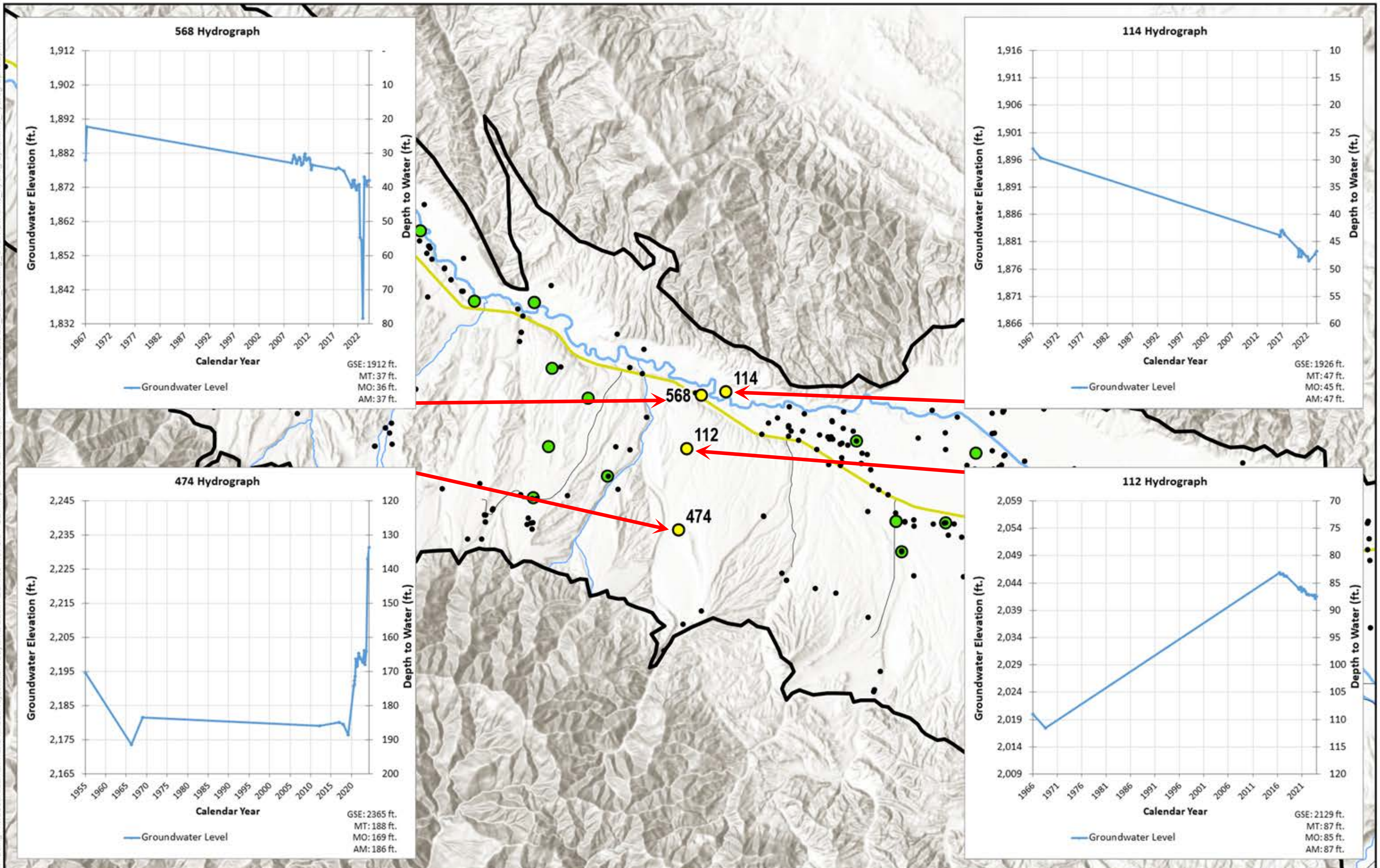

Figure 2-43: Monitoring Well Network Hydrographs

Cuyama Valley Groundwater Basin

Legend

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

N

0 0.5 1 2 Miles

Map Created: August 2024

Woodard & Curran

Cuyama Basin Groundwater Sustainability Agency

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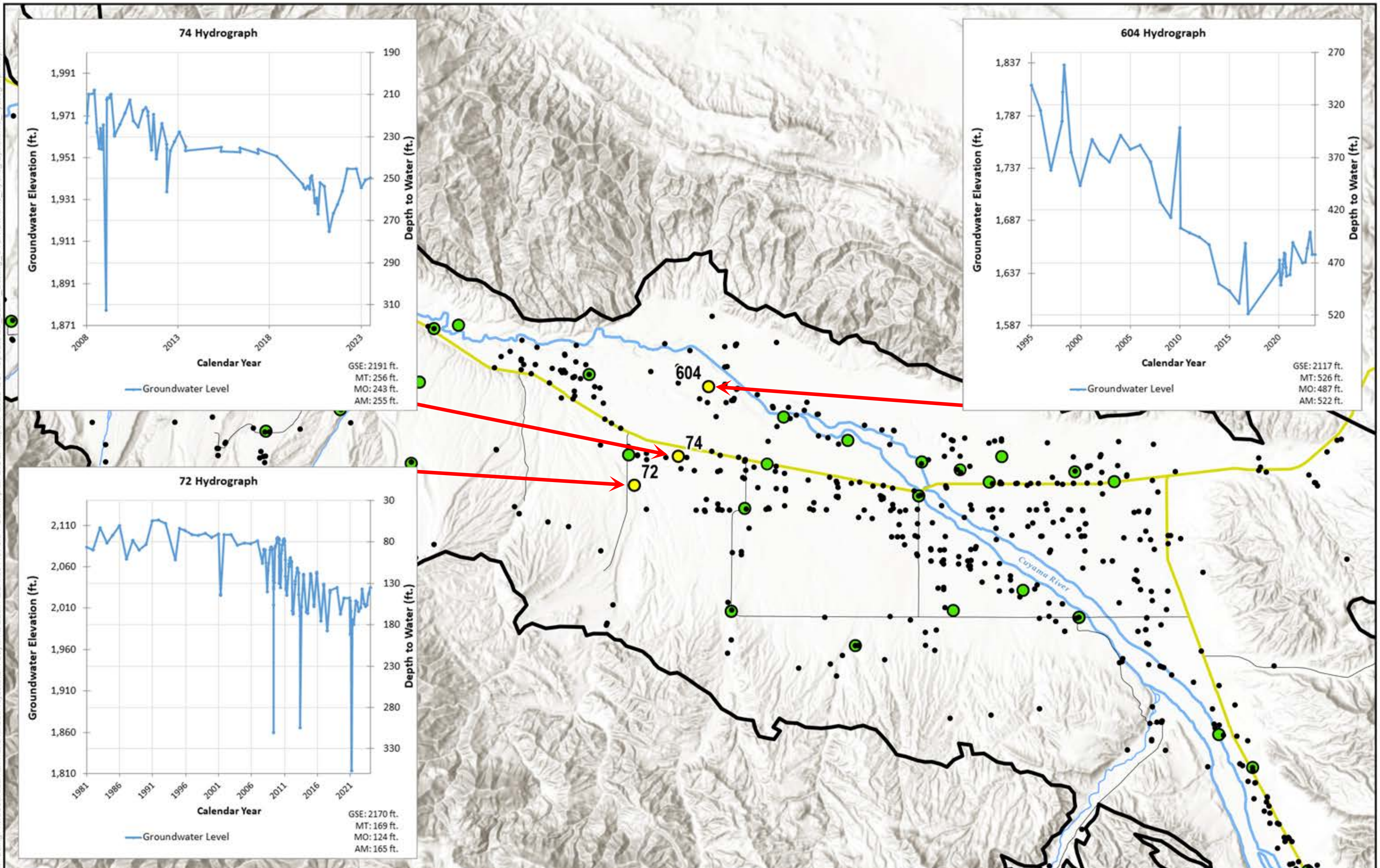

Figure 2-44: Monitoring Well Network Hydrographs

Cuyama Valley Groundwater Basin

Legend

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

N

0 0.5 1 2 Miles

Map Created: August 2024

Woodard & Curran

Cuyama Basin Groundwater Sustainability Agency

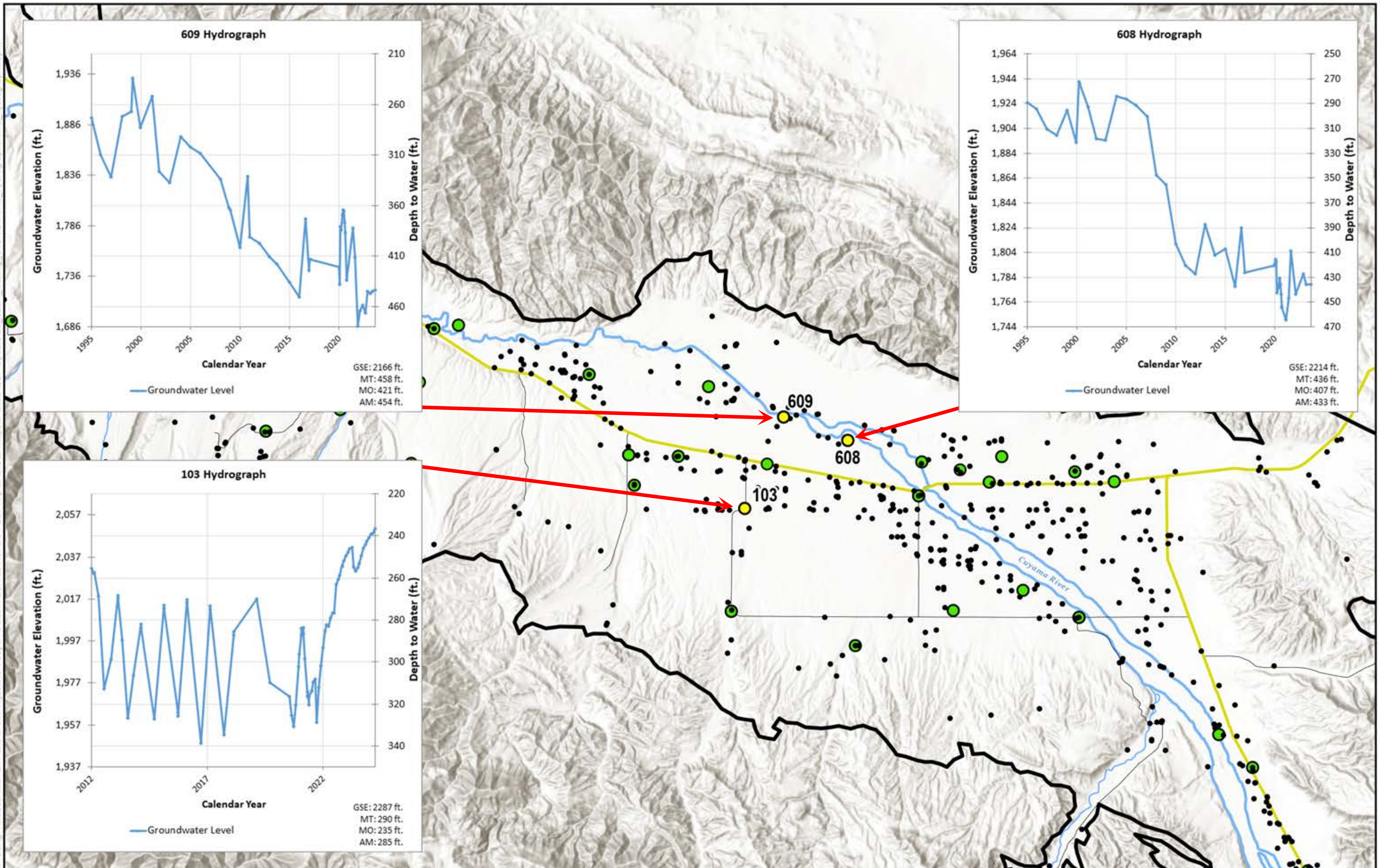

Figure 2-45: Monitoring Well Network Hydrographs

Cuyama Valley Groundwater Basin

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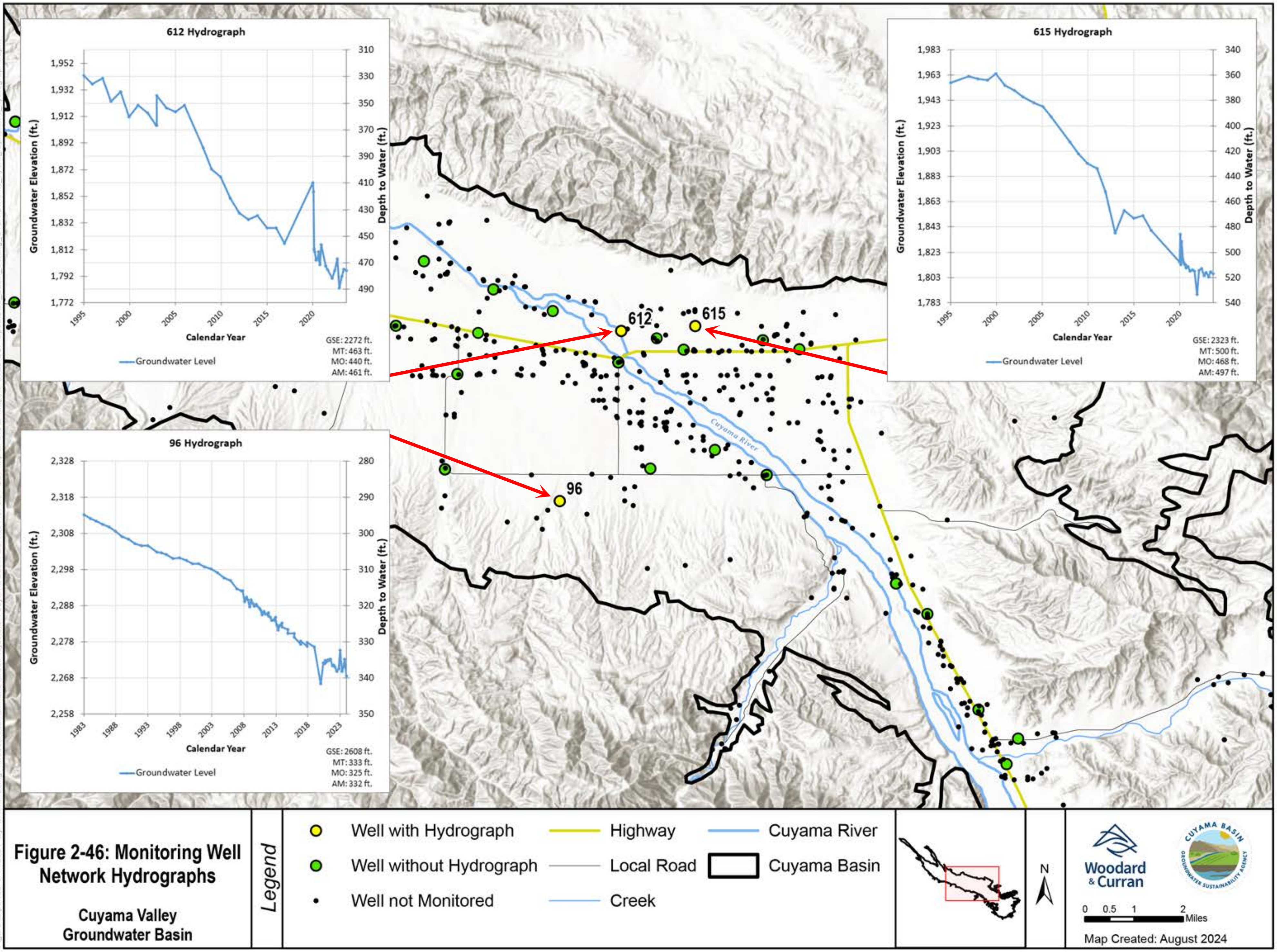

Figure 2-46: Monitoring Well Network Hydrographs

Cuyama Valley Groundwater Basin

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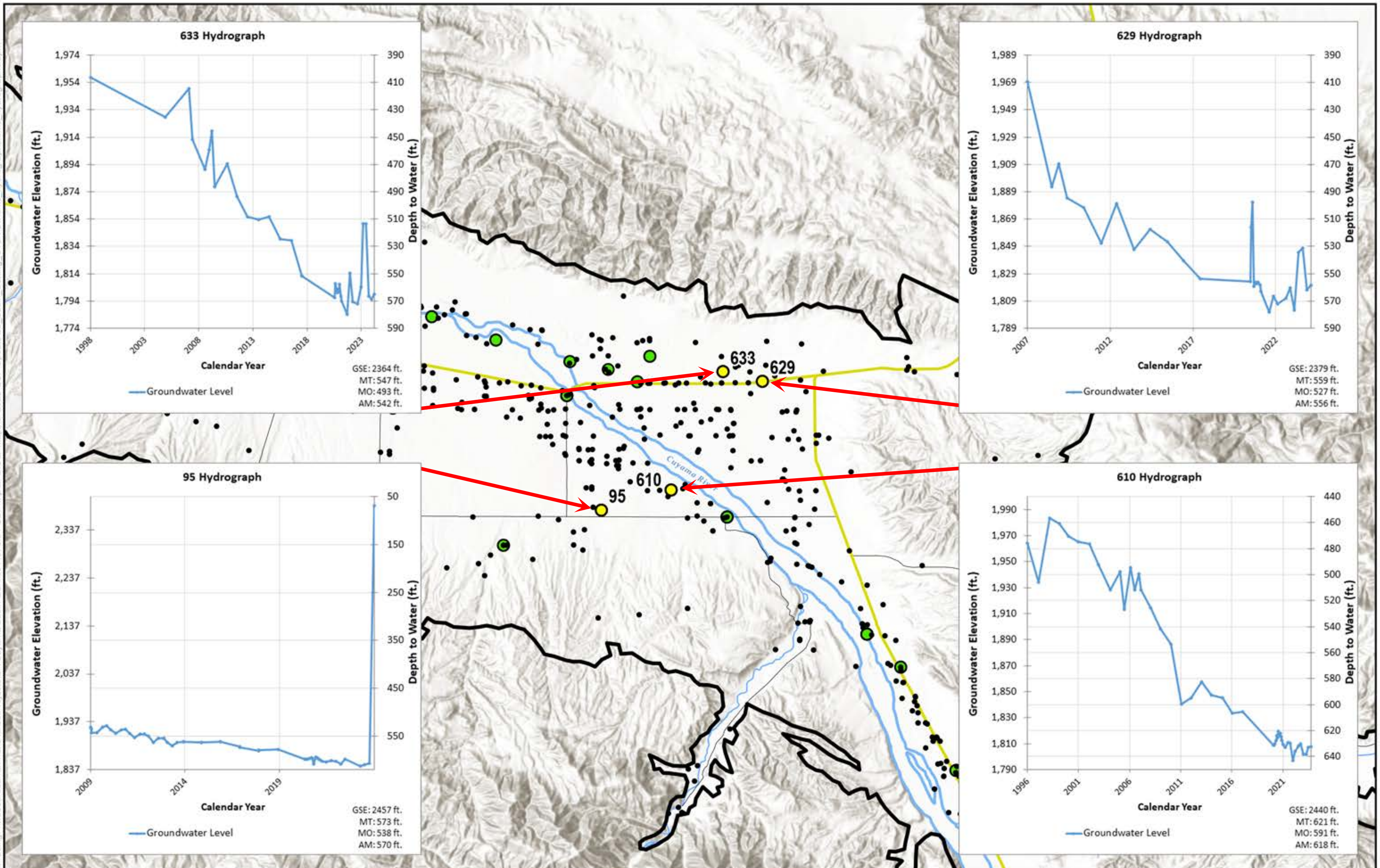

Figure 2-47: Monitoring Well Network Hydrographs

Cuyama Valley Groundwater Basin

Legend

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

N

0 0.5 1 2 Miles

Map Created: August 2024

Woodard & Curran

Cuyama Basin Groundwater Sustainability Agency

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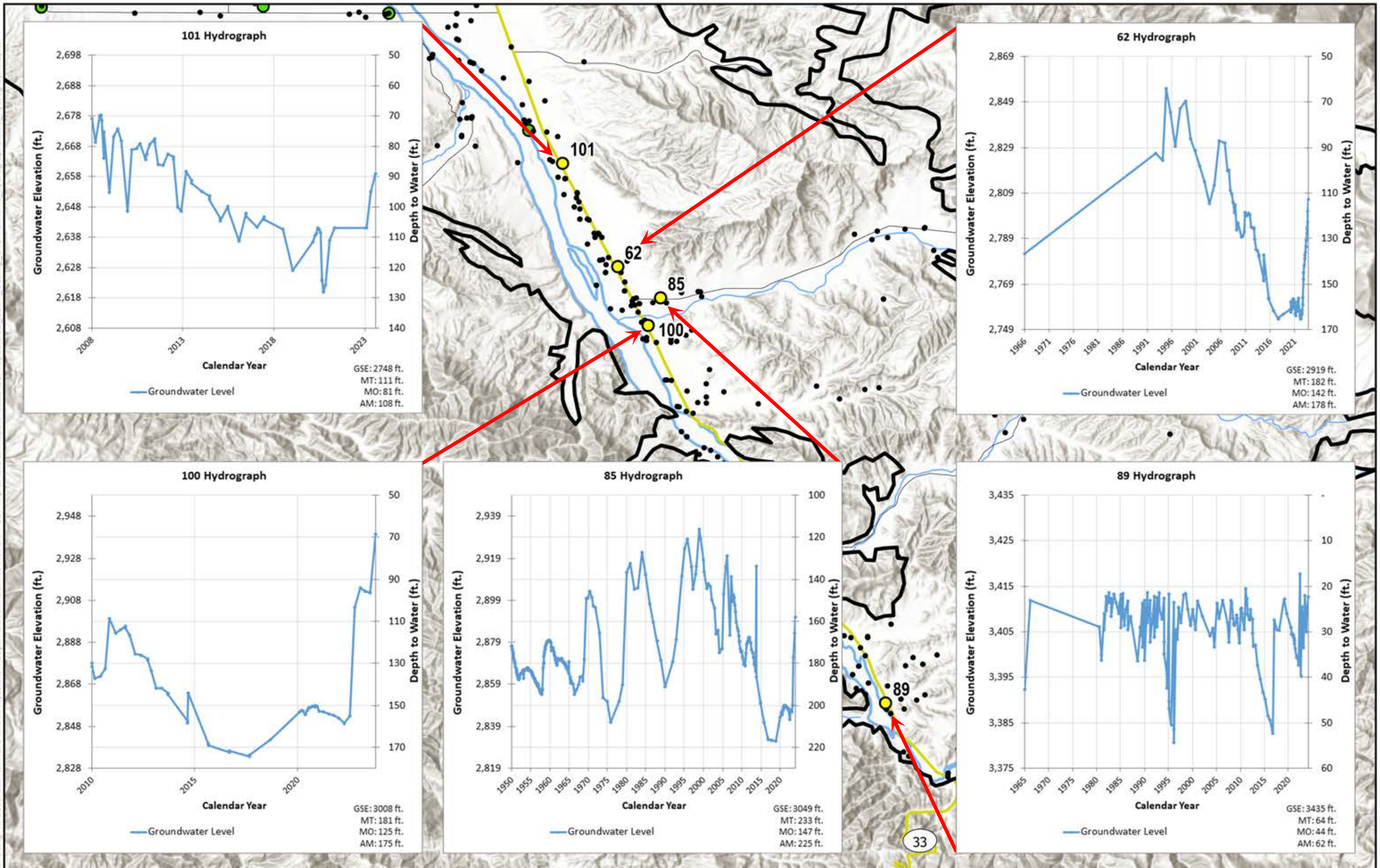

Figure 2-48: Monitoring Well Network Hydrographs

Cuyama Valley Groundwater Basin

Legend

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

N

0 0.5 1 2 Miles

Map Created: August 2024

Woodard & Curran

Cuyama Basin Groundwater Sustainability Agency

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**

Vertical Gradients

A vertical hydraulic gradient represents the movement of groundwater perpendicular to the ground surface and may be up or down. A vertical gradient is calculated by comparing the elevations of groundwater in wells with different screen depths. If groundwater elevations in the shallower well are higher than in the deeper well, the gradient is downward, corresponding to downward groundwater flow. If groundwater elevations in the shallower well are lower than in the deeper well, the gradient is upward, corresponding to upward groundwater flow. If groundwater elevations are similar, the vertical gradient 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 11 multiple completion nested wells in the Basin. 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 CVFR, CVBR, and CVKR. These nests are named after their location on Foothill Road, Bell Road, and Kirschenmann Road, respectively. Each location consists of four individual nested wells.

Three additional multi-completion nested well 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 TSS #1, 903-905 at TSS #3, and 906-908 at TSS #2 (numbering according to DWR). The CBGSA received additional grant funding through the SGMA implementation grant and has installed five multi-completion wells (Opti wells 912 to 920). 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 2-49 shows the locations of these 11 multi-competition wells. Opti well 914 was drilled in a location that was identified as a potential multi-completion well, but due to the geology encountered during drilling, only one well was constructed. Multi-completion nested wells at the MW-D location have not been constructed yet but will be completed prior to the GSP 2025 submittal.

Figure 2-50 shows the combined hydrograph for the multi-completion well CVFR, which was constructed by the USGS.[8] The first measurements were recorded on October 27, 2009. CVFR is comprised of four 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.

[8] All three multiple-completion wells were constructed by the USGS as part of the Cuyama Valley Water Availability Study in cooperation with SBCWA

- Opti well 317 (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. Water level measurements for this well stopped in 2014 when the depth to water dropped below 610 feet bgs (i.e., the well is dry).

The hydrograph of the four wells shows similar groundwater elevations, with a difference of only three feet on the last recorded measurement date of April 26, 2024. Therefore, the vertical gradient is very low at this location. Figure 2-51 is scaled to show more detail for the years 2020-2024 to differentiate variations in recent water levels. The hydrograph shows consistent water levels for the wells prior to mid-2022. Afterwards, the third deepest well, 316, had the lowest water levels by several feet. Presumably, measurement errors in late 2020 at well 91 and mid-2023 at well 317 cause the anonymous water levels shown on the hydrograph.

Figure 2-52 shows the combined hydrograph for the multi-completion well CVBR. The first water level measurements were recorded on September 29, 2009. CVBR is comprised of four 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.

Historical measurements in the four wells indicate 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 have been about the same, with a difference of only about two feet. These recent measurements indicate a very low vertical gradient. Figure 2-53 is scaled to show more detail for the years 2020-2024 to differentiate variations in recent water levels. The hydrograph shows consistent water levels at wells at the beginning of each year. At mid-year, the deepest well, 325, had the shallowest water level and the third deepest well, 322, had the deepest water level.

Figure 2-54 shows the combined hydrograph for the multi-completion well CVKR. The first measurements were recorded on March 3, 2009. CVKR is comprised of four 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.

Similar to CVBR, the hydrograph of these four wells indicates 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 2-55 is scaled to show more detail for the years 2020-2024 to differentiate variations in recent water levels. The hydrograph shows consistent water levels at the wells during this period except for presumed measurement error in mid-2022 at well 420.

Figure 2-56 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 screened 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 completion 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, recorded on April 24, 2024, shows only a two-foot variation between the three wells.

Figure 2-57 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 screened interval from 540 to 570 feet bgs.
- Opti well 904 has the second deepest completion with a screened interval from 360 to 400 feet bgs.
- Opti well 903 has the shallowest completion with a screened interval from 265-305 feet bgs.

Similar to TSS #1, the hydrograph shows the deepest well typically has the highest water level, indicating a small upward vertical gradient. This vertical gradient has remained consistent throughout the monitoring period from July 2022 to the latest measurement recorded on April 24, 2024.

Figure 2-58 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 screened interval from 650-660 feet bgs.

- Opti well 907 is the second deepest completion with a screened interval from 515-525 feet bgs.
- Opti well 906 is the shallowest completion with a screened 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 deepest wells is higher than the vertical gradient between the shallowest and intermediate wells. These water level differences are generally consistent throughout the monitoring period.

Table 2-2 shows the screen depths for multi-completion wells recently constructed by the CBGSA under the SGMA grant and initial groundwater levels.

Table 2-2: CBGSA Nested Wells

Nested Well	Deep Completion (feet bgs)	Shallow Completion (feet bgs)	Water Level Measurements (feet btoc)
Opti well 912-913 (MW-F)			
Opti 913	350-370		39.29 (6/5/2024)
Opti 912		180-200	8.05 (6/5/2024)
Opti 915-916 (MW-H)			
Opti 916	880- 900		507.82 (5/15/2024)
Opti 915		660-680	574.67 (5/15/2024)
Opti 917-918 (MW-E)			
Opti 918	720-740		386 (7/1/2024)
Opti 917		610- 630	381 (7/1/2024)
Opti Well 919-920 (MW-G)			
Opti 920	420-440		370.65 (8/2/2024)
Opti 919		280-300	196.10 (8/2/2024)
Opti 914 (MW-C)			
Opti 914	500-520 (Only one completion due to the geology encountered during drilling)		481.15 (4/11/2024)
Opti 921 (MW-D)			
Opti 921	820-840 (Only one completion due to the geology encountered during drilling)		Not available at the time of GSP Development

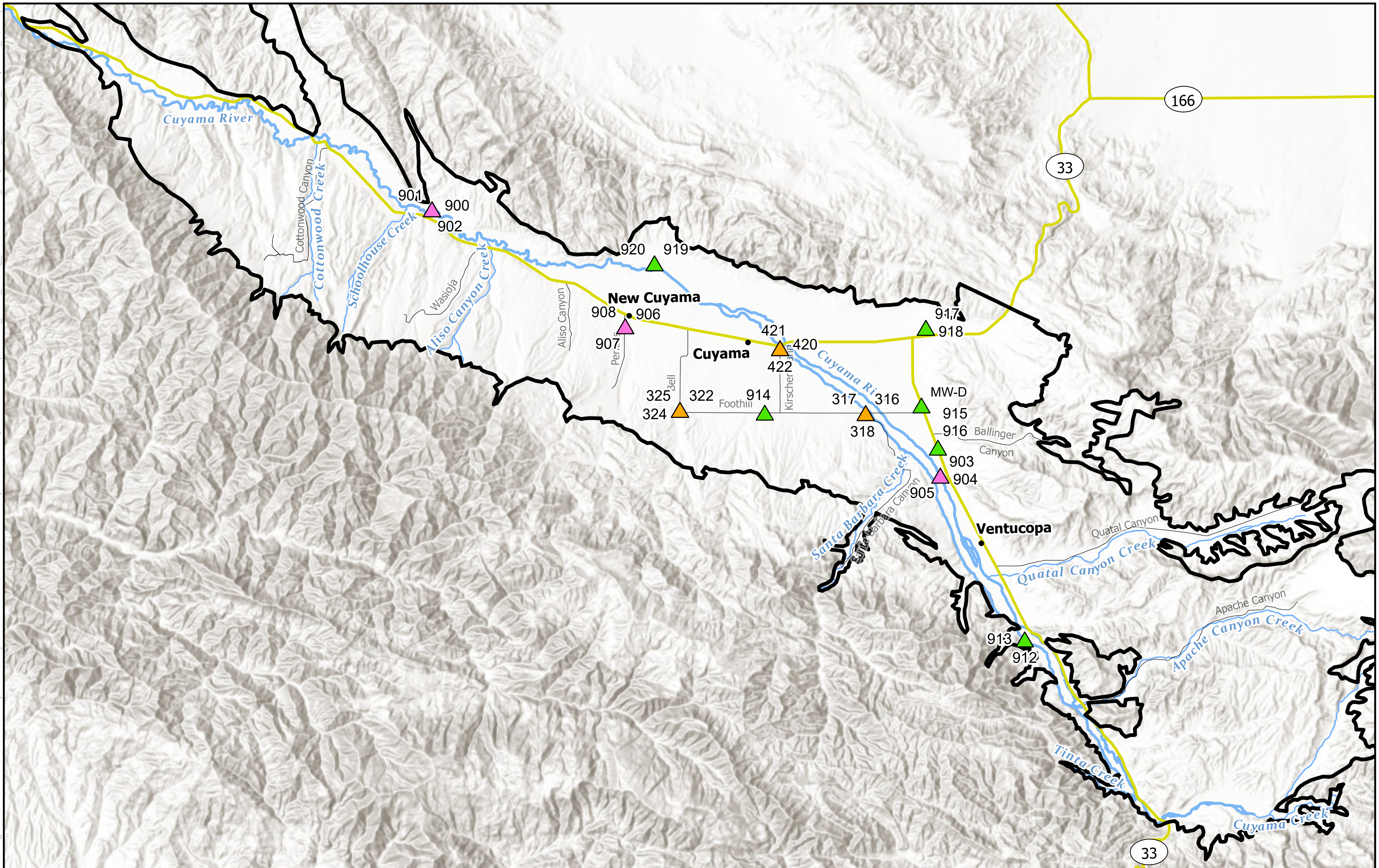

Figure 2-49: Multi Completion And Nested Wells

Cuyama Valley Groundwater Basin

Legend

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

N

0 1.25 2.5 5 Miles

Woodard & Curran

Cuyama Basin Groundwater Sustainability Agency

Map Created: July 2024

Figure Exported: 7/15/2024 By: DHunt Using: \\woodardcurran.net\shared\Projects\CA Cuyama Basin GSA\0011078.01 GSP\wip\Z_GIS\2. Maps\3. 2025 GSP Update\02_Basin_Setting_Overview\multi_completion_wells\multi_completion_wells.aprx

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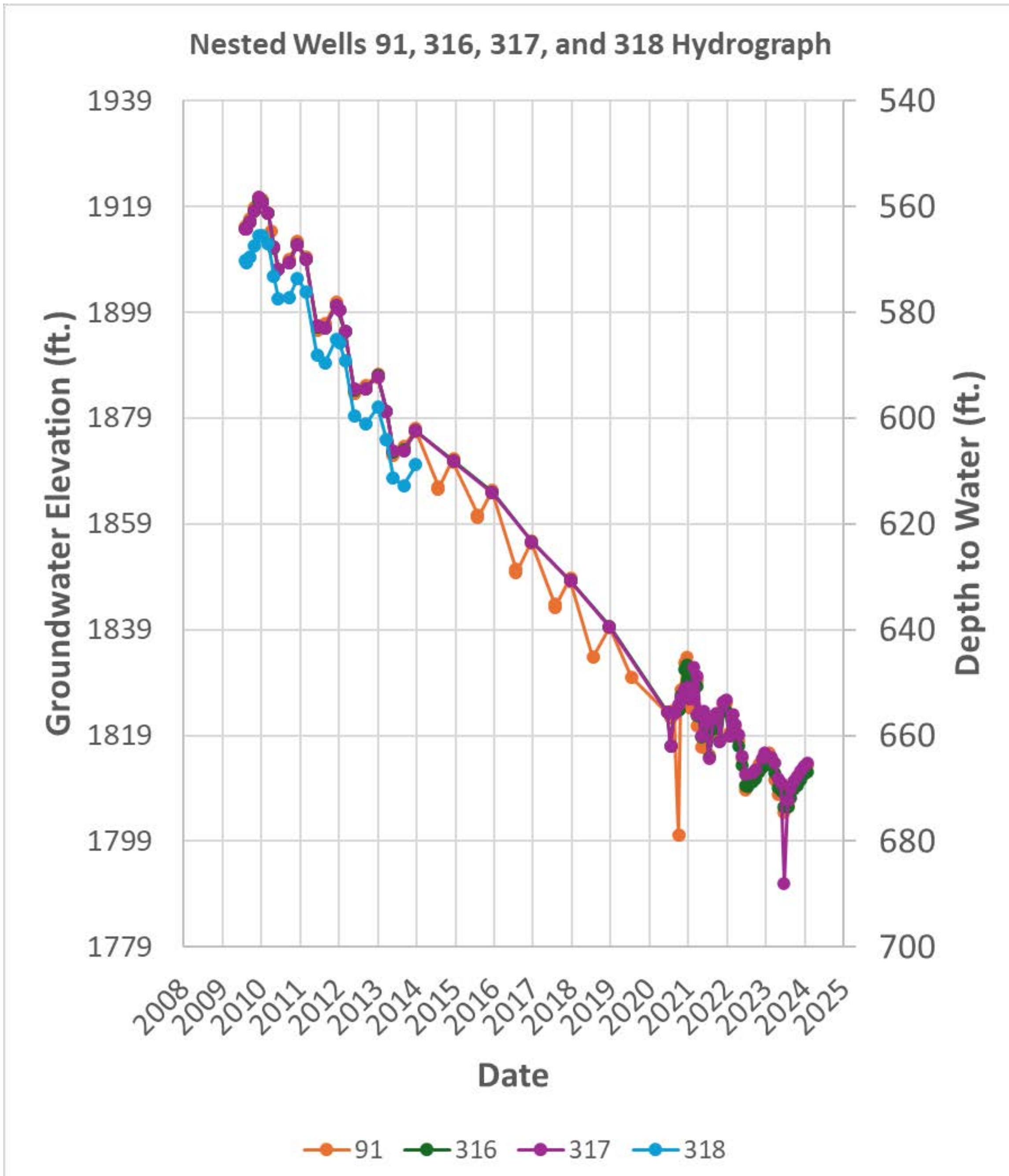

Figure 2-50: Hydrographs of Opti well 91, 316, 317, 318 (USGS Well CVFR)

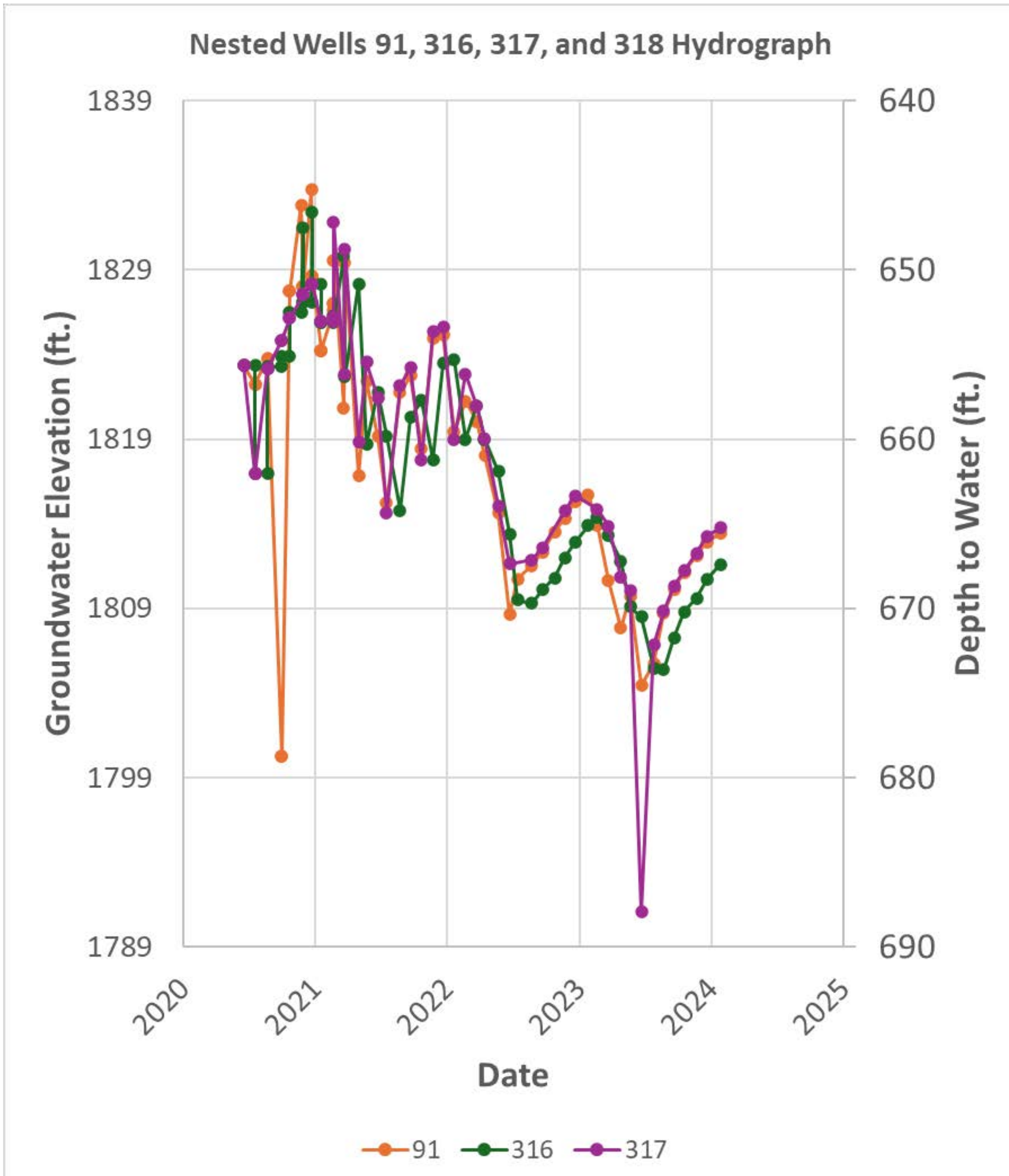

Figure 2-51: Hydrographs of Opti well 91, 316, 317, and 318 (USGS Well CVFR) 2020 - 2024 Only

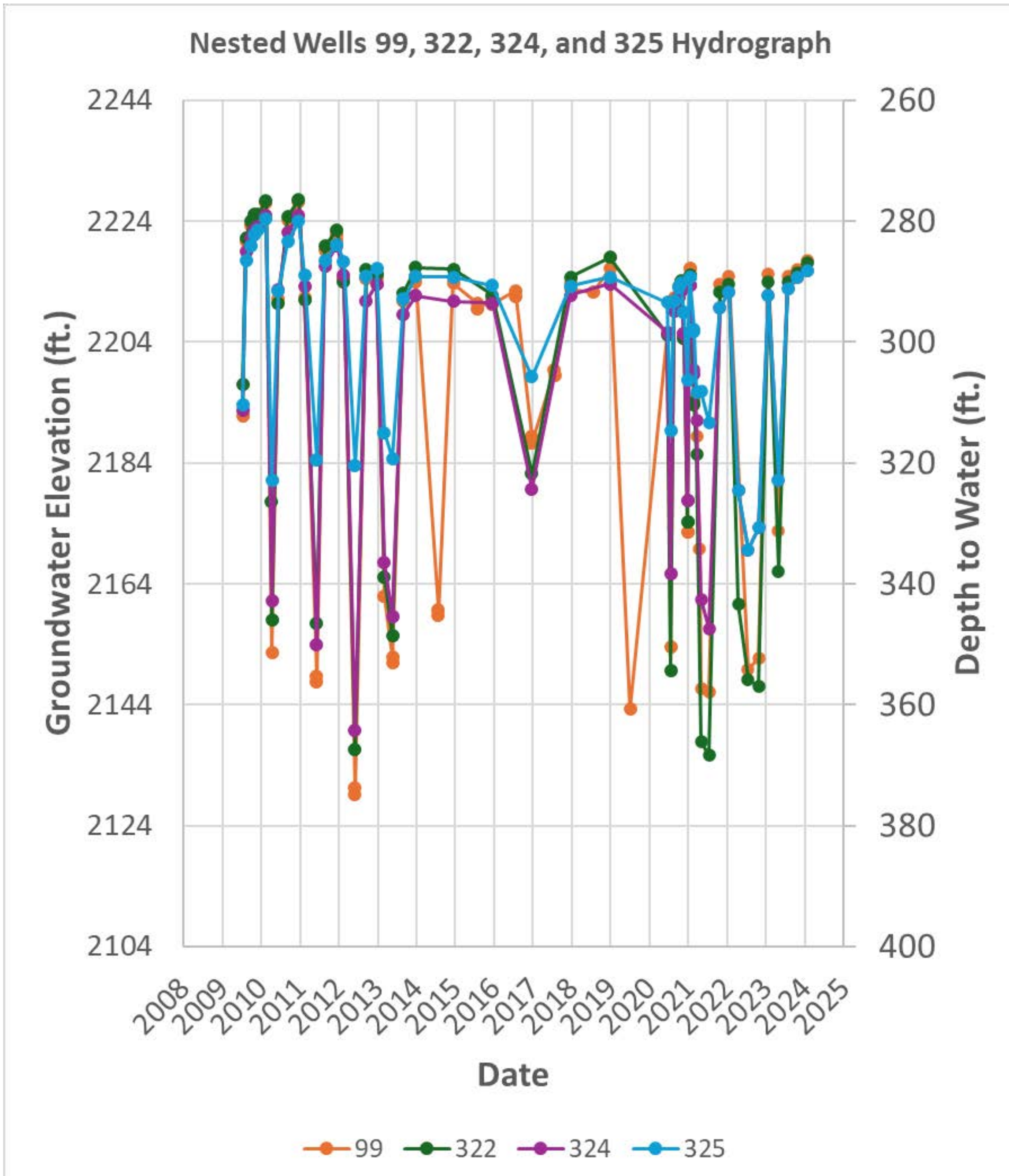

Figure 2-52: Hydrographs of Opti well 99, 322, 325, and 325 (USGS Well CVBR)

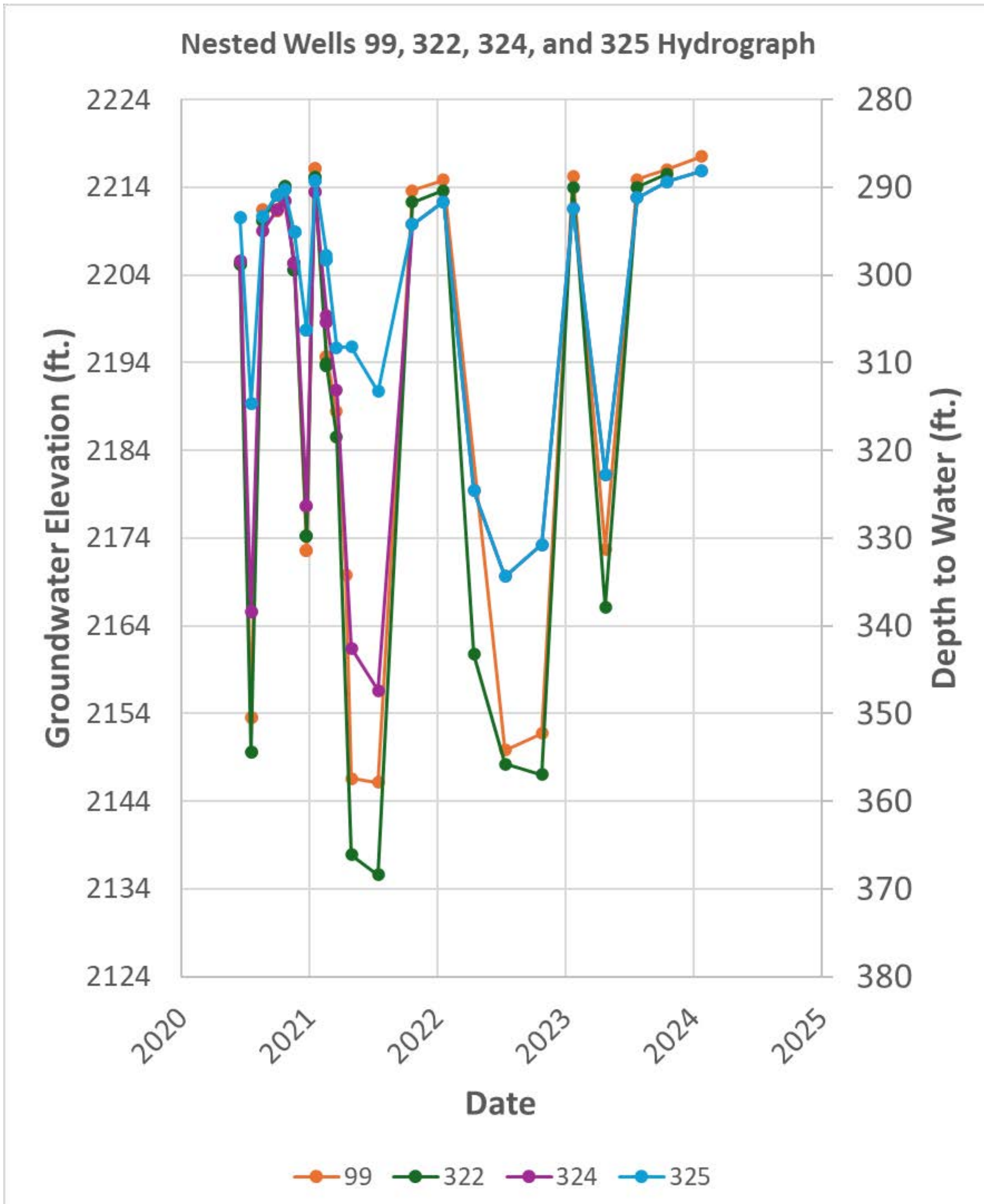

Figure 2-53: Hydrographs of Opti well 99, 322, 325, and 325 (USGS Well CVBR) 2020 - 2024 Only

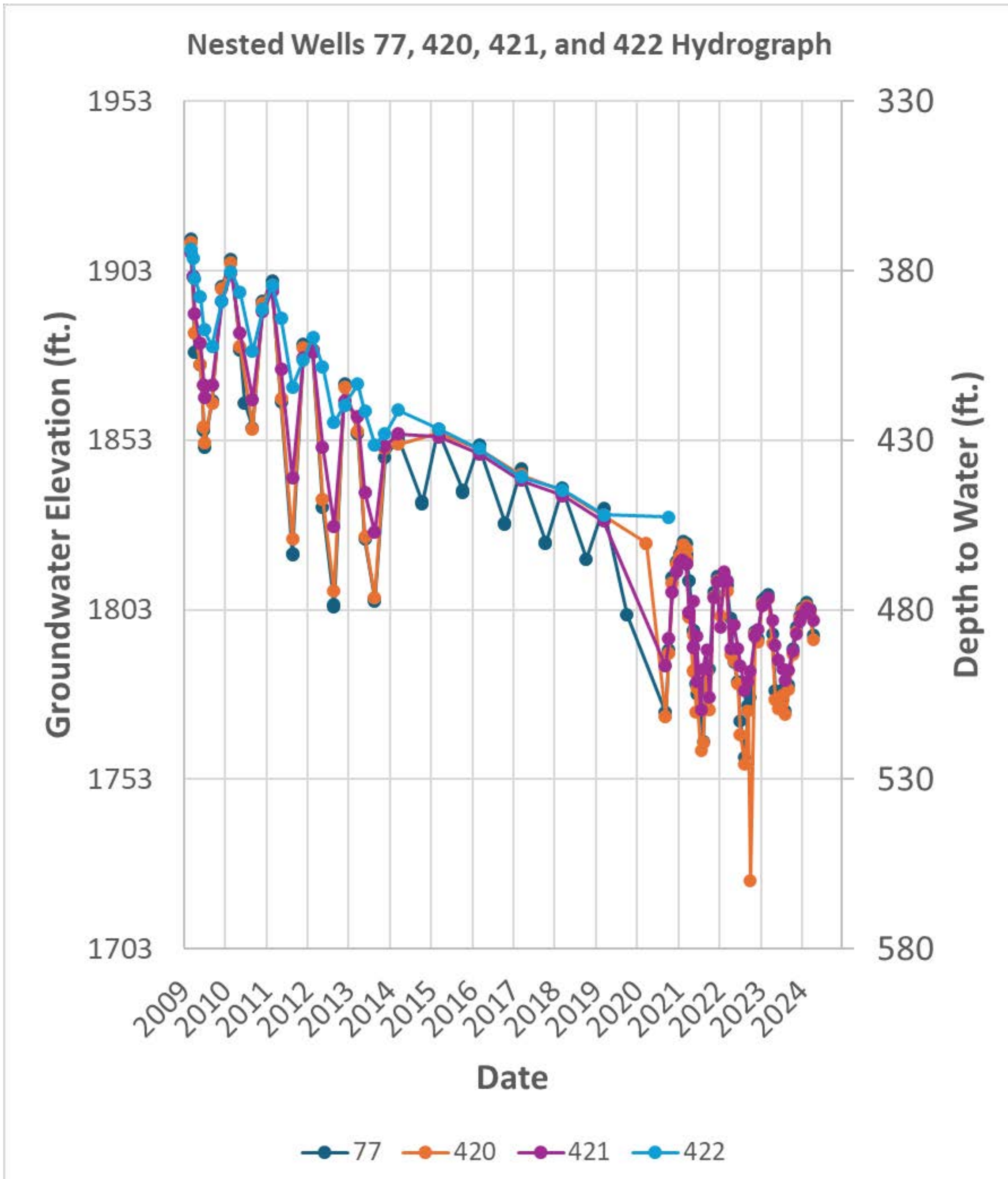

Figure 2-54: Hydrographs of Opti well 77, 420,421, and 422 (USGS well CVKR)

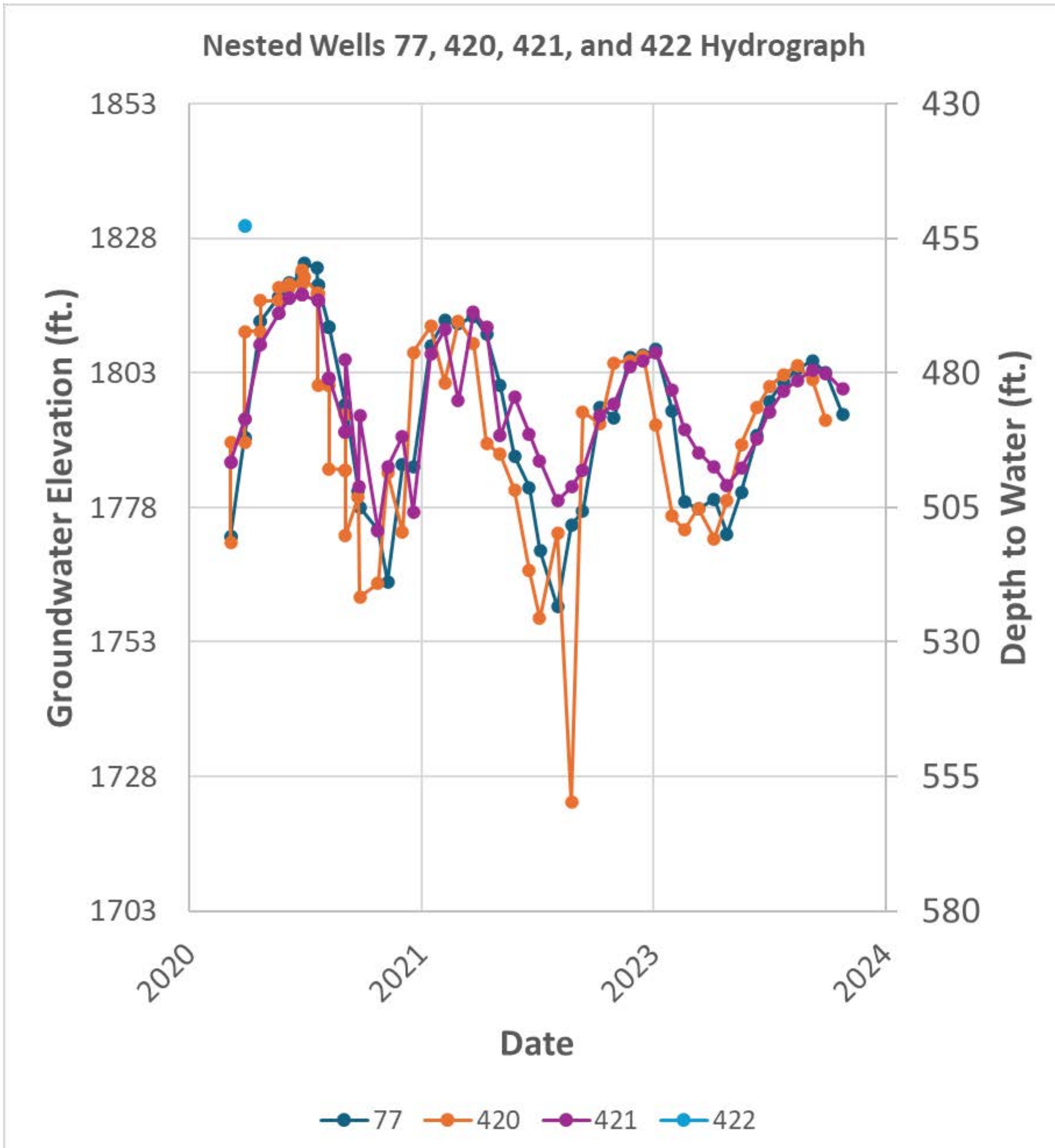

Figure 2-55: Hydrographs of Opti well 77, 420,421, and 422 (USGS well CVKR) 2020-2024 Only

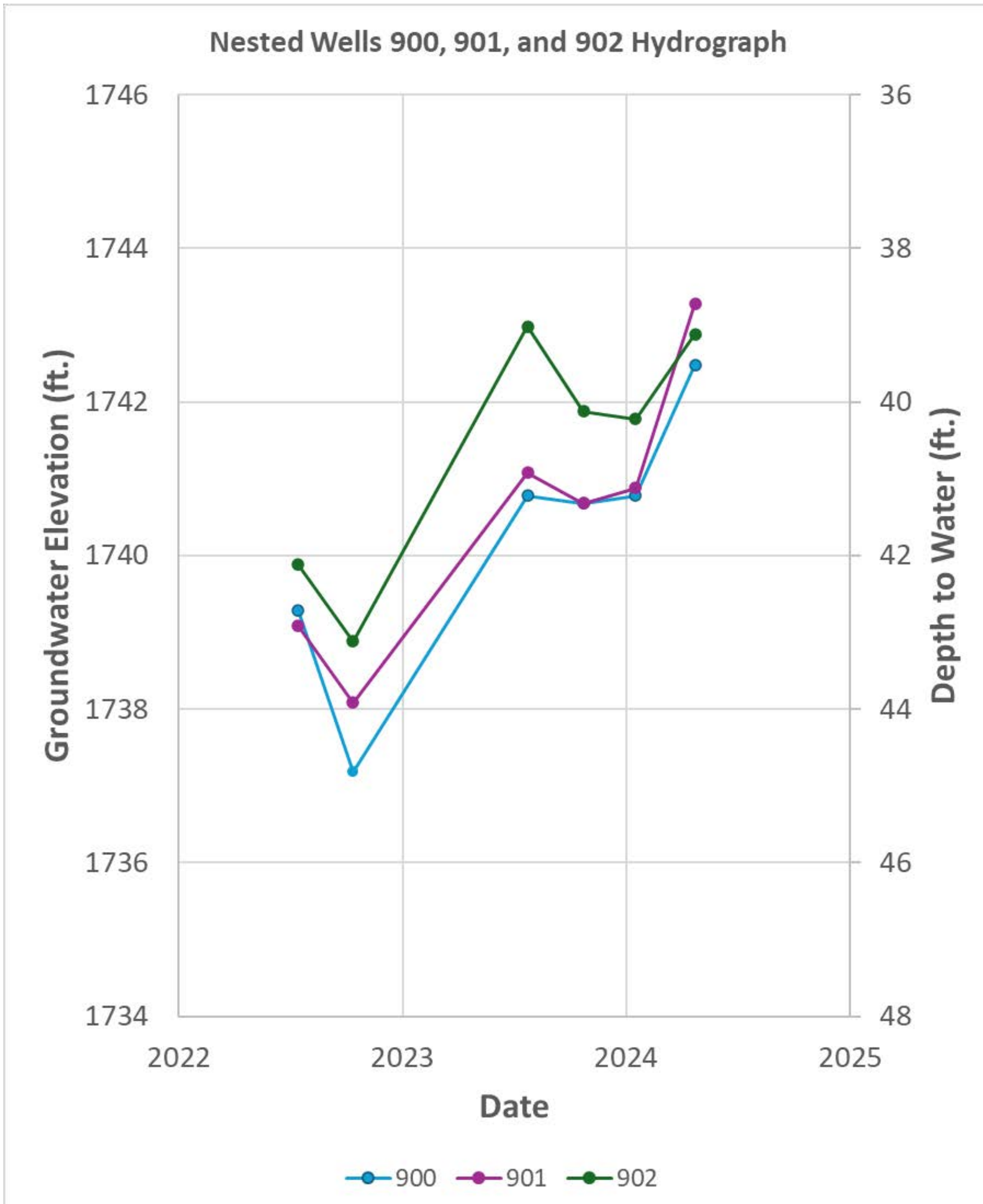

Figure 2-56: Hydrographs Opti well 900, 901 and 902 (TSS Well #1)

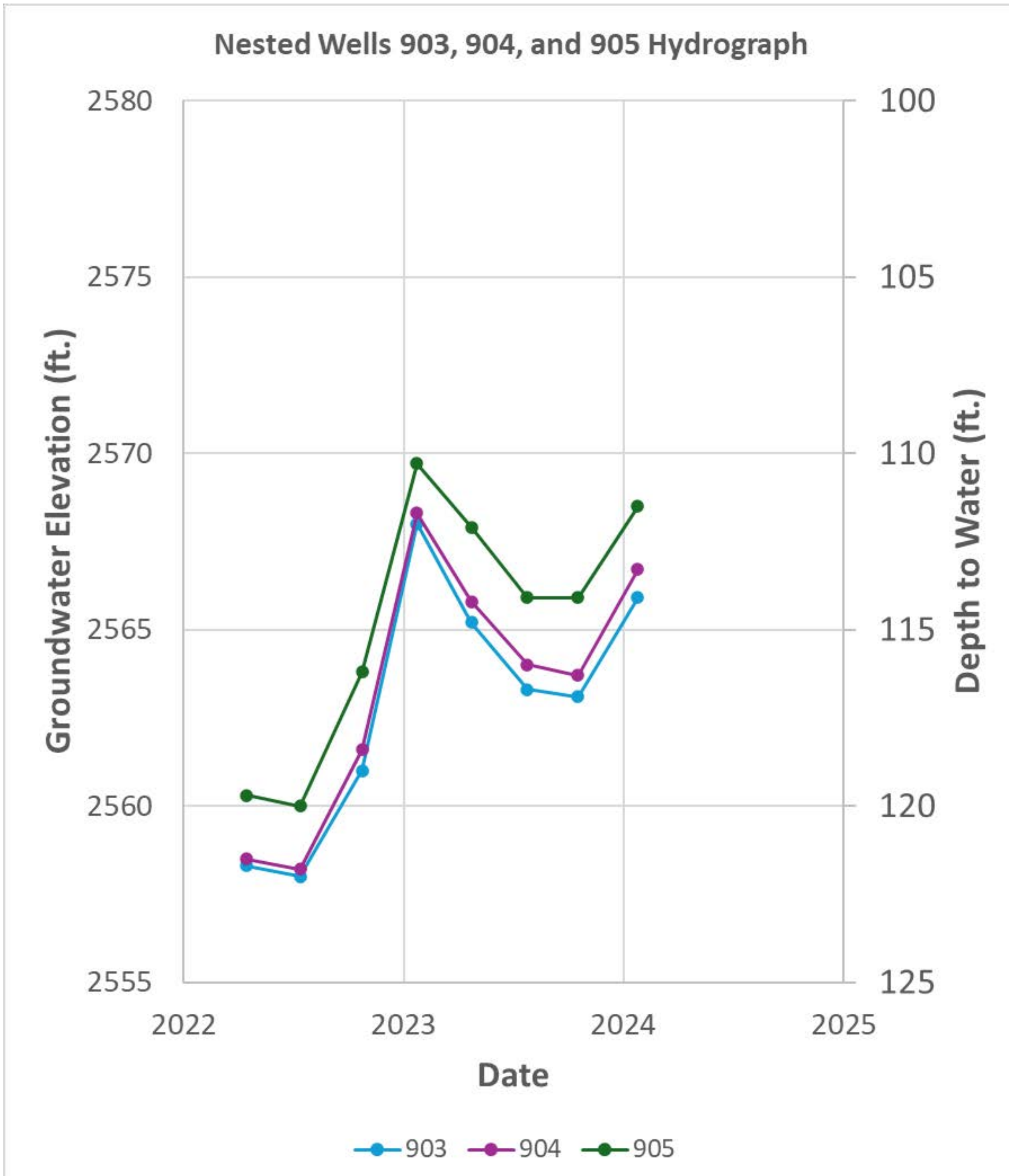

Figure 2-57: **Hydrograph Opti wells 903, 904, and 905 (TSS Well #3)**

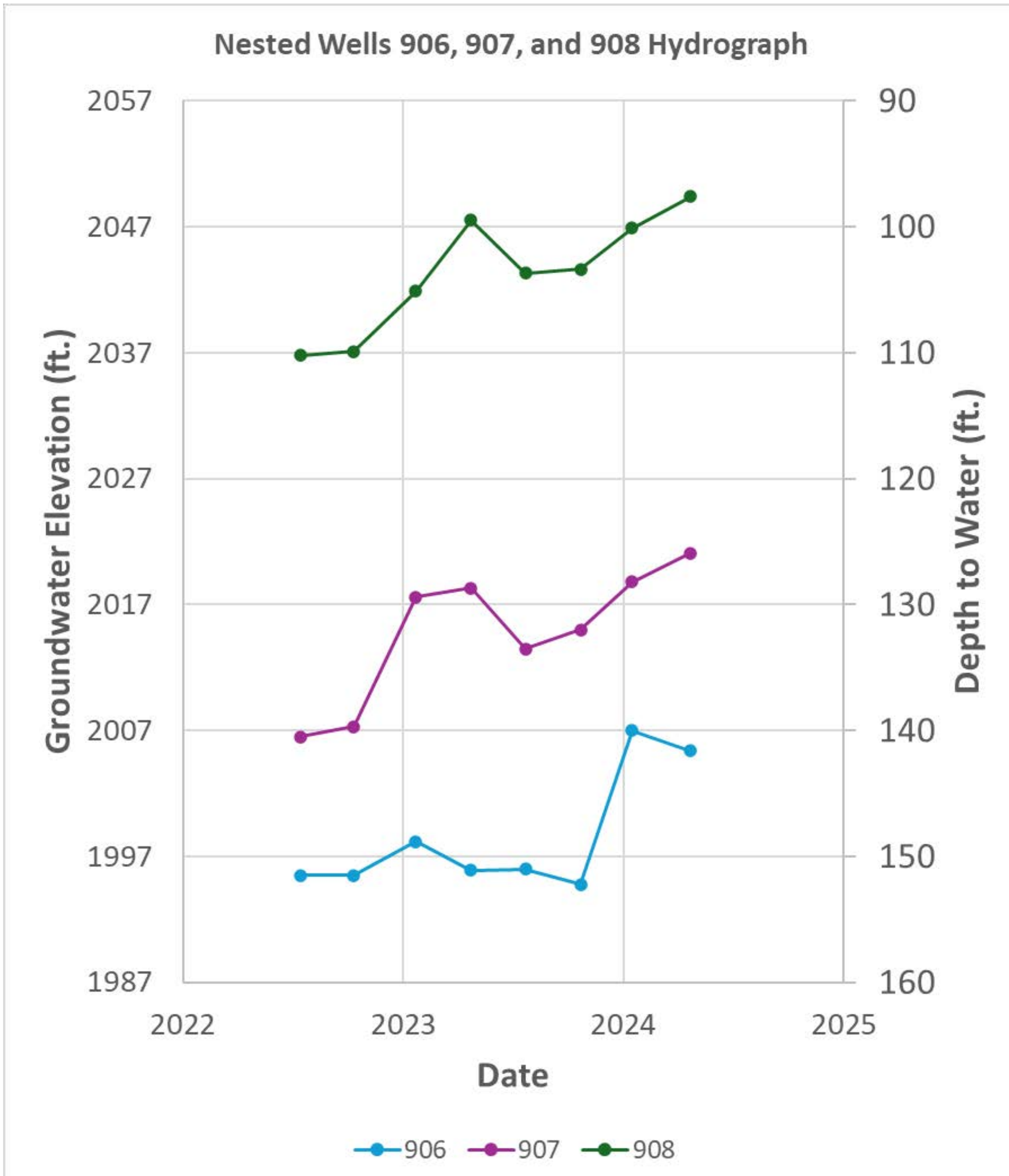

Figure 2-58: Hydrograph for Opti wells 906, 907, and 908 (TSS Well #2).

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 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 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

These years were selected for display because they are representative of current conditions and seasonal patterns. The contour maps are described below.

Each contour map follows the same general format using a 100-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 between are inferred because the available data 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 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 within that season.

These assumptions 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 contours reflect approximate conditions between measurement points. The contours do not account for topography or bedrock outcrops within the Basin. Therefore, a well on a ridge may have a greater depth to groundwater than a well in a canyon, and the contour map will not reflect that level of detail.

Figure 2-59 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 land surface elevations and towards the Cuyama River.

Figure 2-60 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 decreases (i.e., is closer to ground surface) to the west towards New Cuyama, where the depth to 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 2-61 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 2-62 shows depth to groundwater contours for fall of 2022. North of the SBCF, depth to groundwater declines rapidly to over 600 feet bgs. Depth to groundwater decreases (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 2-63 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 land surface elevations and towards the Cuyama River.

Figure 2-64 shows depth to groundwater contours for fall of 2020. North of the SBCF, depth to groundwater declines rapidly to over 600 feet bgs. Depth to groundwater decreases (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 2-65 shows groundwater elevation contours for spring of 2018.In the southeastern portion of the Basin near Ventucopa, groundwater flows to the northwest. The gradient increases in the vicinity of the SBCF and groundwater flows to an area of lower groundwater elevation southeast of the town of Cuyama. Lower 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 elevation contours reflect a gradient and flow to the northeast, from areas with higher land surface elevations towards areas with lower land surface elevations and towards the Cuyama River.

Figure 2-66 shows depth to groundwater contours for spring of 2018. Just south of the SBCF, depth to groundwater is about 100 feet bgs. North of the SBCF, depth to groundwater declines rapidly to over 600 feet bgs. Depth to groundwater decreases (i.e., is closer to ground surface) to the west towards New Cuyama, where groundwater is around 200 feet bgs. West of Bitter Creek, groundwater is shallower than 100 feet bgs in most locations.

Figure 2-67 shows groundwater elevation contours for fall of 2017. The contour map shows a steep gradient across the SBCF and groundwater flow to an area of lower groundwater elevations 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 northeast, from areas with higher land surface elevations towards areas with lower land surface elevations and towards the Cuyama River.

Figure 2-68 shows depth to water contours for fall of 2017. 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 (i.e., shallower) to the west of New Cuyama. West of Bitter Creek, groundwater is generally shallower than 100 feet below bgs.

Figure 2-69 shows groundwater elevation contours for spring of 2017. 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 northeast, from areas with higher land surface elevations towards areas with lower land surface elevations and towards the Cuyama River.

Figure 2-70 shows depth to water contours for spring of 2017. 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.

Figure 2-71 shows groundwater elevation contours for spring of 2015. Data for this year is more limited but the groundwater gradient indicates flow that follows the Cuyama River and from areas with higher land surface elevations towards areas with lower land surface elevations towards the central portion of the Basin.

Figure 2-72 shows depth to water contours for spring of 2015. Data indicates 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 300 and 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.

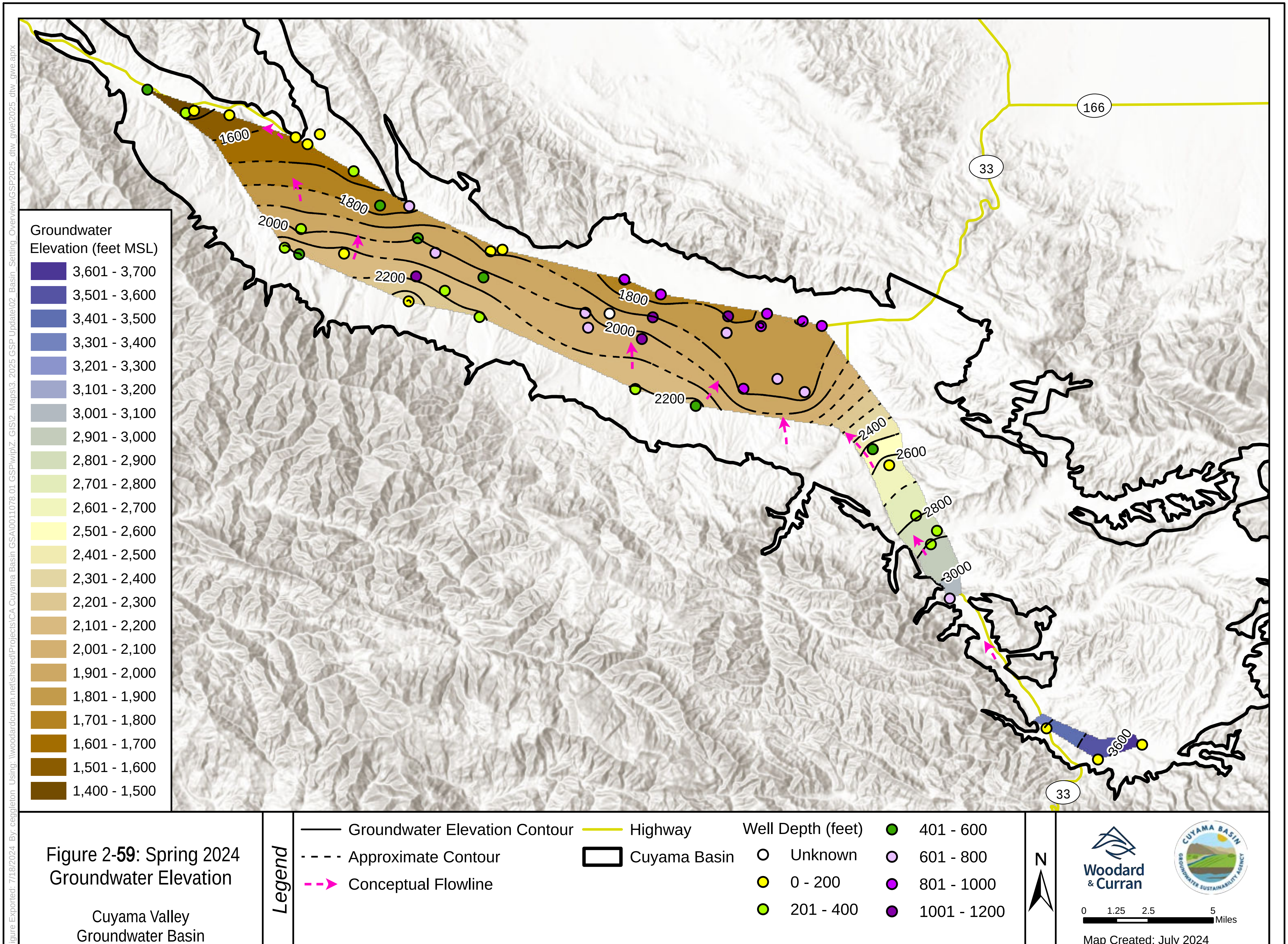

Figure 2-**59**: Spring 2024 Groundwater Elevation

Cuyama Valley Groundwater Basin

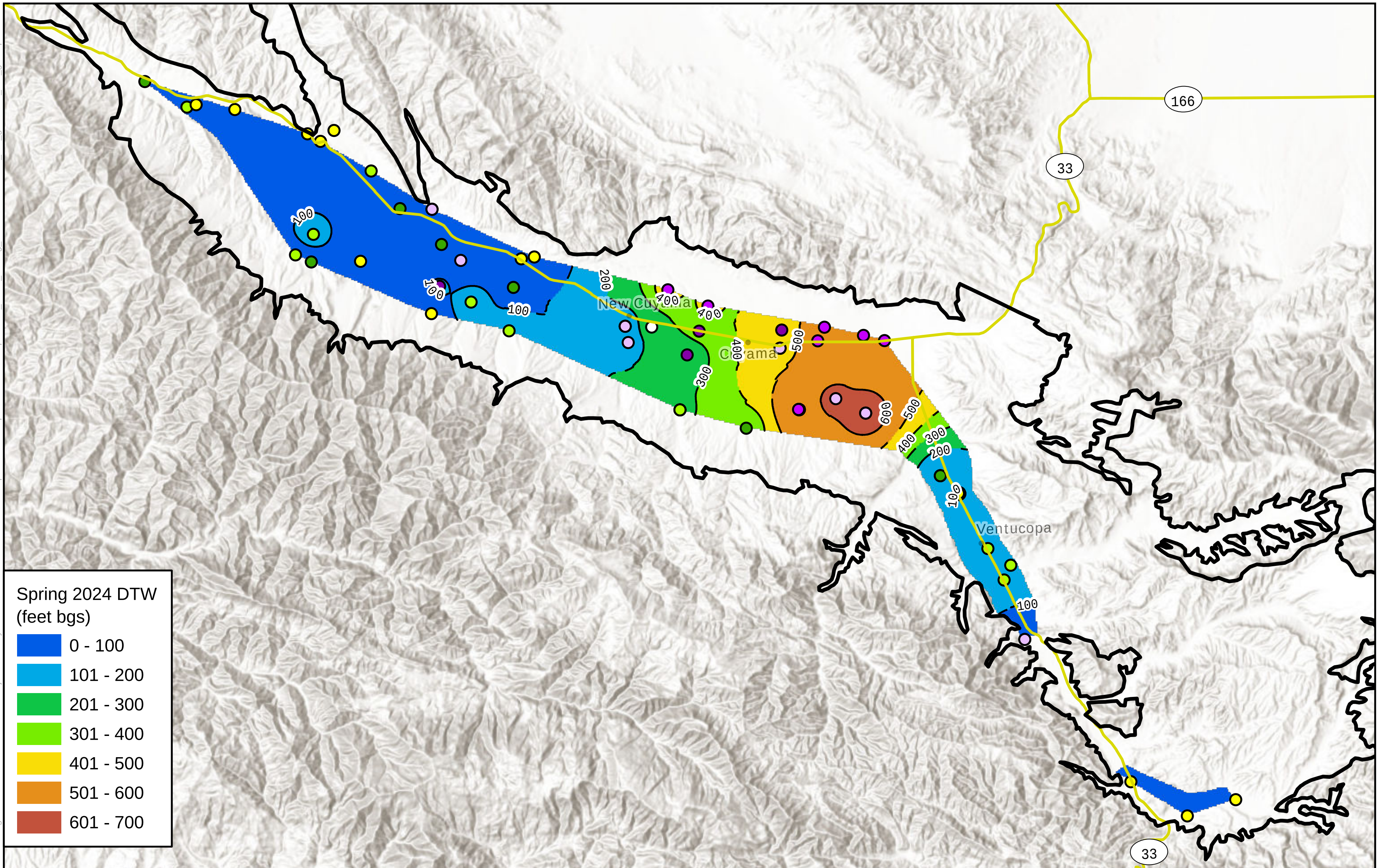

Figure 2-60: Spring 2024 Depth to Water

Cuyama Valley Groundwater Basin

Legend

- Depth to Water Contour
- Approximate Contour
- Highway
- Local Road
- Town
- Cuyama Basin

Well Depth

- Unknown
- 0 - 200
- 201 - 400
- 401 - 600
- 601 - 800
- 801 - 1000
- 1001 - 1200

N

Woodard & Curran

CUYAMA BASIN GROUNDWATER SUSTAINABILITY AGENCY

0 1.25 2.5 5 Miles

Map Created: July 2024

Figure Exported: 7/18/2024 By: ceggleton Using: \\woodardcurran.net\shared\Projects\CA Cuyama Basin GSA\0011078.01 GSPwip\Z. GIS\2. Maps\3. 2025 GSP Update\02_Basin_Setting_Overview\GSP2025_dtw_gwe\2025_dtw_gwe.aprx

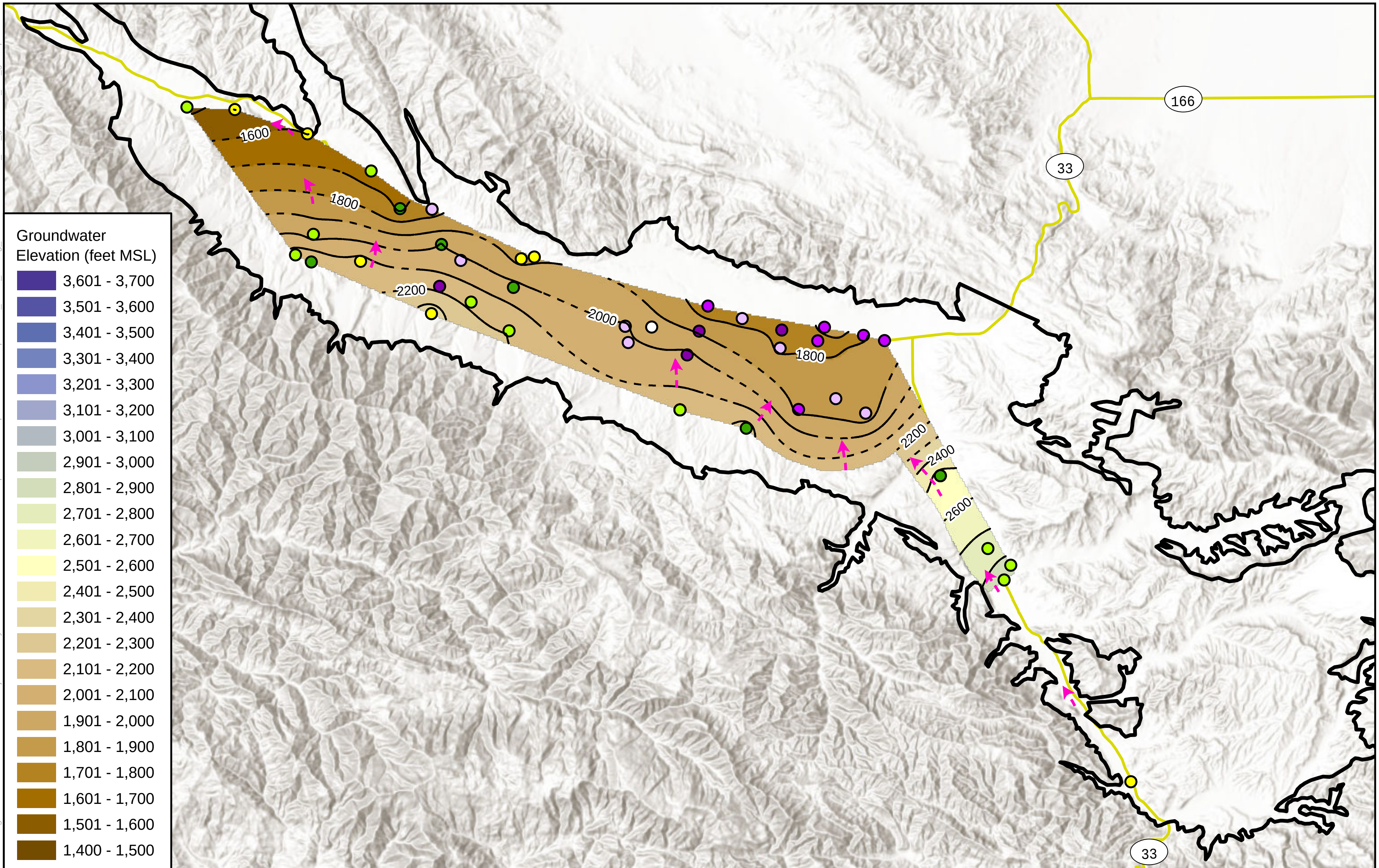

Figure 2-61: Fall 2022 Groundwater Elevation

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

Woodard & Curran

CUYAMA BASIN GROUNDWATER SUSTAINABILITY AGENCY

0 1.25 2.5 5 Miles

Map Created: July 2024

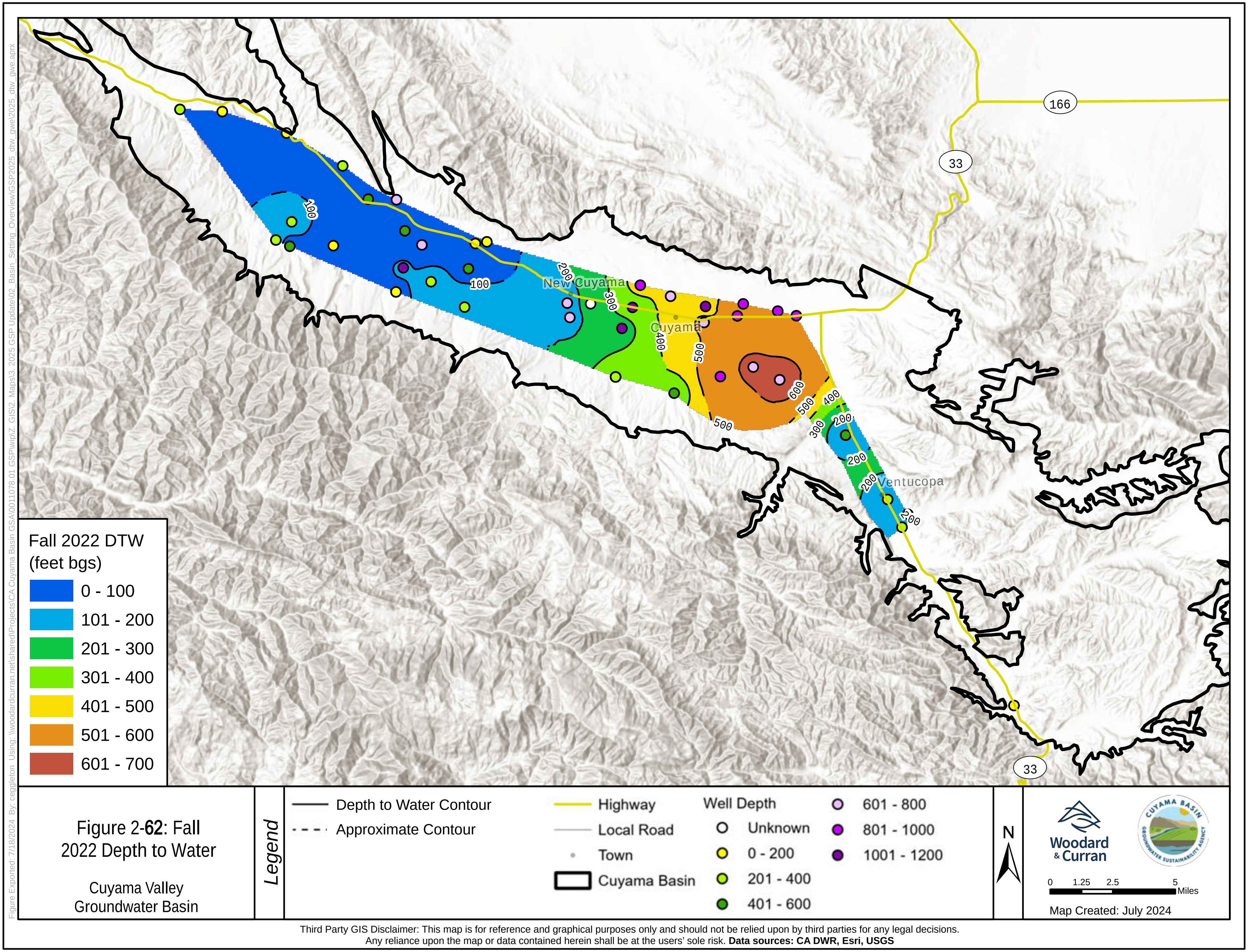

Figure 2-62: Fall 2022 Depth to Water

Cuyama Valley Groundwater Basin

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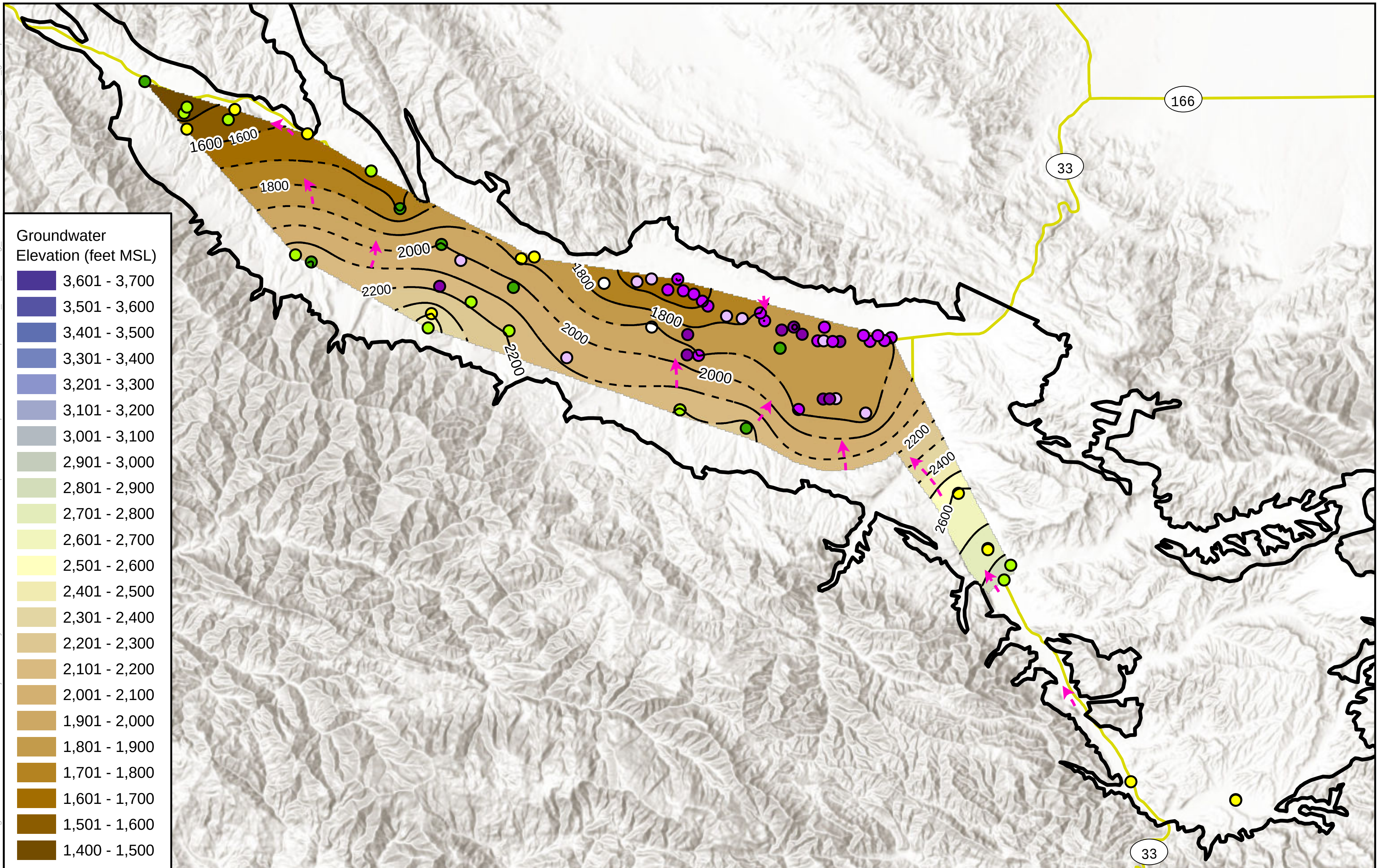

Figure 2-63: Fall 2020 Groundwater Elevation

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

Woodard & Curran

CUYAMA BASIN GROUNDWATER SUSTAINABILITY AGENCY

0 1.25 2.5 5 Miles

Map Created: July 2024

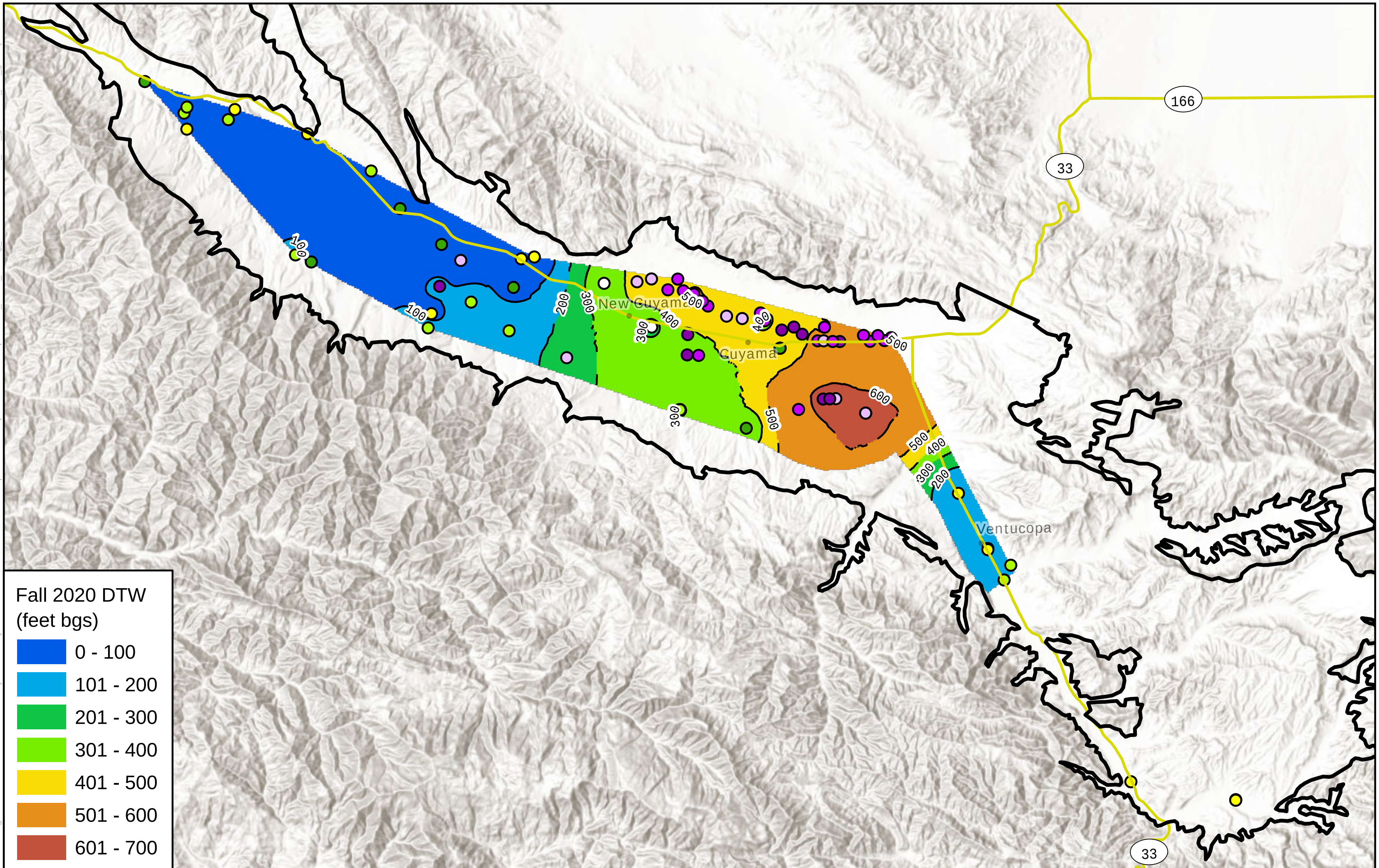

Figure 2-**64**: Fall 2020 Depth to Water

Cuyama Valley Groundwater Basin

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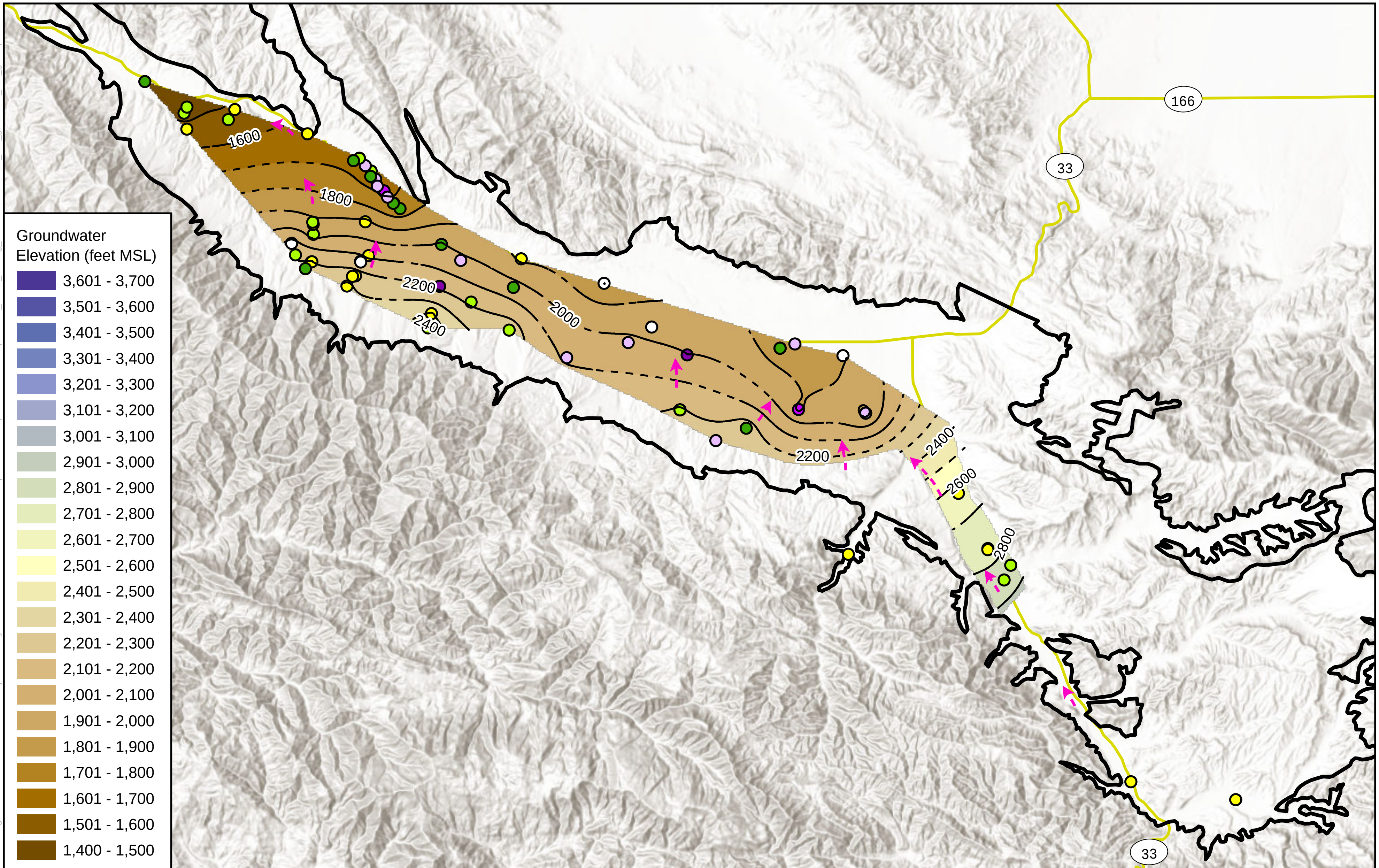

Figure 2-**65**: Spring 2018 Groundwater Elevation

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

Woodard & Curran

CUYAMA BASIN GROUNDWATER SUSTAINABILITY AGENCY

0 1.25 2.5 5 Miles

Map Created: July 2024

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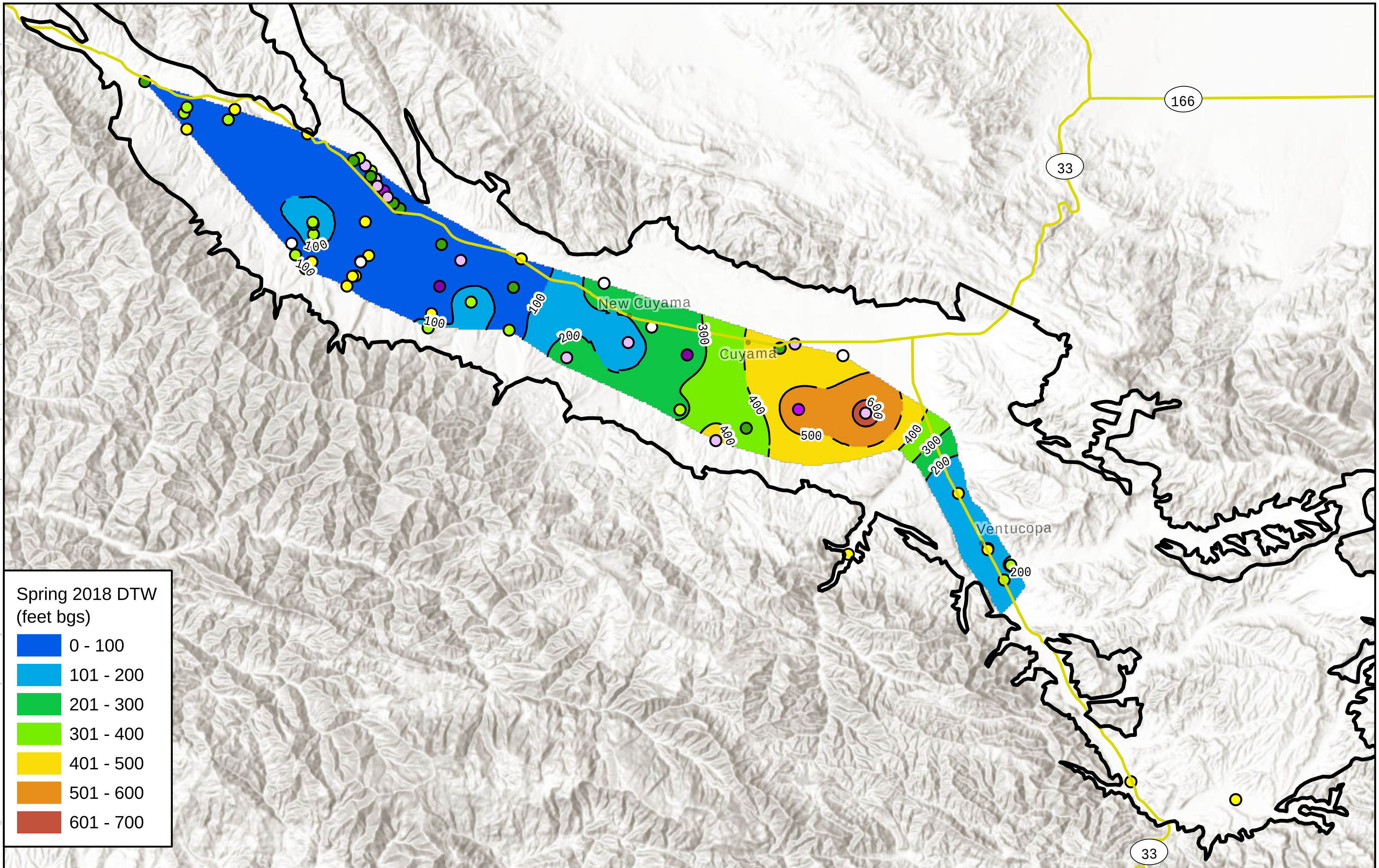

Figure 2-66: Spring 2018 Depth to Water

Cuyama Valley Groundwater Basin

Legend

- Depth to Water Contour
- Approximate Contour
- Highway
- Local Road
- Town
- Cuyama Basin

Well Depth

- Unknown
- 0 - 200
- 201 - 400
- 401 - 600
- 601 - 800
- 801 - 1000
- 1001 - 1200

N

Woodard & Curran

CUYAMA BASIN GROUNDWATER SUSTAINABILITY AGENCY

0 1.25 2.5 5 Miles

Map Created: July 2024

Figure Exported: 7/18/2024 By: ceggleton Using: \\woodardcurran.net\shared\Projects\CA Cuyama Basin GSA\0011078.01 GSP\wip\Z. GIS\2. Maps\3. 2025 GSP Update\02_Basin_Setting_Overview\GSP2025_dtw_gwe\2025_dtw_gwe.aprx

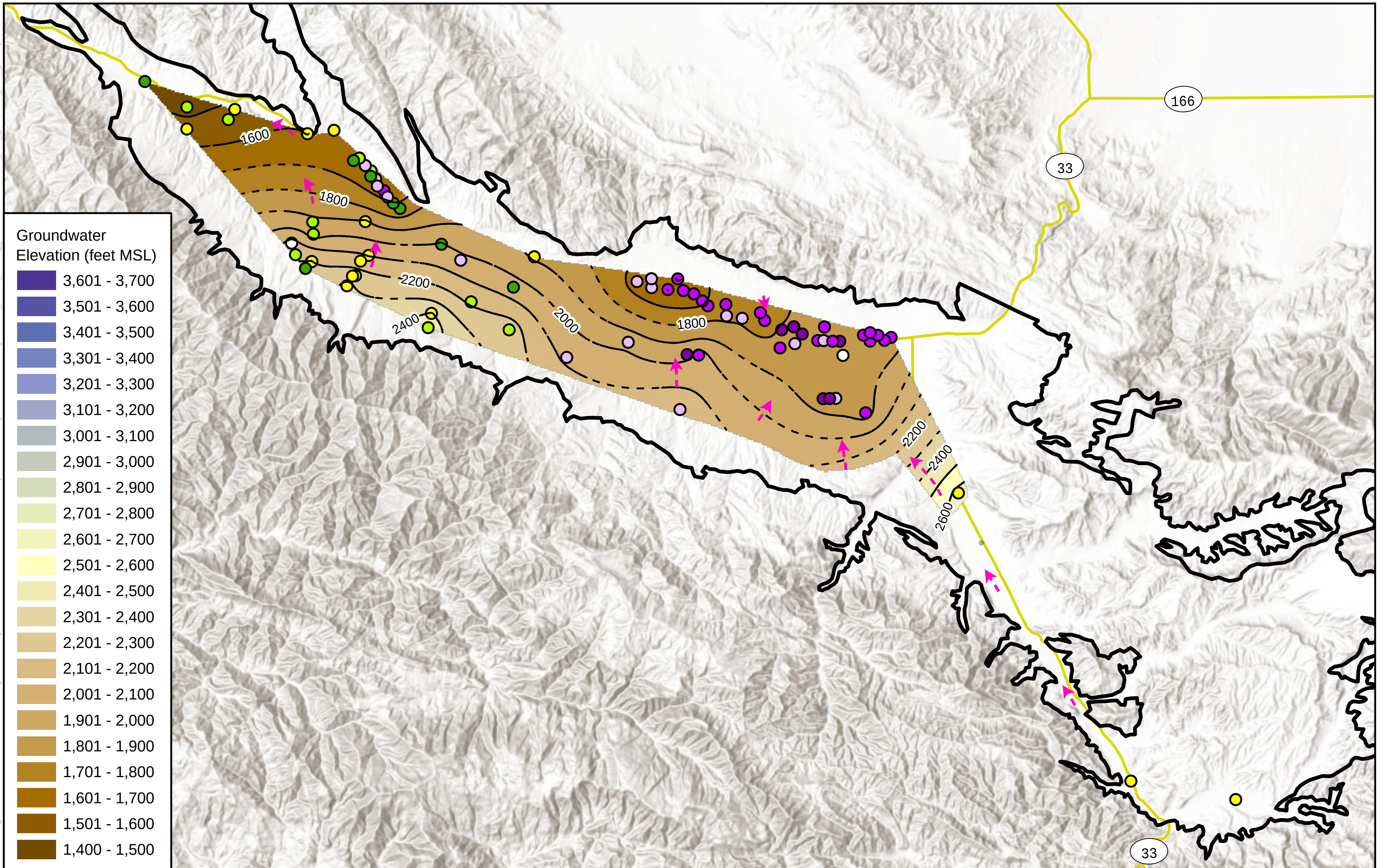

Figure 2-67: Fall 2017 Groundwater Elevation

Cuyama Valley Groundwater Basin

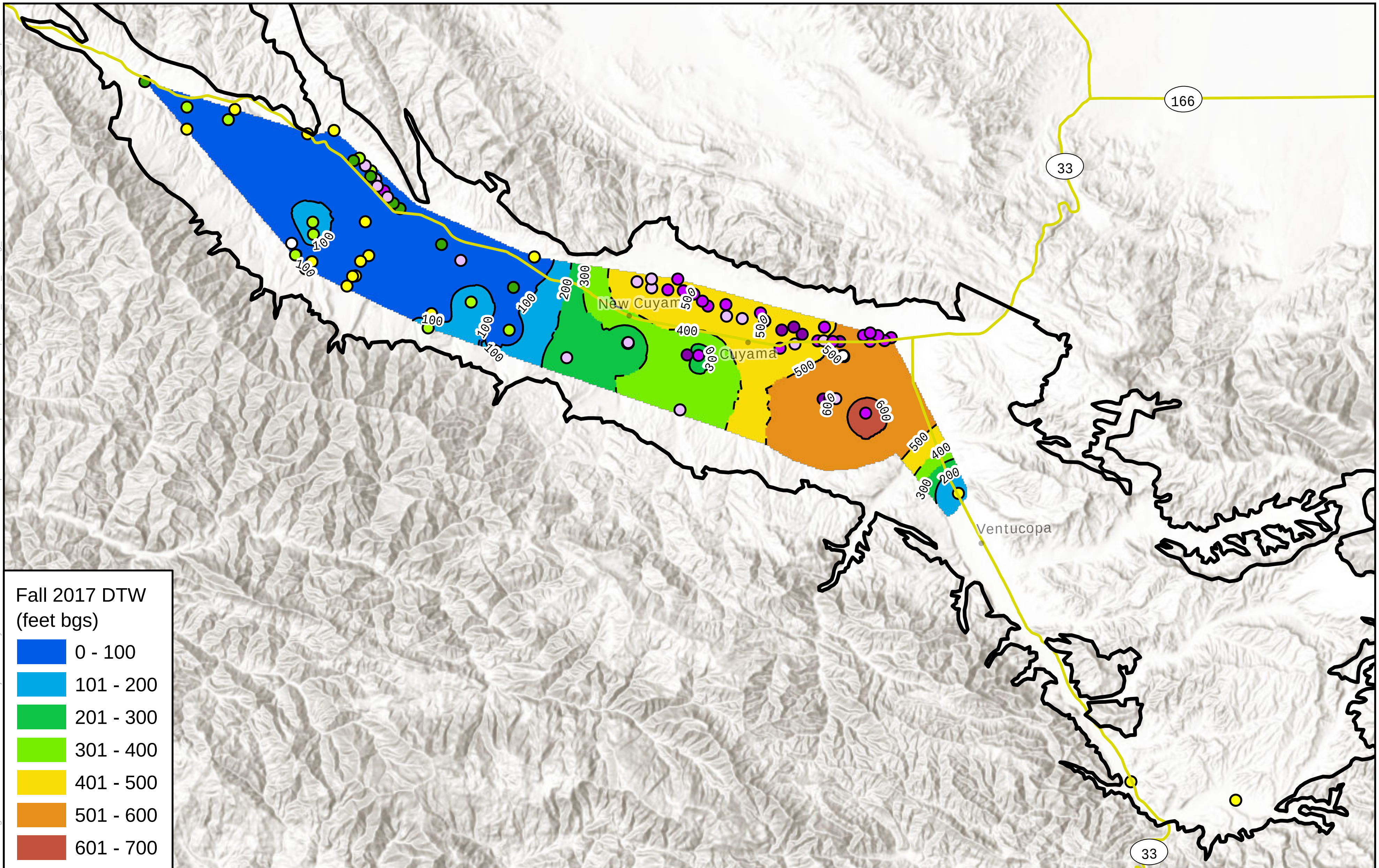

Figure 2-68: Fall 2017 Depth to Water

Cuyama Valley Groundwater Basin

Legend

- Depth to Water Contour
- Approximate Contour
- Highway
- Local Road
- Town
- Cuyama Basin

Well Depth
- Unknown
- 0 - 200
- 201 - 400
- 401 - 600
- 601 - 800
- 801 - 1000
- 1001 - 1200

N

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CUYAMA BASIN GROUNDWATER SUSTAINABILITY AGENCY

0 1.25 2.5 5 Miles

Map Created: July 2024

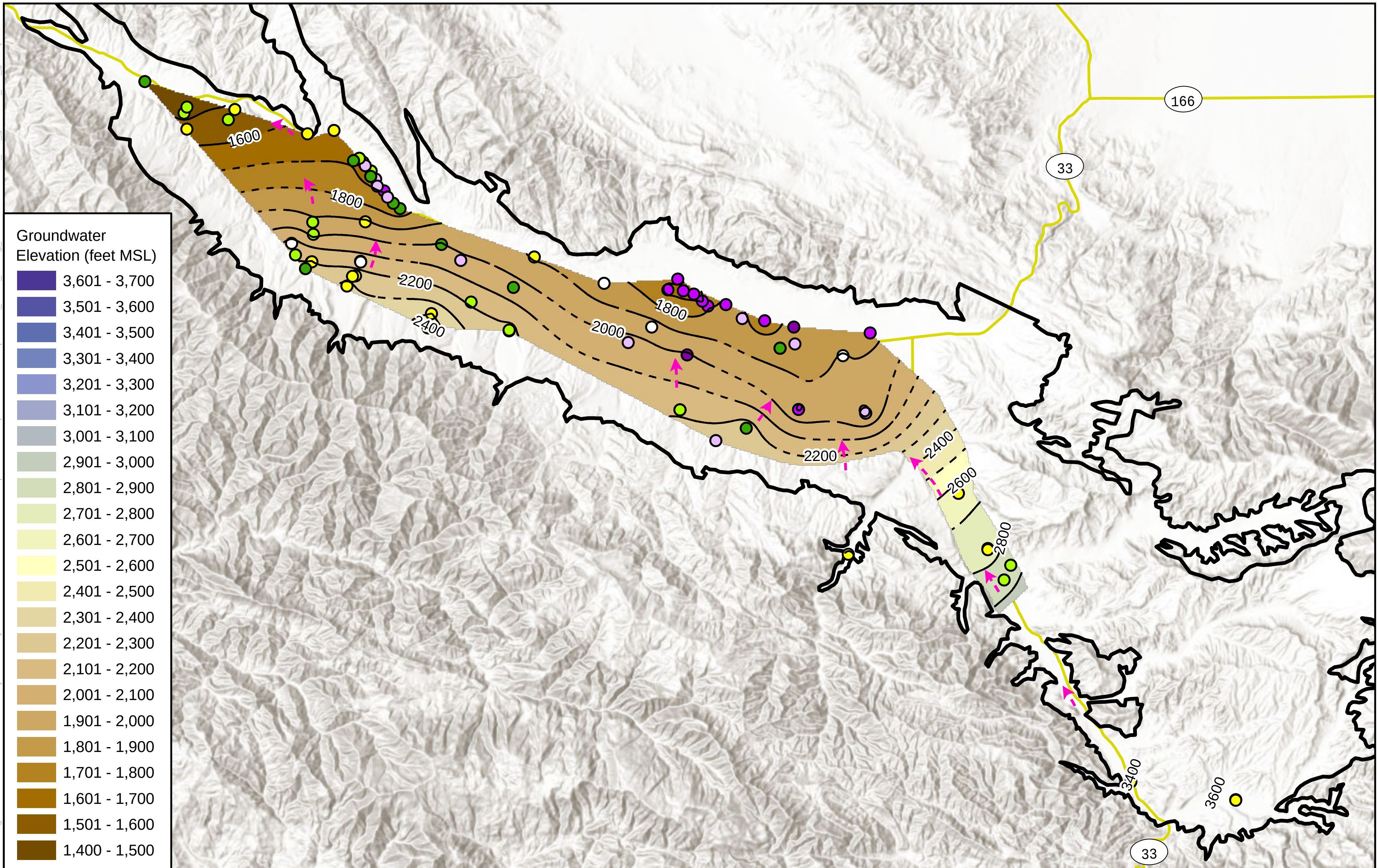


Figure 2-**69**: Spring 2017 Groundwater Elevation

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

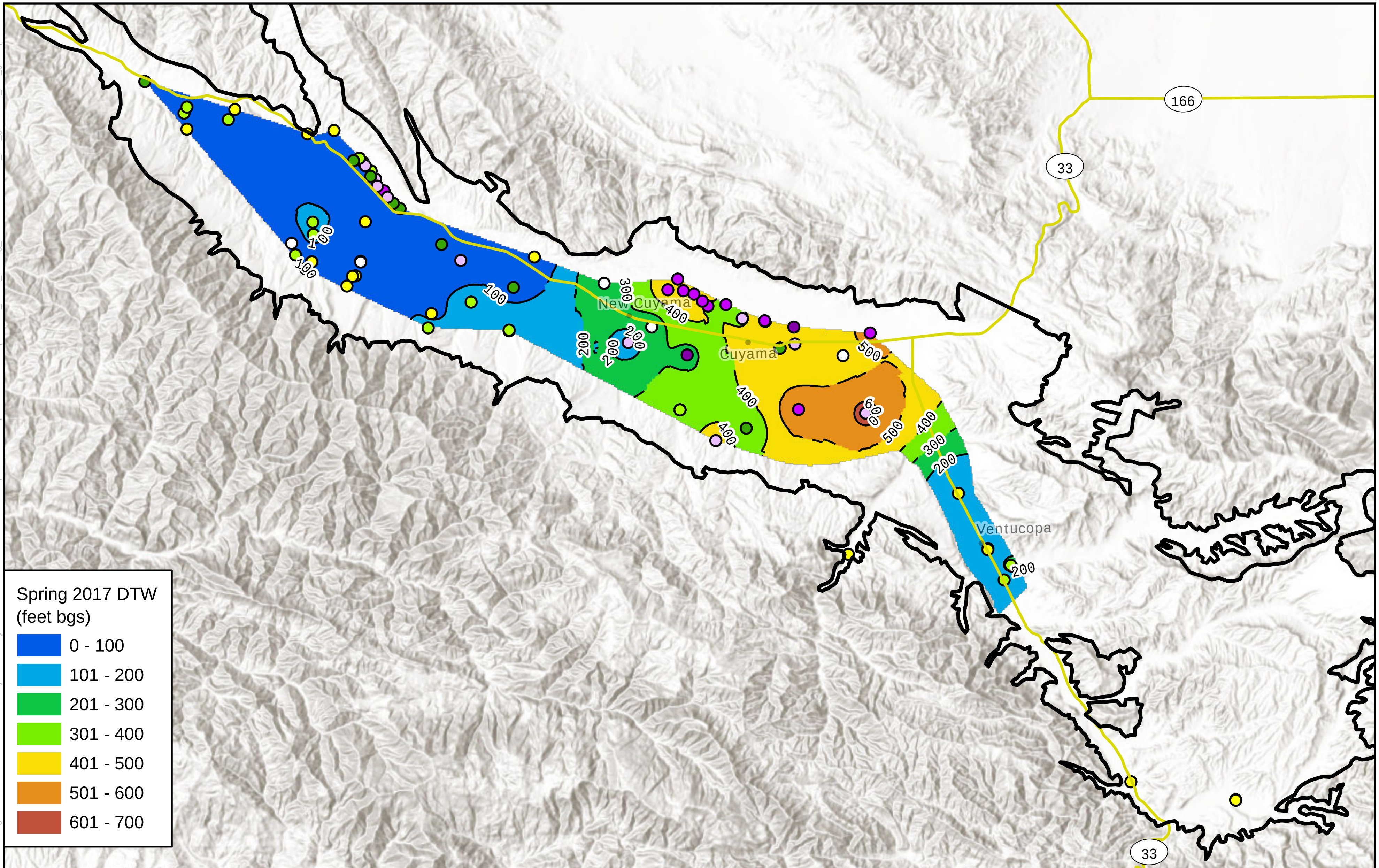
N

Woodard & Curran

0 1.25 2.5 5 Miles

Map Created: July 2024

Figure Exported: 7/18/2024 By: ceggleton Using: \\woodardcurran.net\shared\Projects\CA Cuyama Basin GSA\0011078.01 GSP\wip\Z. GIS\2. Maps\3. 2025 GSP Update\02_Basin_Setting_Overview\GSP2025_dtw_gwe\2025_dtw_gwe.aprx



Legend

- Depth to Water Contour
- Approximate Contour
- Highway
- Local Road
- Town
- Cuyama Basin

Well Depth

- Unknown
- 0 - 200
- 201 - 400
- 401 - 600
- 601 - 800
- 801 - 1000
- 1001 - 1200

Figure 2-**70**: Spring 2017 Depth to Water

Cuyama Valley Groundwater Basin

N

0 1.25 2.5 5 Miles

Map Created: July 2024

Woodard & Curran

Cuyama Basin Groundwater Sustainability Agency

Figure Exported: 7/18/2024 By: ceggleton Using: \\woodardcurran.net\shared\Projects\CA\Cuyama Basin GSA\0011078.01 GSP\wip\Z. GIS\2. Maps\3. 2025 GSP Update\02_Basin_Setting_Overview\GSP2025_dtw_gwe\2025_dtw_gwe.aprx

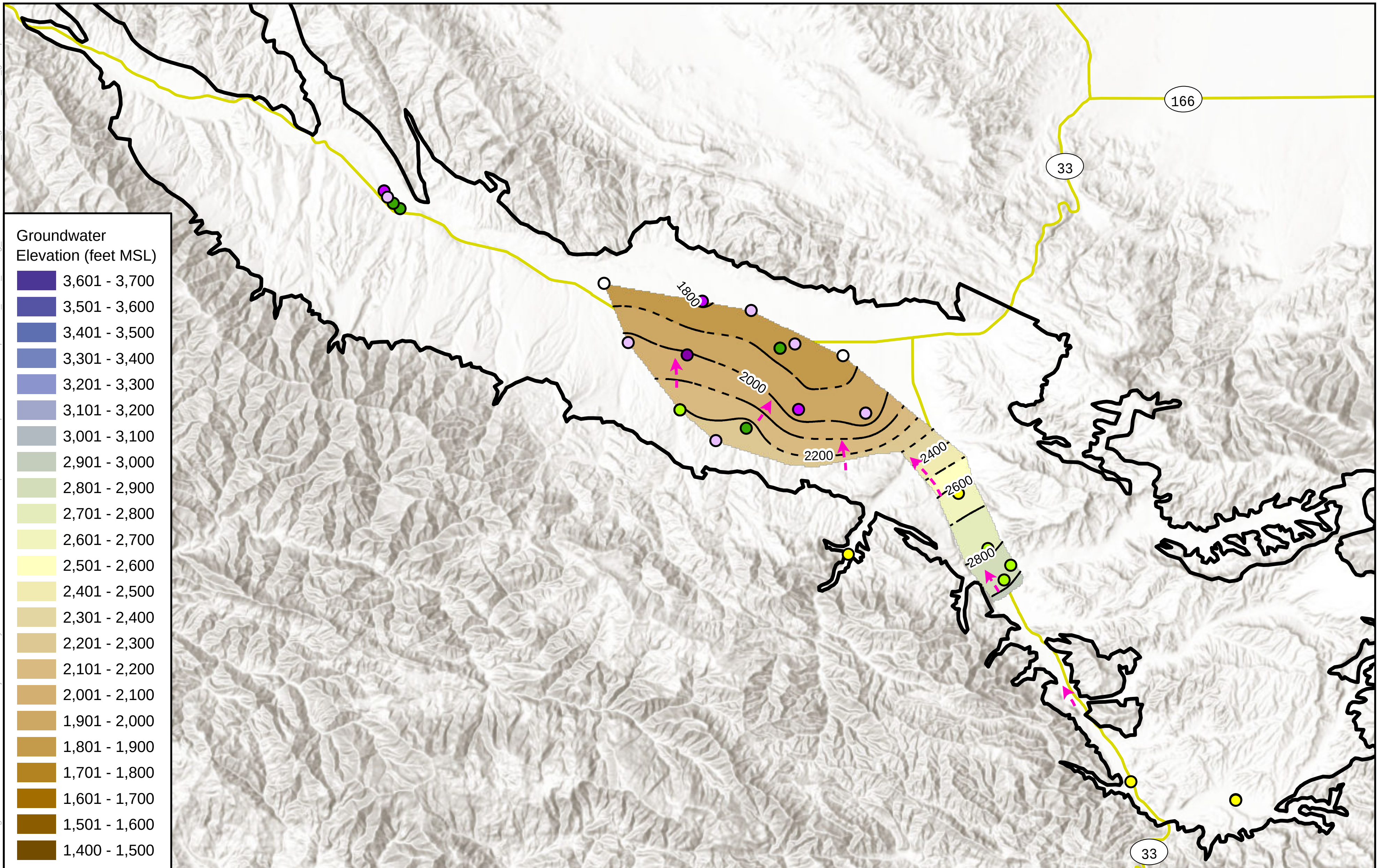


Figure 2-**71**: Spring 2015 Groundwater Elevation

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

Woodard & Curran

0 1.25 2.5 5 Miles

Map Created: July 2024

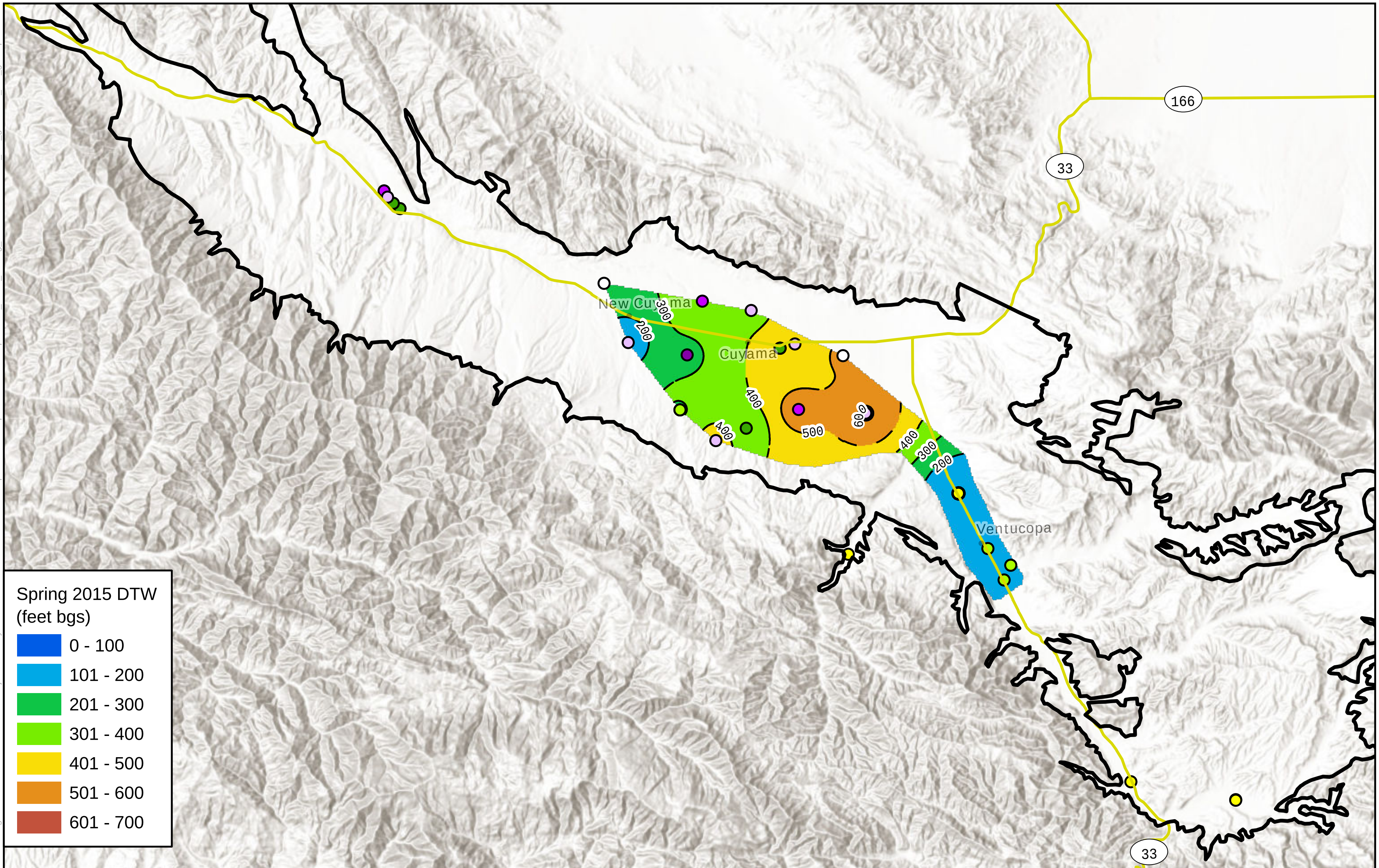


Figure 2-72: Spring 2015 Depth to Water

Cuyama Valley Groundwater Basin

Legend

Depth to Water Contour
Approximate Contour
Highway
Local Road
Town
Cuyama Basin

Well Depth
Unknown
0 - 200
201 - 400
401 - 600
601 - 800
801 - 1000
1001 - 1200

N

Woodard & Curran

Cuyama Basin Groundwater Sustainability Agency

0 1.25 2.5 5 Miles

Map Created: July 2024

2.2.6 Change in Groundwater Storage

Historical change in Basin groundwater storage has shown a consistent decline. Figure 2-73 shows change in storage by year, water year type,[9] and cumulative water volume for the last 26 years. Change in storage was calculated using the Cuyama Basin Water Resources Model (CBWRM). Average annual depletion of groundwater storage over the 26-year period was -20,300 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 22 of the 25 years, and was positive during three of the four wet years, as designated by the water year type.

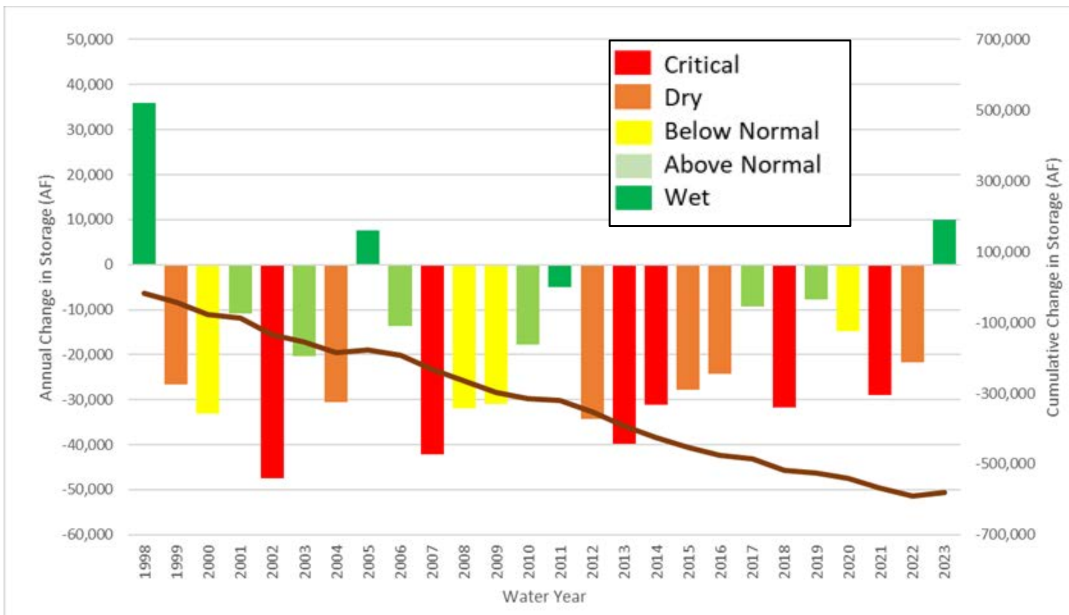


Figure 2-73: Cuyama Groundwater Storage by Year, Water Year Type, and cumulative Water volume

[9] 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.

2.2.7 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.

2.2.8 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 2-74 (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 2-75 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 339 millimeters (approximately 1.1 feet of subsidence have occurred in the vicinity of New Cuyama over the 25 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.

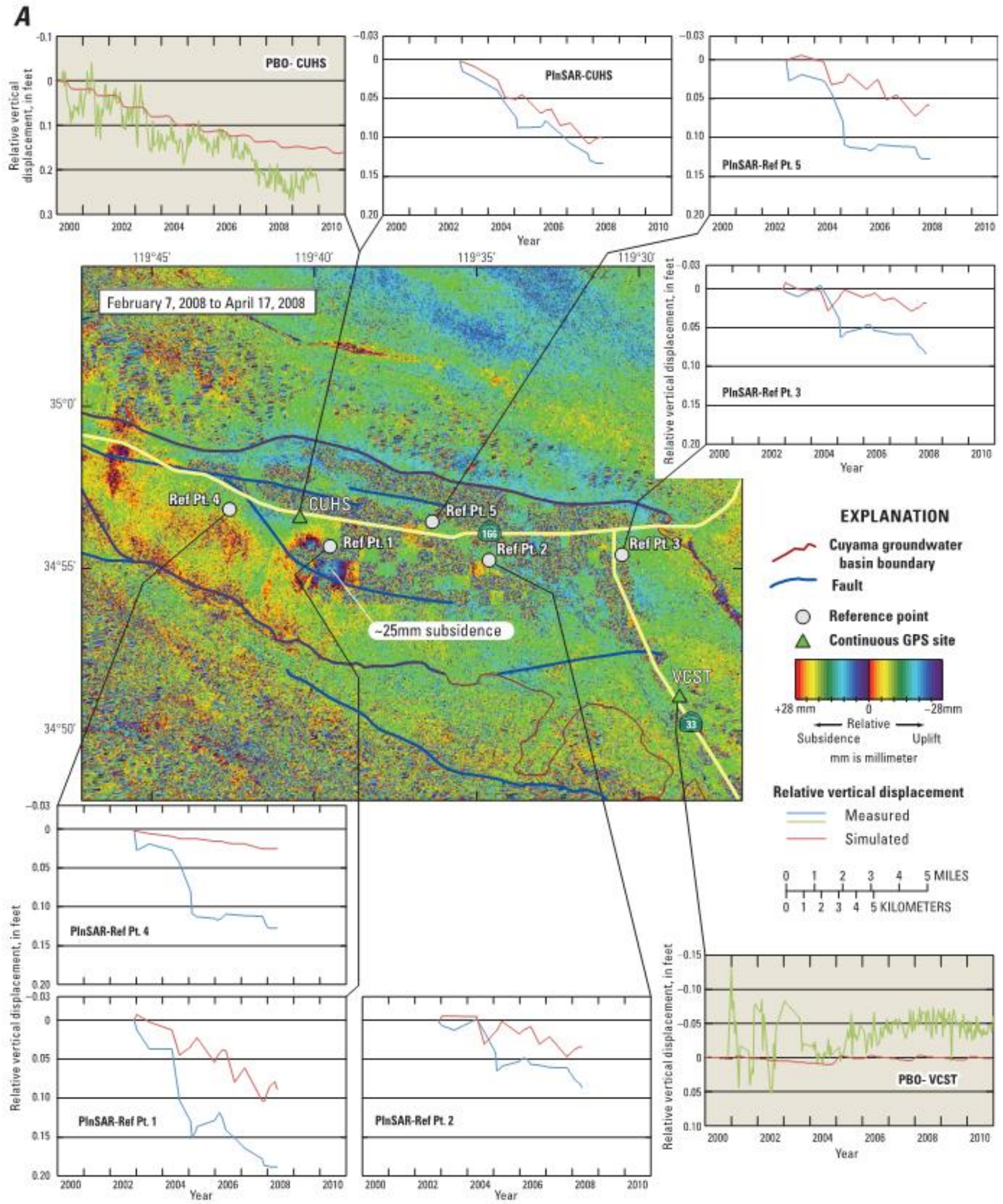


Figure 29. Historical subsidence as *A*, map of seasonal InSAR with graphs of simulated and measured time series for selected locations of relative land-surface deformation from Plate-Boundary Observation (PBO) sites and Point InSAR targets, and *B*, simulated total subsidence 1950–2010 for the calibrated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

Source: USGS, 2015

Figure 2-74: Locations of Continuous GPS and Reference InSAR Sites in the Cuyama Valley

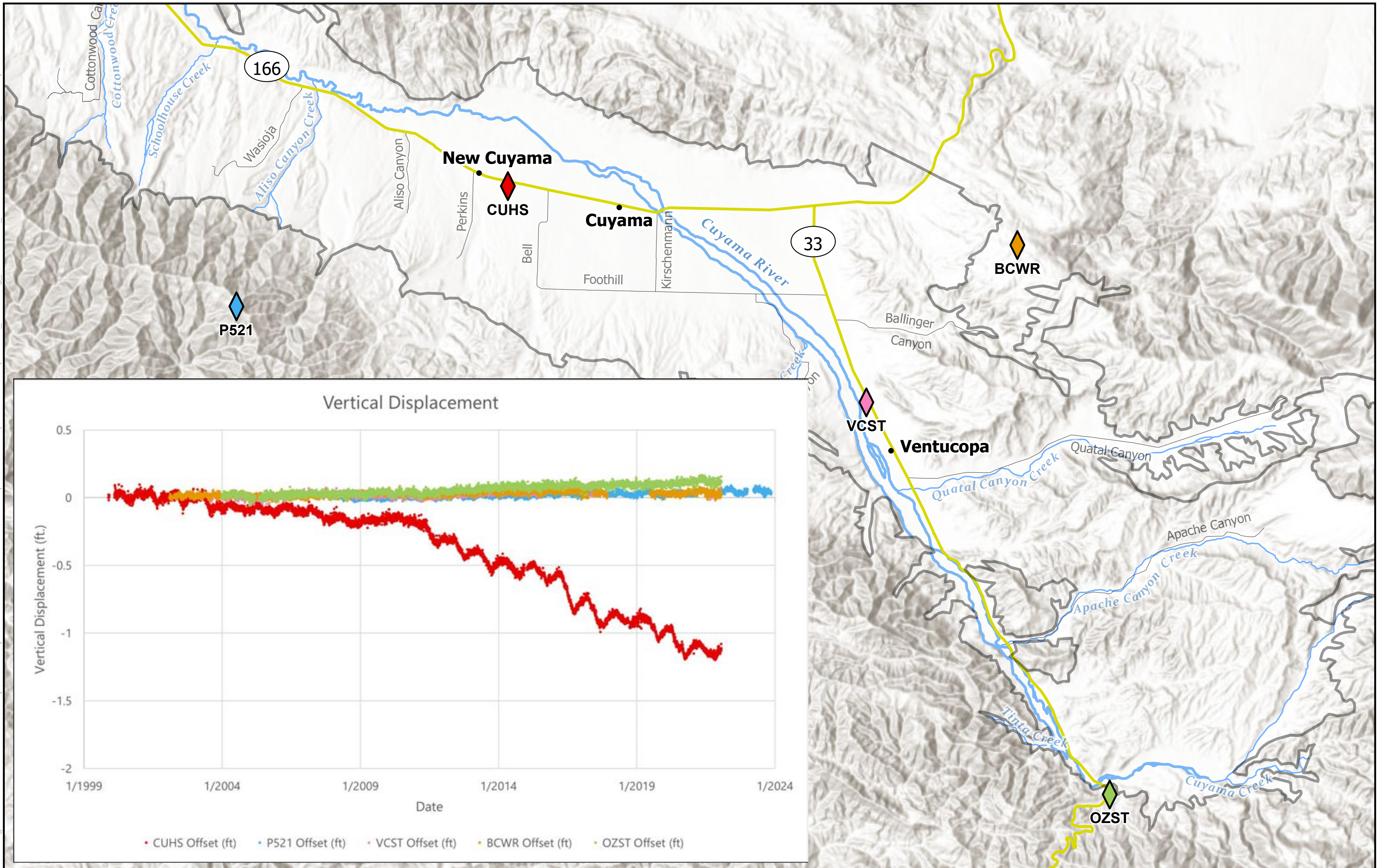


Figure 2-75: Subsidence Monitoring Network

Cuyama Valley Groundwater Basin

Legend

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

N

0 1 2 4 Miles

Map Created: December 2023

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. UNAVCO gps data access from: https://www.unavco.org/data/gps-gnss/data-access-methods/dai1/perm_sta.php**

2.2.9 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 was 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 2-76 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 2-77 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 2-78 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 corresponds 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 2-79 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 2-80 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 2-81 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 μg/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 2-82 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 2-83 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 2-84 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 2-85 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).

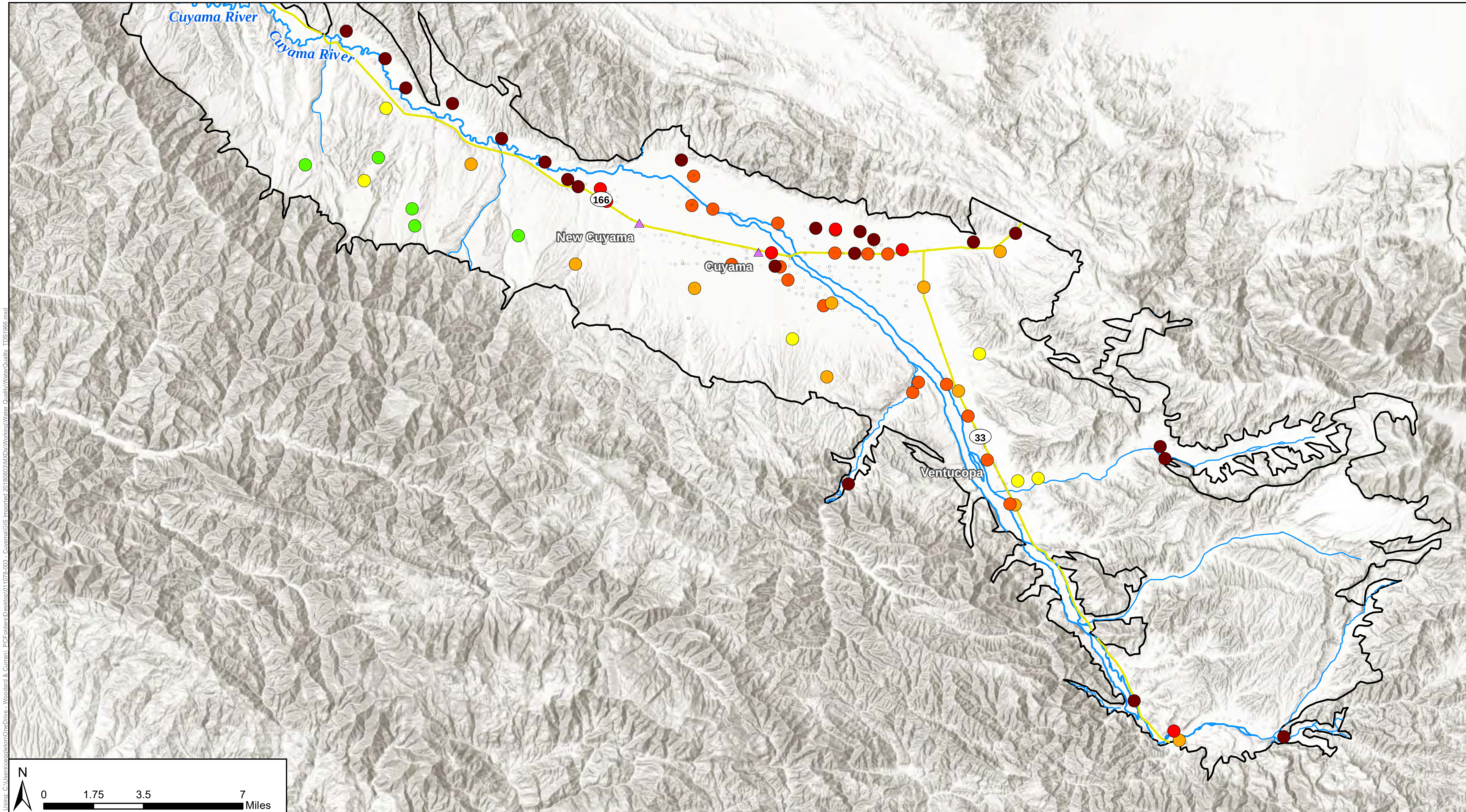


Figure 2-76: 1966 Average Well Measurements of Total Dissolved Solids, mg/L

Cuyama Basin Groundwater Sustainability Agency

Cuyama Valley Groundwater Basin Groundwater Sustainability Plan

December 2019

WOODARD & CURRAN

Legend

TDS, mg/L

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

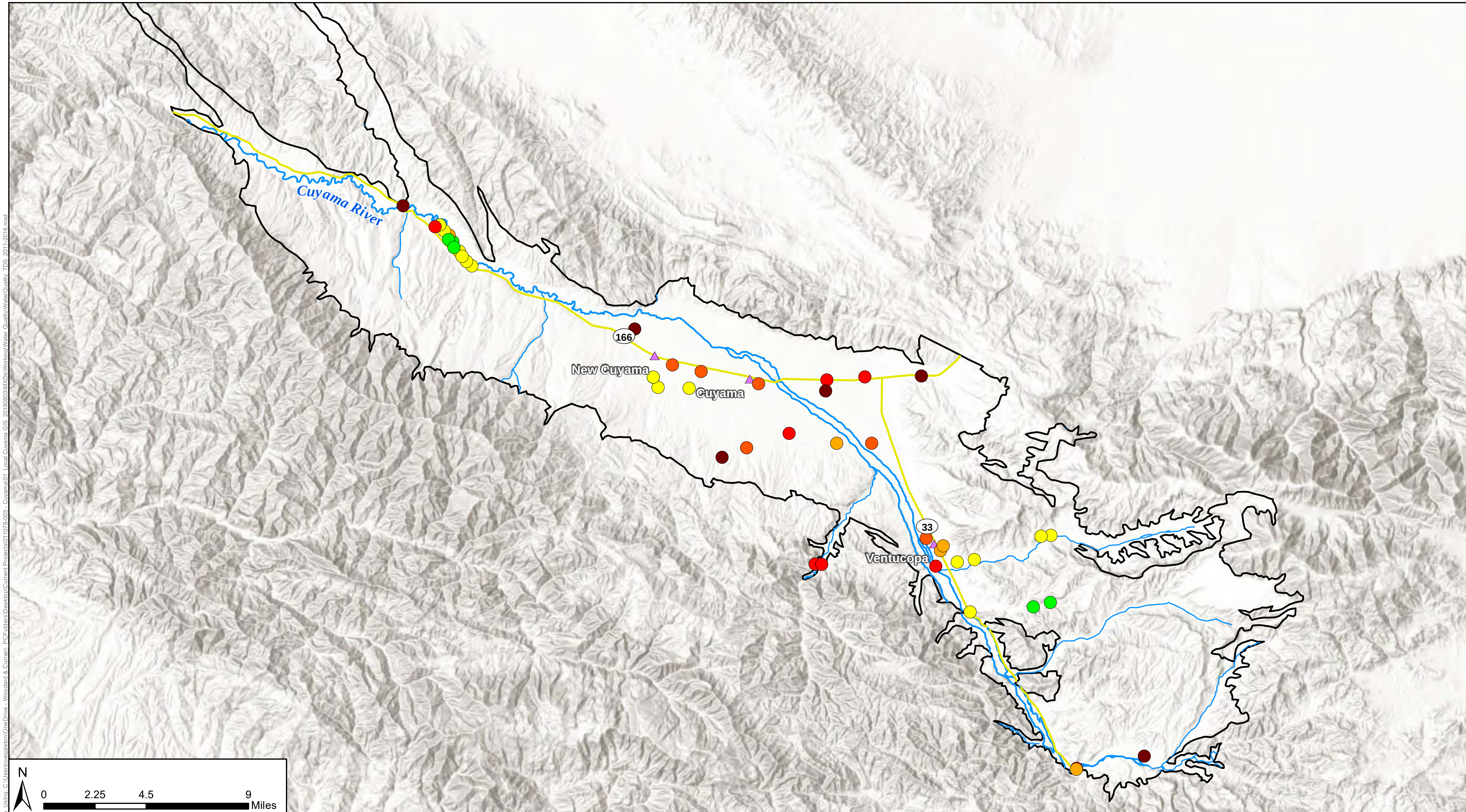


Figure 2-77: 2011-2018 Average Well Measurements of Total Dissolved Solids, mg/L

Cuyama Basin Groundwater Sustainability Agency

Cuyama Valley Groundwater Basin Groundwater Sustainability Plan

December 2019

WOODARD & CURRAN

Legend

TDS, mg/L

Average_Re

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

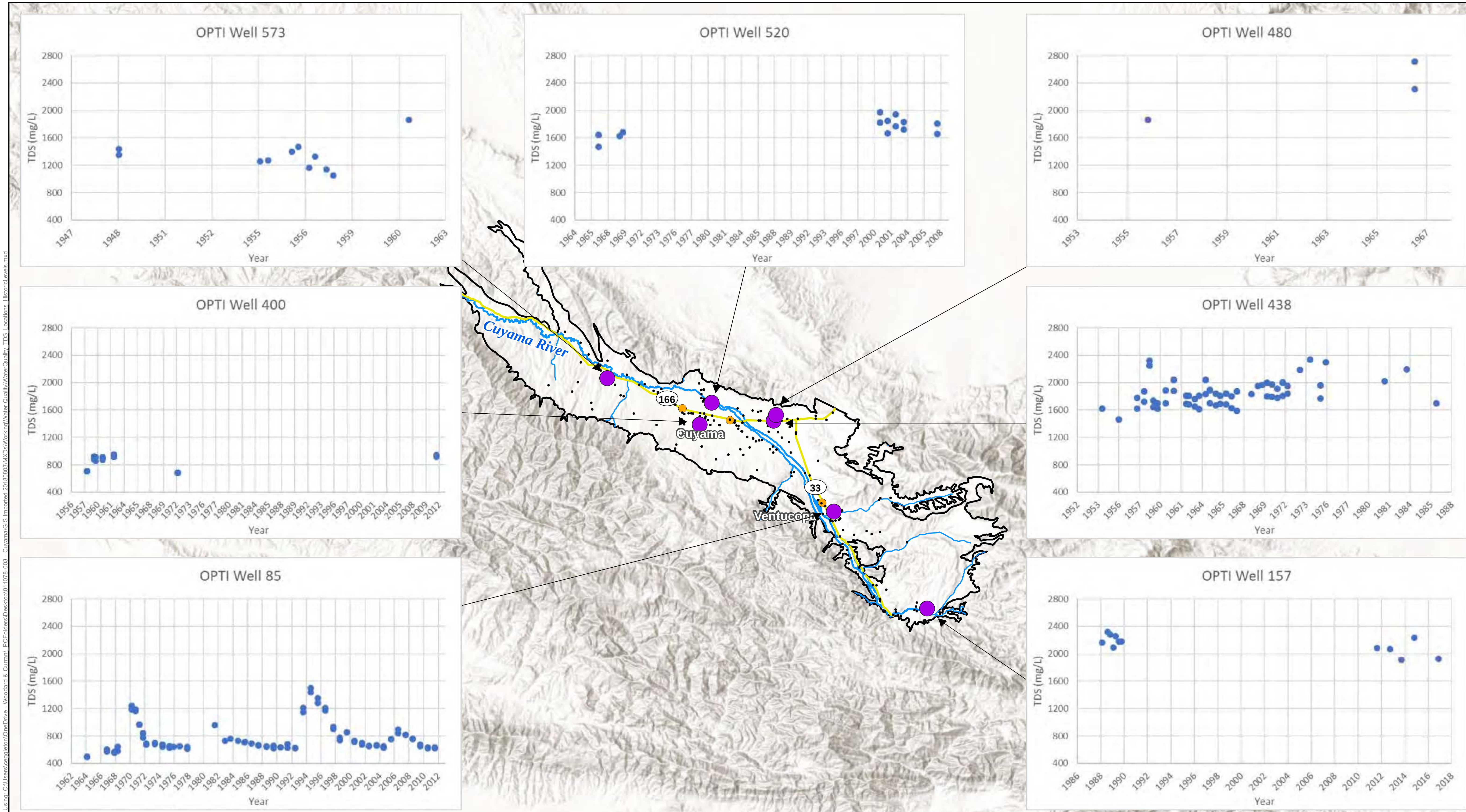


Figure 2-78: Cuyama Groundwater Basin Historic TDS Levels in Selected Wells

Cuyama Basin Groundwater Sustainability Agency

Cuyama Valley Groundwater Basin Groundwater Sustainability Plan

December 2019

WOODARD & CURRAN

Legend

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

N

0 4.5 9 18 Miles

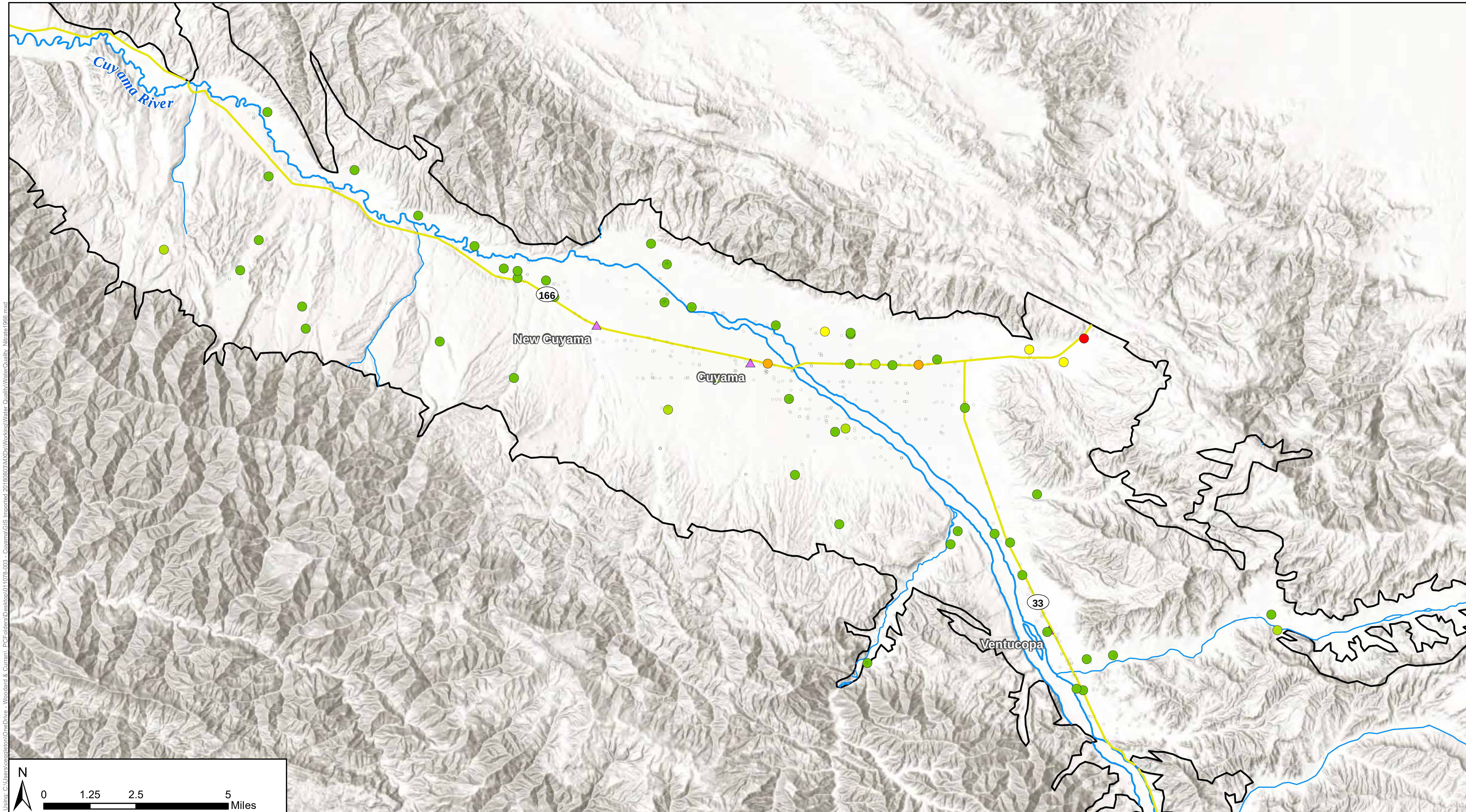


Figure 2-79: 1966 Average Well Measurements of Nitrate (NO3) as Nitrogen

Cuyama Basin Groundwater Sustainability Agency

Cuyama Valley Groundwater Basin Groundwater Sustainability Plan

December 2019

WOODARD & CURRAN

Legend

Nitrate (NO3) as N, mg/L

- No Measurements
- < 5 mg/L
- 5 - 8 mg/L
- 8 - 10 mg/L
- 10 - 15 mg/L
- 15 - 20 mg/L
- > 20 mg/L

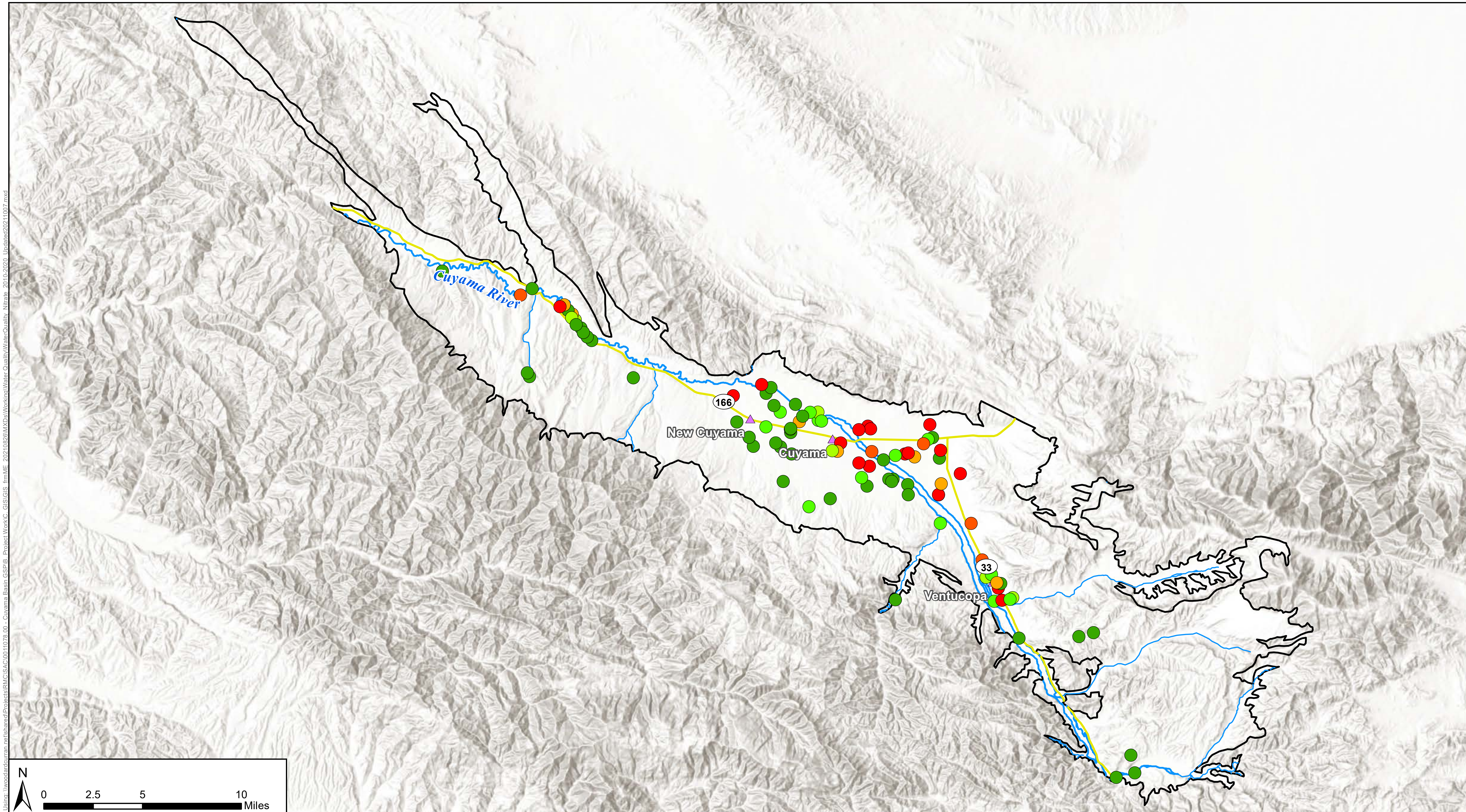


Figure 2-80: 2010-2020 Average Well Measurements of Nitrate (NO3) as Nitrogen

Cuyama Basin Groundwater Sustainability Agency

Cuyama Valley Groundwater Basin Groundwater Sustainability Plan

October 2021

WOODARD & CURRAN

Legend

Nitrate (NO3) as N, mg/L

- < 5 mg/L
- 5 - 8 mg/L
- 8 - 10 mg/L
- 10 - 15 mg/L
- 15 - 20 mg/L
- > 20 mg/L

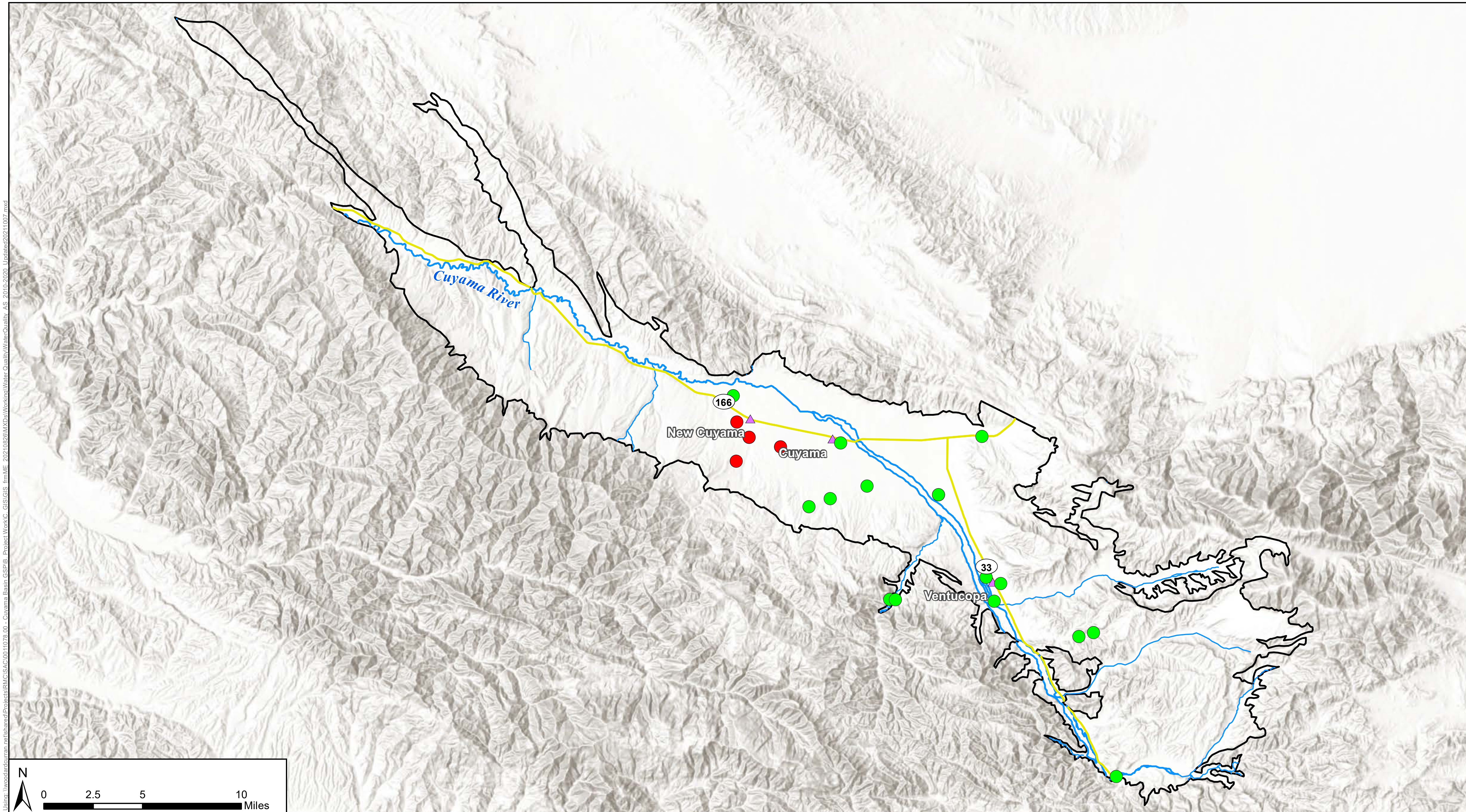


Figure 2-81: 2010-2020 Average Well Measurements of Arsenic, µg/L

Cuyama Basin Groundwater Sustainability Agency

Cuyama Valley Groundwater Basin Groundwater Sustainability Plan

October 2021

WOODARD & CURRAN

Legend

Aresenic (As), ug/L

- < 5 ug/L
- 5 - 10 ug/L
- 10 - 20 ug/L
- > 20 ug/L

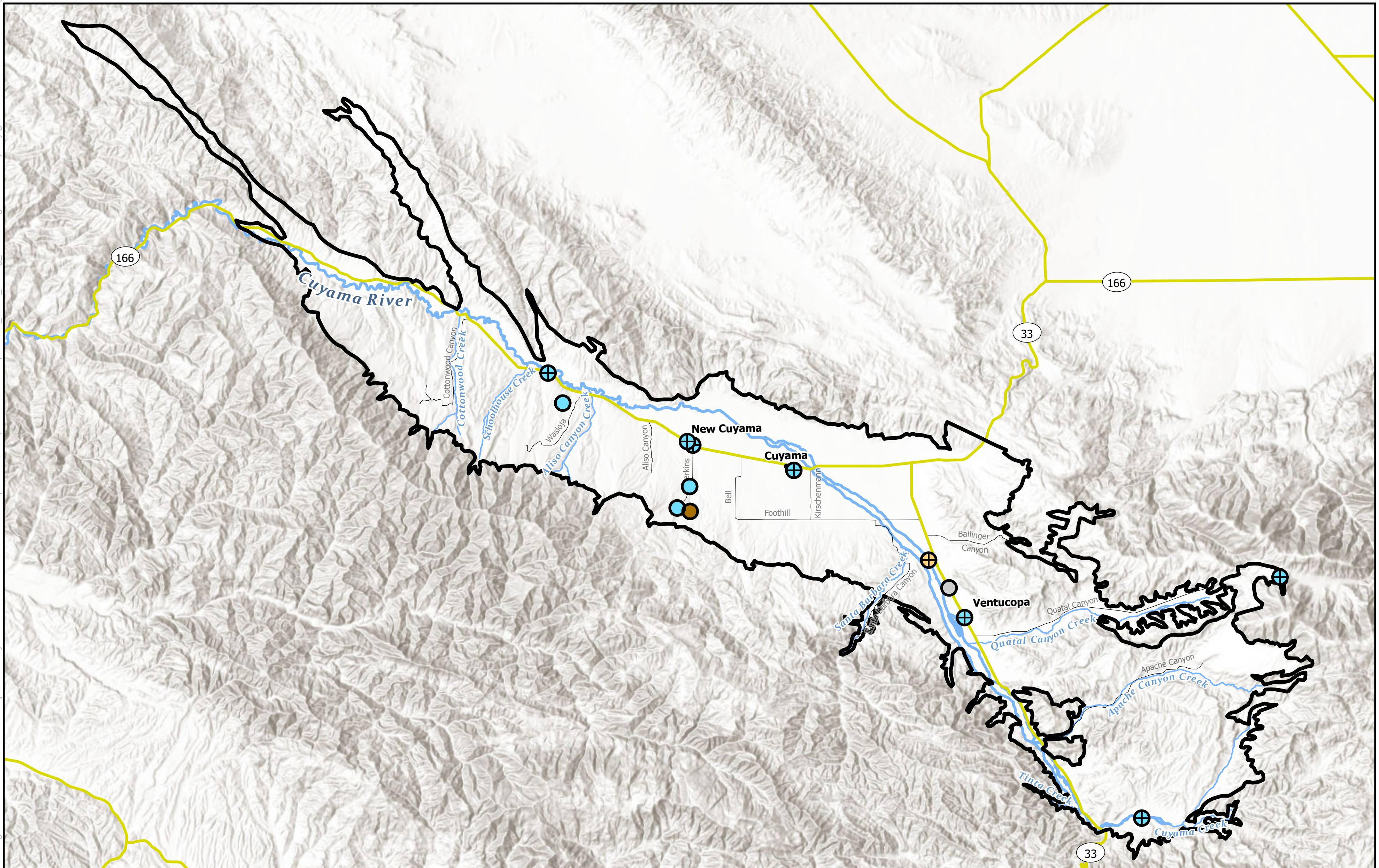


Figure 2-82: Sites with Water Quality Concerns

Cuyama Valley Groundwater Basin

Legend

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

N

Woodard & Curran

CUYAMA BASIN GROUNDWATER SUSTAINABILITY AGENCY

0 1.75 3.5 7 Miles

Map Created: April 2024

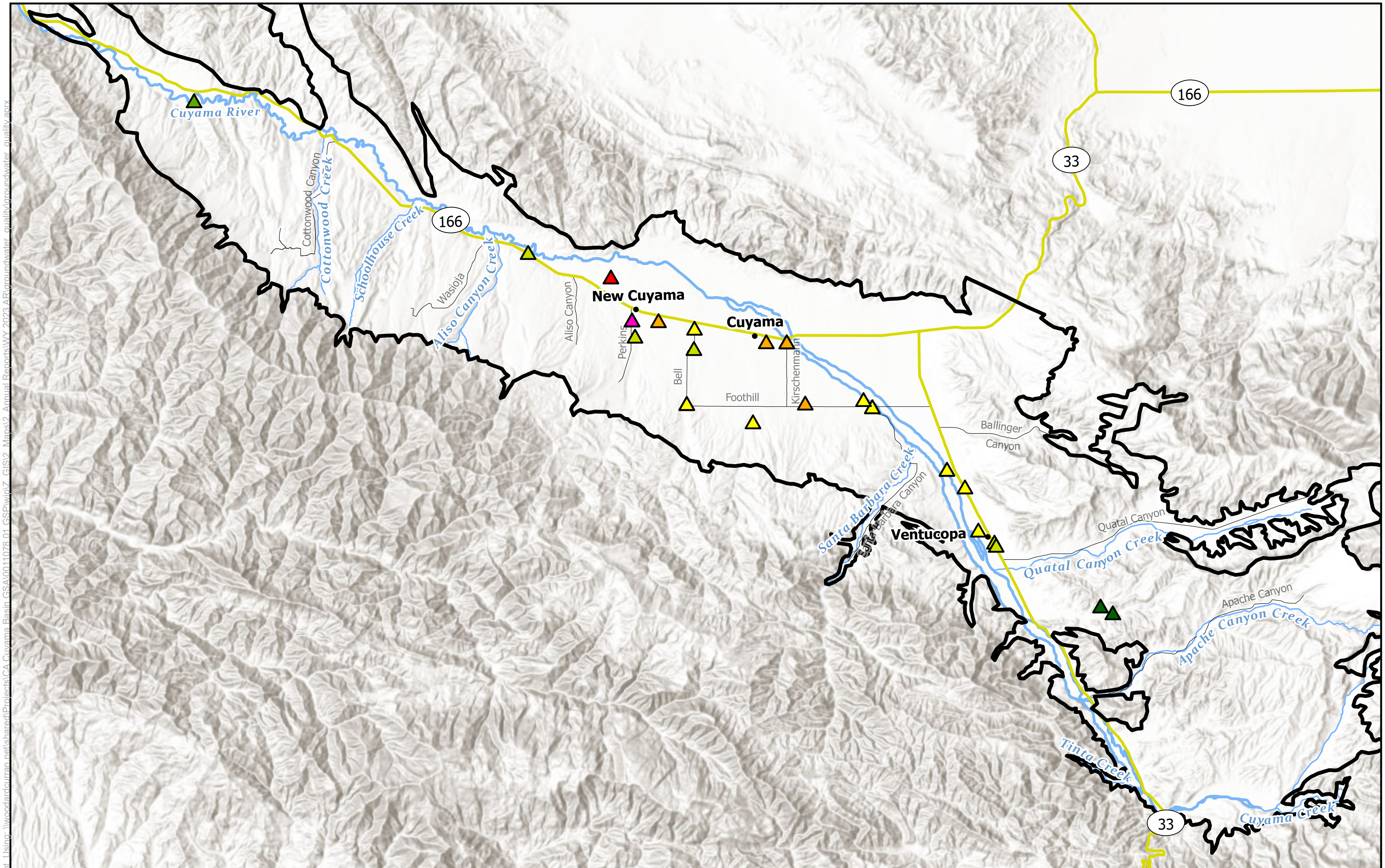


Figure 2-83: Groundwater Quality Measurements - TDS

2023 Data

Cuyama Valley Groundwater Basin

Legend

< 500 mg/L	1,251 - 1,500 mg/L
501 - 750 mg/L	1,501 - 1,750 mg/L
751 - 1,000 mg/L	1,751 - 2,000 mg/L
1,001 - 1,250 mg/L	2,001 - 2,250 mg/L

Highway
Local Road
Town
Creek
Cuyama River
Cuyama Basin

N

0 1.25 2.5 5 Miles

Map Created: March 2024

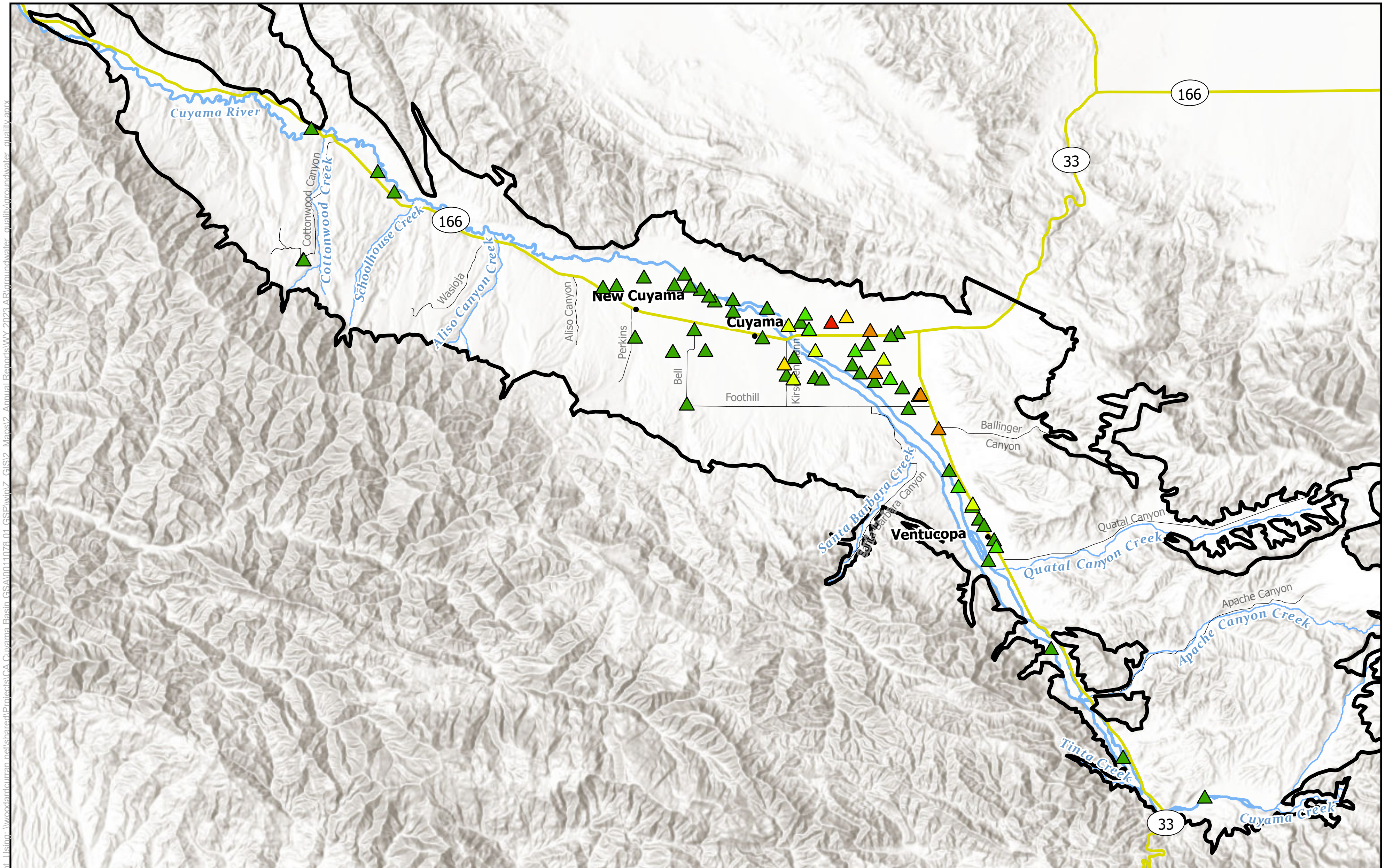


Figure 2-84: Groundwater Quality Measurements - Nitrate

Years 2022 and 2023

Cuyama Valley Groundwater Basin

Legend

- < 5 mg/L
- 5 - 8 mg/L
- 8 - 10 mg/L
- 10 - 15 mg/L
- 15 - 20 mg/L
- > 20 mg/L
- Highway
- Local Road
- Town
- Creek
- Cuyama River
- Cuyama Basin

N

0 1.25 2.5 5 Miles

Woodard & Curran

CUYAMA BASIN GROUNDWATER SUSTAINABILITY AGENCY

*Values from monitoring wells with multiple observations were averaged with respect to year sampled. **Nested well at this location.

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 DWR, Esri, USGS**

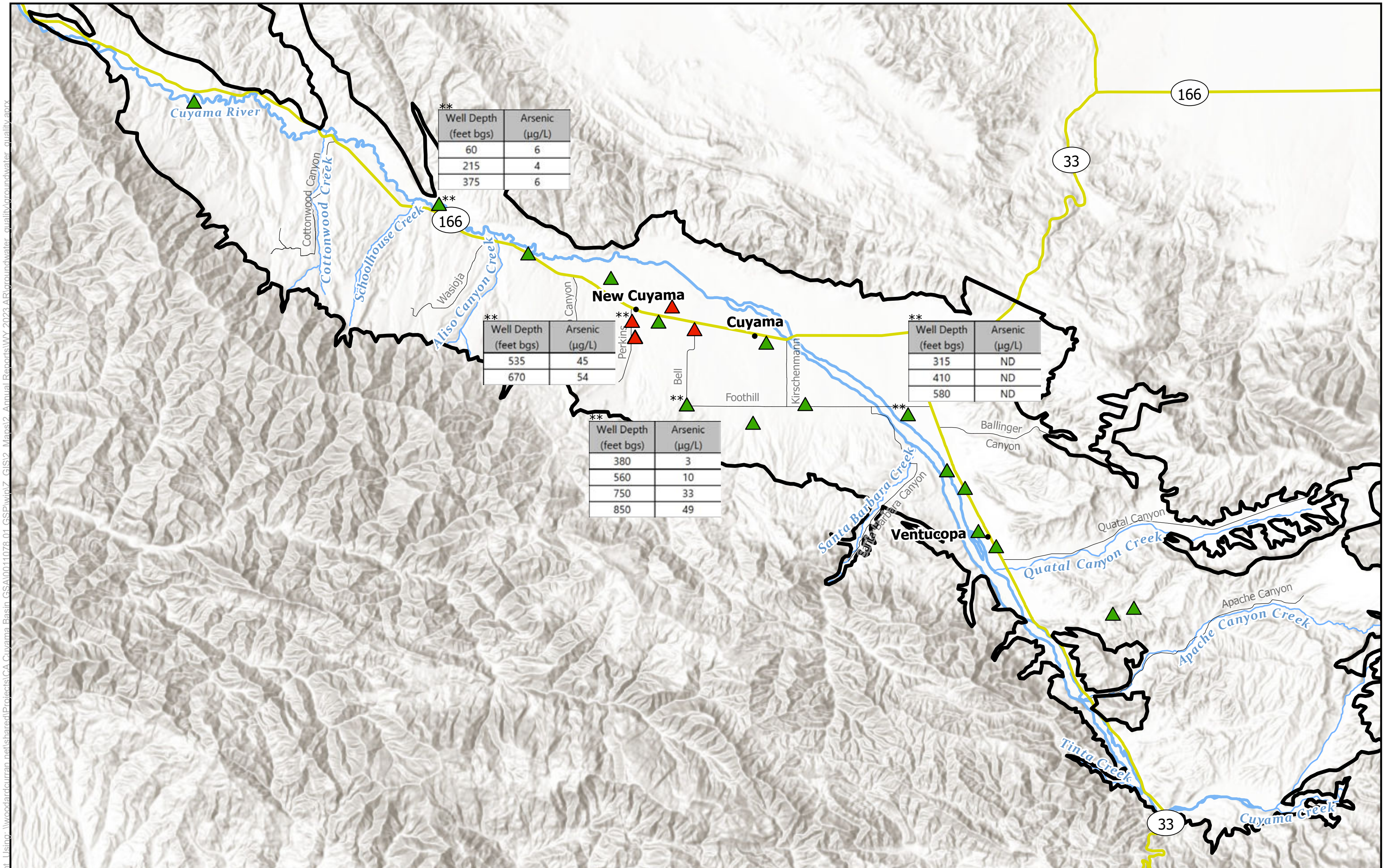


Figure 2-85: Groundwater Quality Measurements - Arsenic

Years 2022 and 2023

Cuyama Valley Groundwater Basin

Legend

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

N

0 1.25 2.5 5 Miles

Map Created: April 2024

*Values from monitoring wells with multiple observations were averaged with respect to year sampled. **Nested well at this location.

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 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 the 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 2-86 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 (µS/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

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 a 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 2-87 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.

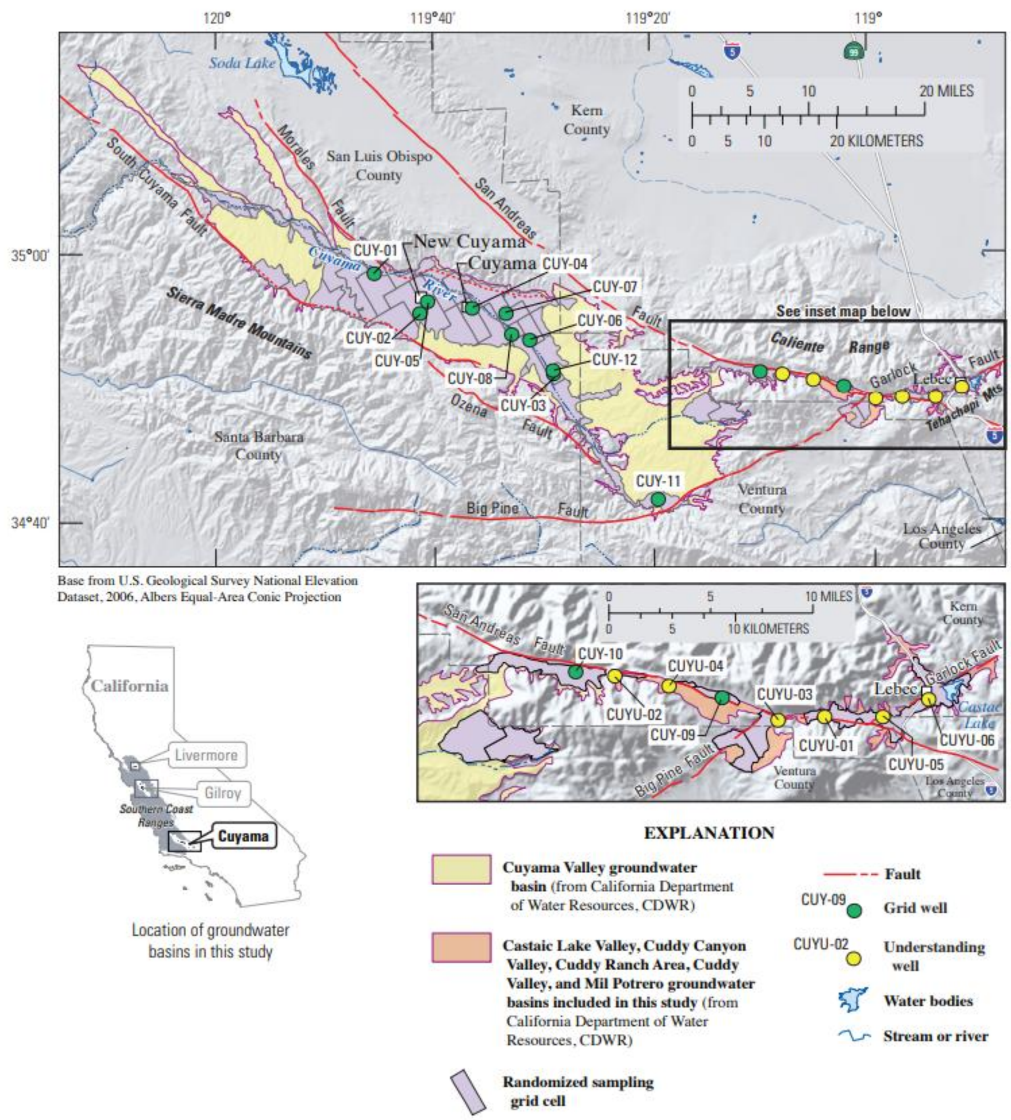


Figure 5. The South Coast Interior Basins Groundwater Ambient Monitoring and Assessment (GAMA) study unit showing the distribution of the Cuyama study-area grid cells, the location of sampled grid wells and understanding wells, the Cuyama Valley, Castaic Lake Valley, Cuddy Canyon Valley, Cuddy Ranch 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 2-86: Locations of GAMA Sample Locations

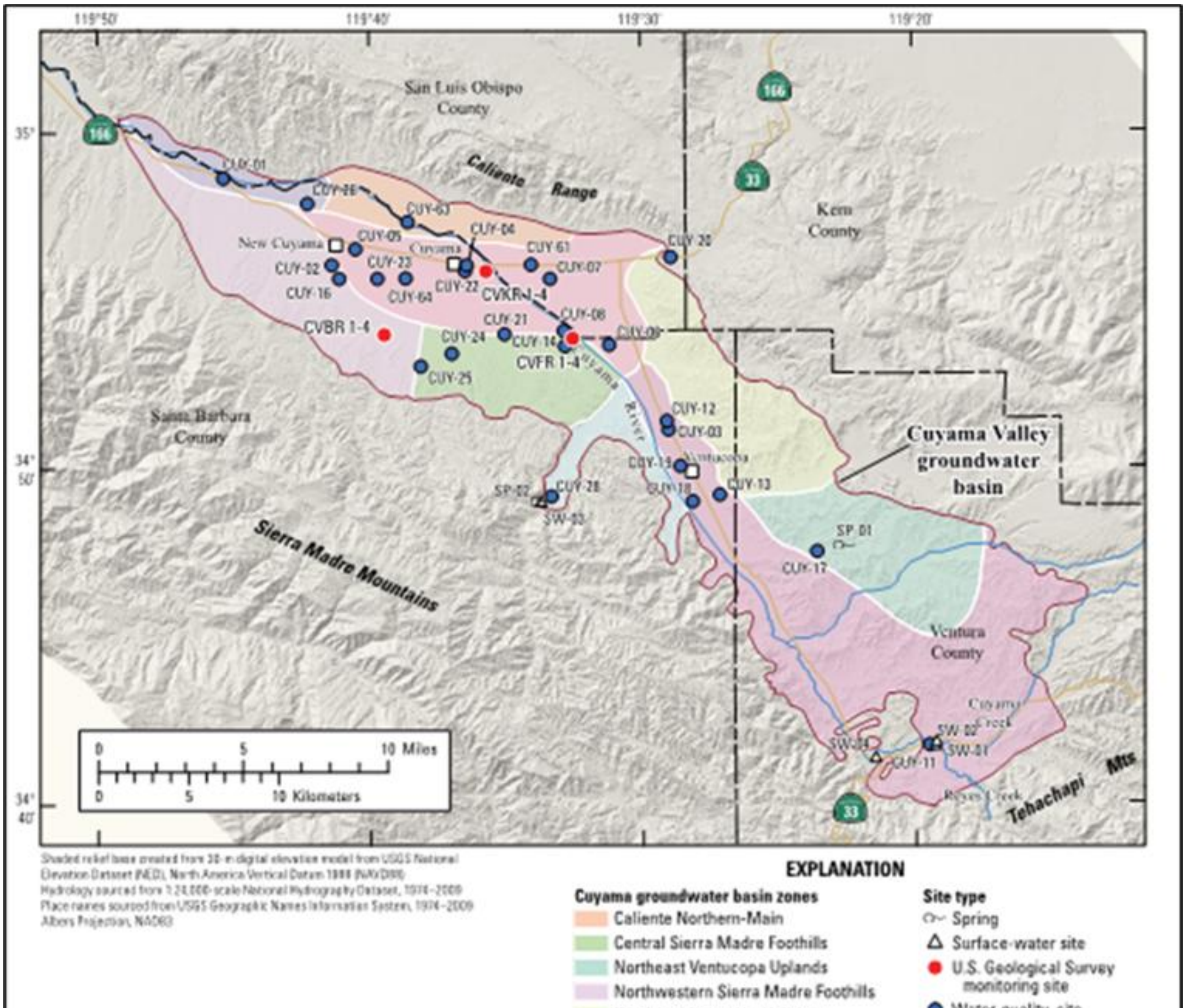


Figure 8. The location of multiple-well monitoring sites, domestic and supply wells, springs, and surface water sites with available water-quality data, Cuyama Valley, Santa Barbara County, California.

USGS 2013c

Figure 2-87: USGS 2013c Water Quality Monitoring Sites

2.2.10 Interconnected Surface Water Systems

The following content reflects what was included in the 2020 GSP. DWR is in the process of developing additional guidance documents to assist GSAs in addressing the interconnected surface waters sustainability indicator. At this time, those guidance documents have not been published, but the CBGSA plans to utilize those resources when they become available for future updates to the GSP and for future ISW implementation.

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 2-88, with each reach assigned a number. Results of the analysis are shown in Table 2-3 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.

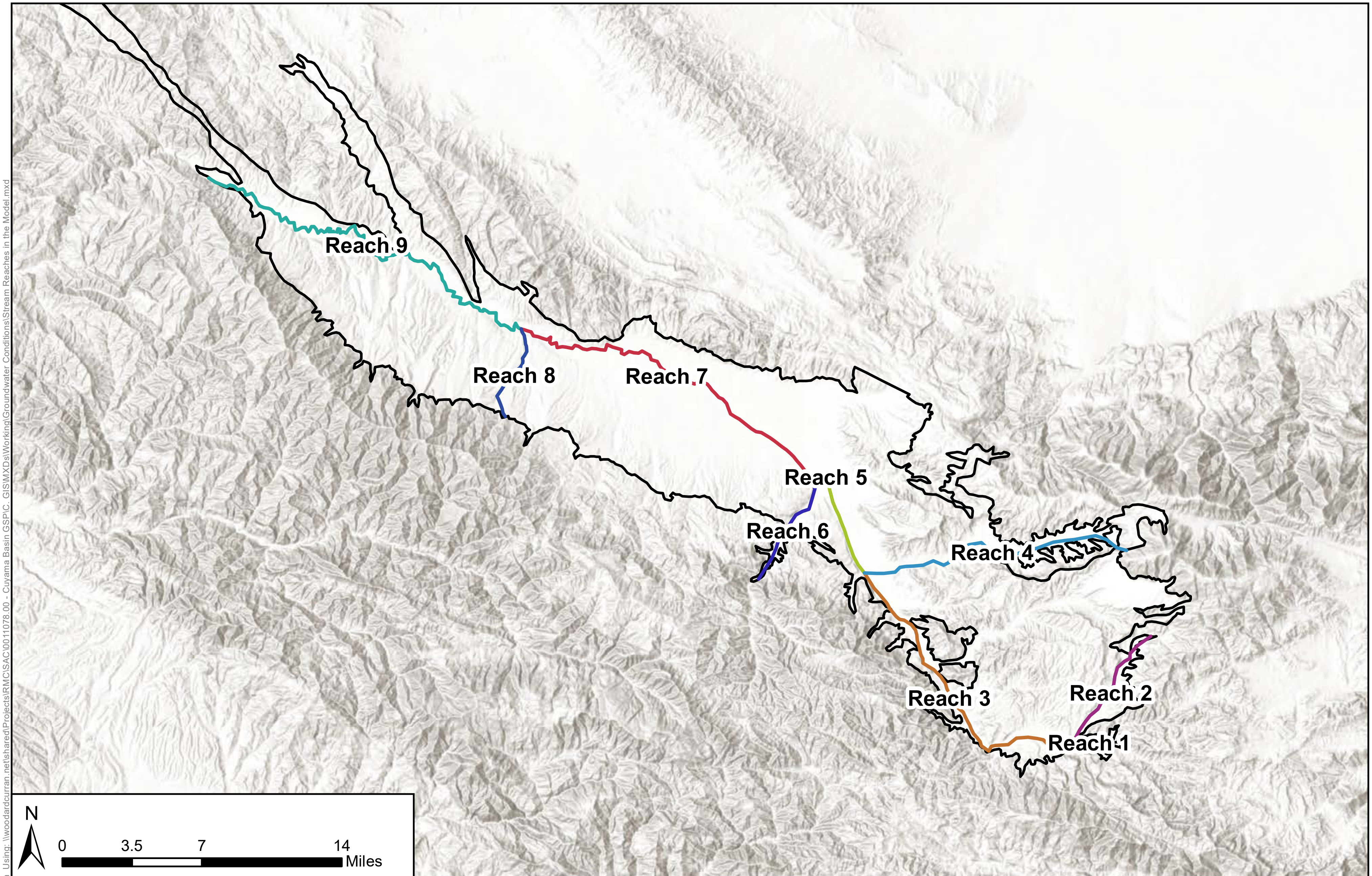


Figure 2-88: Stream Reaches Used in Cuyama Groundwater Model

Cuyama Basin Groundwater Sustainability Agency

Cuyama Valley Groundwater Basin Groundwater Sustainability Plan

April 2019

WOODARD & CURRAN

Legend

Cuyama Basin

Stream Reach

1
2
3
4
5
6
7
8
9

Table 2-3: 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

2.2.11 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 2-89 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 2-90. Analysis concluded that there were 123 probable GDEs and 275 probable non-GDEs in the Basin.

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

- Opti well 911 is completed to a depth of 45 feet bgs with a screen interval from 10-40 feet bgs.
- Opti well 910 is completed to a depth of 50 feet bgs with a screen interval from 25-45 feet bgs.
- Opti well 909 is completed to a depth of 90 feet bgs with a screen interval from 50-80 feet bgs.

Figure 2-91 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 licensed wetlands biologist, the CBGSA no longer relies on the NCAA remote sensing database for estimating or monitoring probable GDE locations.

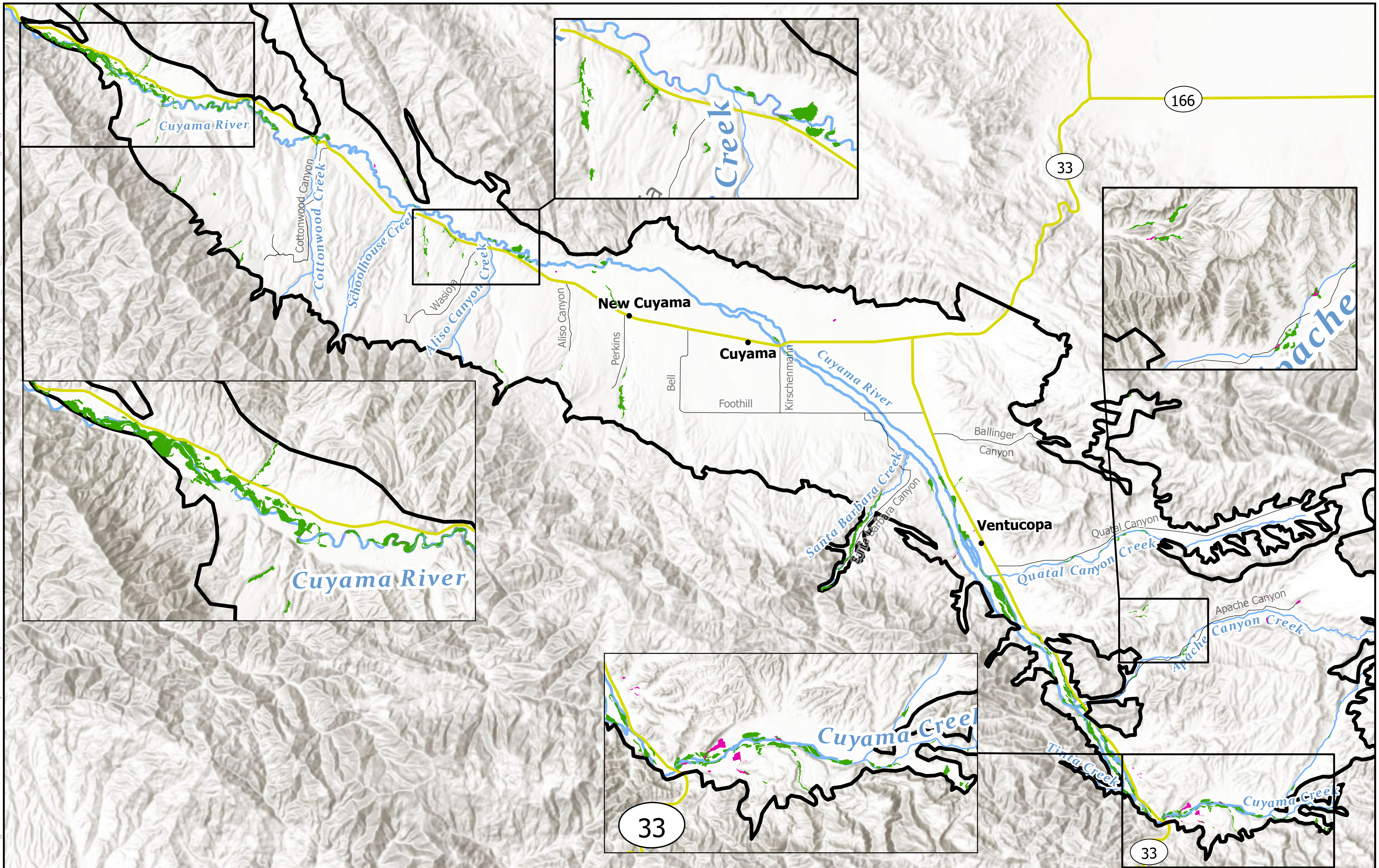


Figure 2-89: Potential GDEs Identified

2018 i02 NCCAG

Cuyama Valley Groundwater Basin

Legend

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

N

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Cuyama Basin Groundwater Sustainability Agency

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**

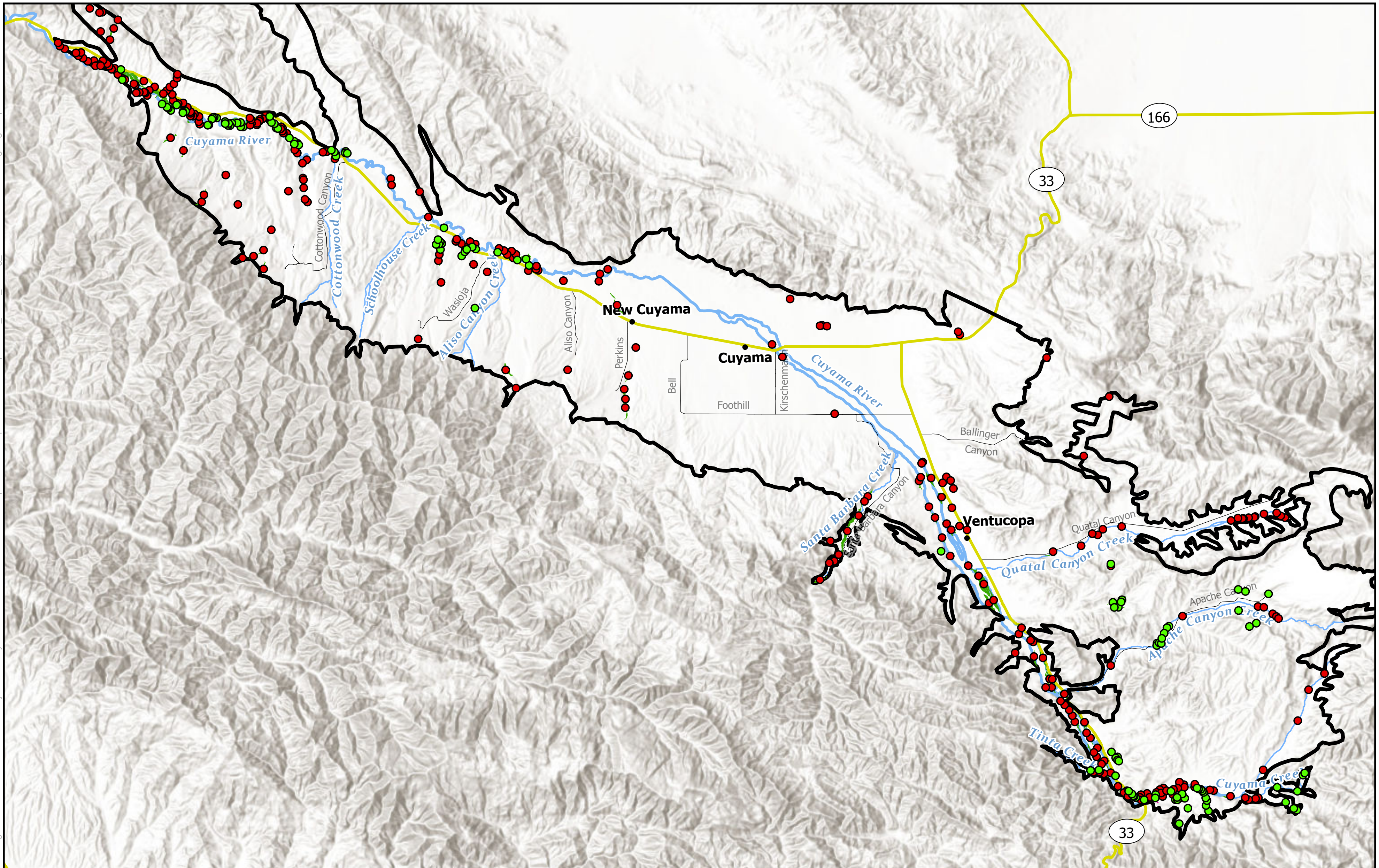


Figure 2-90: GDE Ground Truthing Analysis Results

Cuyama Valley Groundwater Basin

Legend

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

N

0 1.25 2.5 5 Miles

Woodard & Curran

CUYAMA BASIN GROUNDWATER SUSTAINABILITY AGENCY

Map Created: March 2024

Figure Exported: 3/18/2024 By: DHunt Using: \\woodardcurran.net\shared\Projects\CA Cuyama Basin GSA\0011078.01 GSP\wip\Z_GIS\2_Maps\3_2025 GSP Update\02_Basin_Setting_Overview\surface water\gde\gde.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, TNC, USGS**

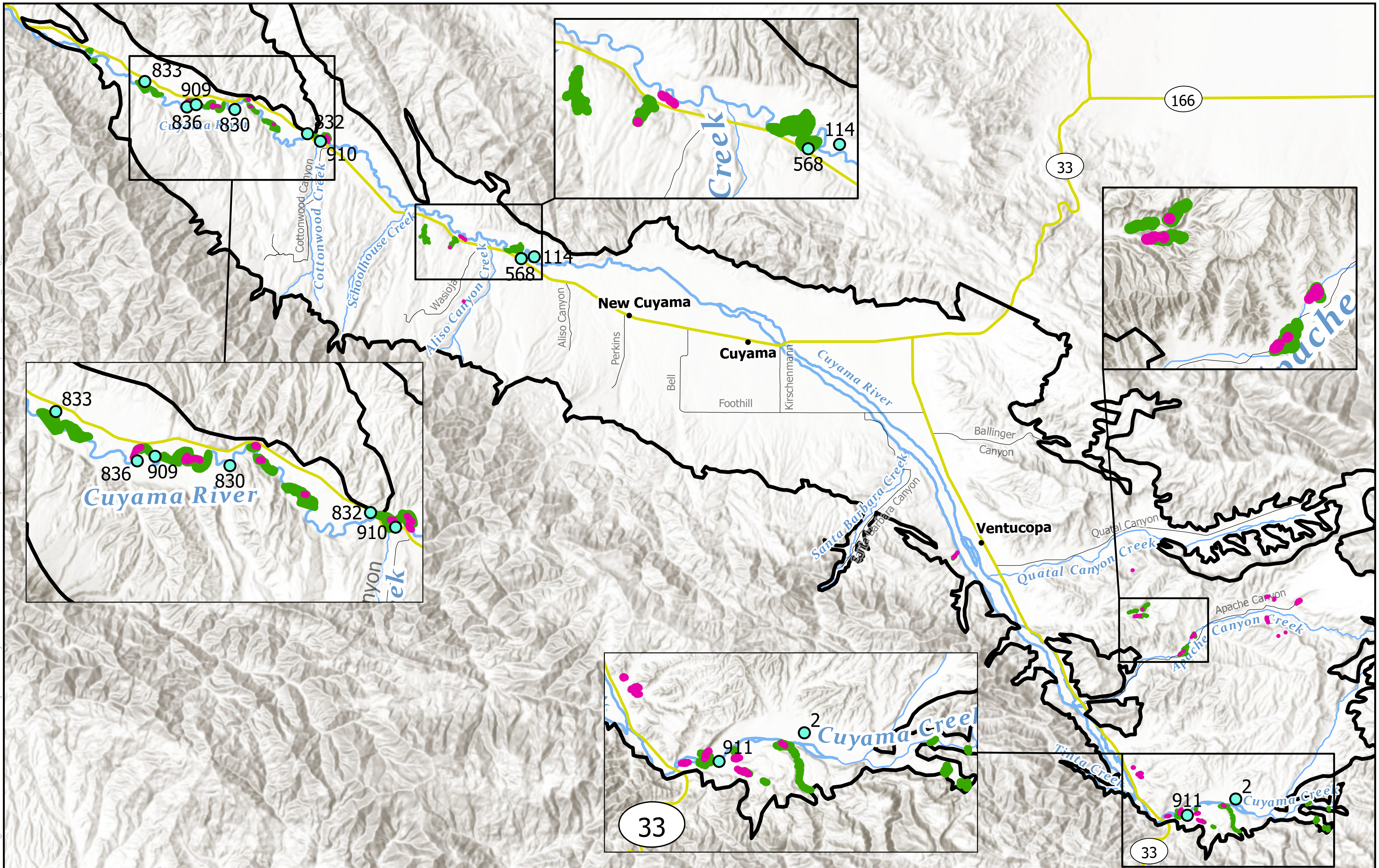


Figure 2-91: Probable GDEs Based on Analysis

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.

N

0 1.25 2.5 5 Miles

Woodard & Curran

Cuyama Basin Groundwater Sustainability Agency

Map Created: June 2024

Figure Exported: 6/27/2024 By: DHunt Using: \\woodardcurran.net\shared\Projects\CA Cuyama Basin GSA\0011078.01 GSP\wip\Z_GIS\2_Maps\3_2025 GSP Update\02_Basin_Setting_Overview\surface water\gde.aprx

2.2.12 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. 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 located near each other.
  - As 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 discreetly 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 discreetly 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.
  - 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.

2.3 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

2.3.1 Useful Terms

This section of Chapter 2 describes 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.

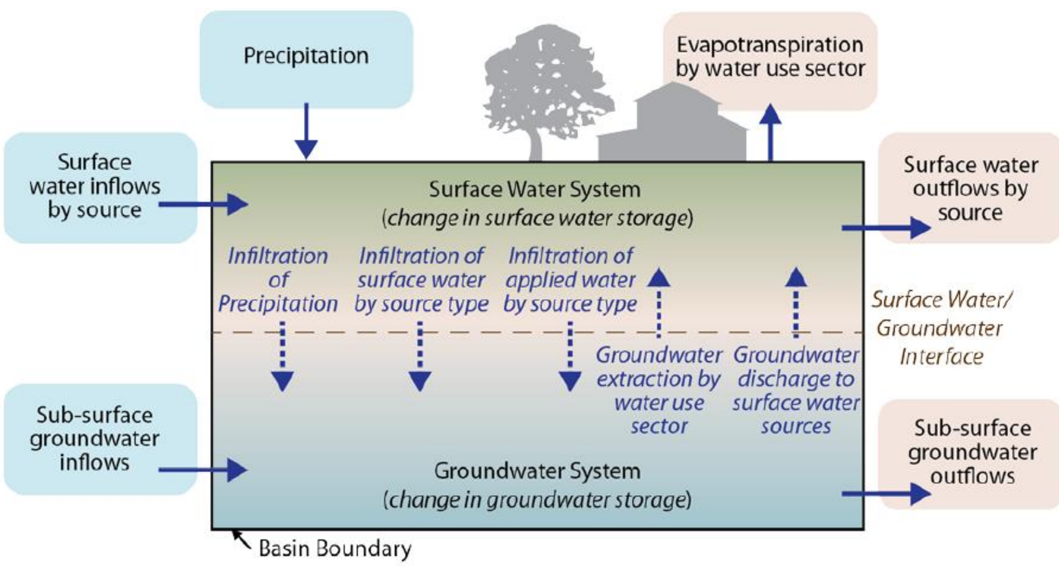
- **Precipitation** – Precipitation is the volume of rainfall that travels from the soil zone to the unsaturated (vadose) zone of the groundwater aquifer.
- **Applied Water** – Applied water is the volume of water that is applied by an irrigation system to assist crop and pasture growth.
- **Evapotranspiration** – 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.

2.3.2 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 2-92 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 om 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 2-92: 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.

2.3.3 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 2-93 shows annual precipitation in the Basin for water years 1968 to 2023. The chart includes bars displaying annual precipitation for each water year and a horizontal line representing the mean precipitation of 13.0 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 2-93. The cumulative departure from mean precipitation is based on 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 2016 illustrates a short period with dramatically dry conditions (i.e., a 16-inch decline in cumulative departure over 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.

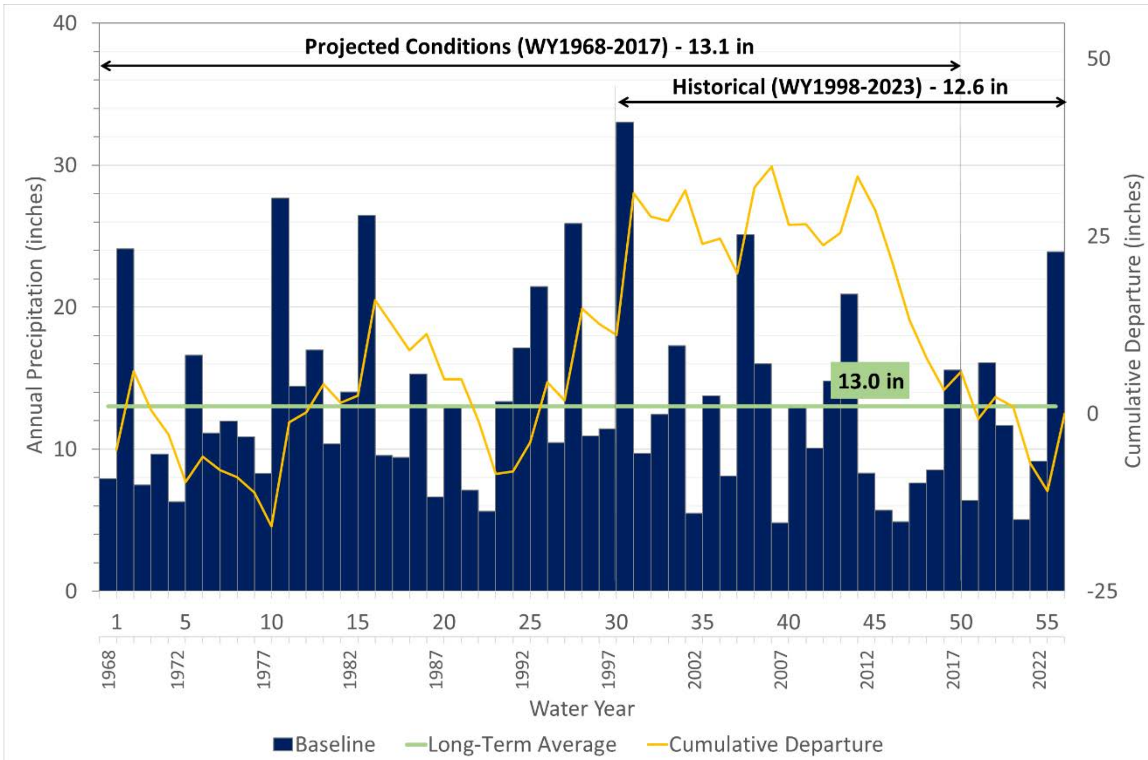


Figure 2-93: 50-Year Historical Precipitation and Cumulative Departure from Mean Precipitation

2.3.4 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 2023 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 updated model used for the 2025 GSP Update was developed based on the best available data and information as of 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 in 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 (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 2-4 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 2023 was selected for the historical water budget to provide a period of representative hydrology while capturing recent Basin operations. The period 1998 through 2023 has an average annual precipitation of 12.6 inches, 0.4 inches less than the long-term average of 13.0 inches and includes the 2012 to 2017 drought, the wet years of 1998, 2005, and 2023, 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 IWFM. This baseline uses current land and water use conditions approximating year 2023 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 information for historical years was developed from private landowner provided 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 IWFM Demand Calculator in conjunction with historical remote sensing technology, Mapping Evapotranspiration at High Resolution and Internalized Calibration (METRIC)

Table 2-4: 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 2023	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 2023 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 IWFM 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 Table 2-5 and Table 2-6 for the historical period and for current and projected conditions. The following sections provide additional information regarding each water budget.

Table 2-5: 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	223,600	231,100	236,400
Applied water	46,100	45,100	46,100
Total Inflow	**269,700**	**273,500**	**282,400**
Outflows			
Evapotranspiration			
Agriculture	49,300	51,100	54,600
Native vegetation	169,700	178,300	180,300
Domestic water use	400	400	400
Deep Percolation			
Precipitation	4,300	5,100	4,900
Applied water	14,700	11,600	11,900
Runoff	31,600	26,900	30,200
Total Outflow	**270,000**	**273,400**	**282,300**

Notes:
AFY = acre-feet per year
[a]From water years 1998 to 2023
[b]Based on 50-year hydrology

Table 2-6: 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	19,000	16,700	16,800
Stream seepage	4,000	5,400	6,000
Subsurface inflow	2,800	2,800	3,200
Total Inflow	**25,800**	**24,900**	**26,000**
Outflows			
Groundwater pumping	46,200	42,400	46,000
Total Outflow	**46,200**	**42,400**	**46,000**
Change in Storage	**(20,400)**	**(17,500)**	**(20,000)**

Notes:
AFY = acre-feet per year
[a]From water years 1998 to 2023
[b]Based on 50-year hydrology

2.3.5 Historical Water Budget

The historical water budget is a quantitative evaluation of the historical surface and groundwater supply covering the 26-year period from 1998 to 2023. 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 2-94 summarizes the average annual historical land surface inflows and outflows in the Basin. Figure 2-95 shows the annual time series of historical land surface inflows and outflows.

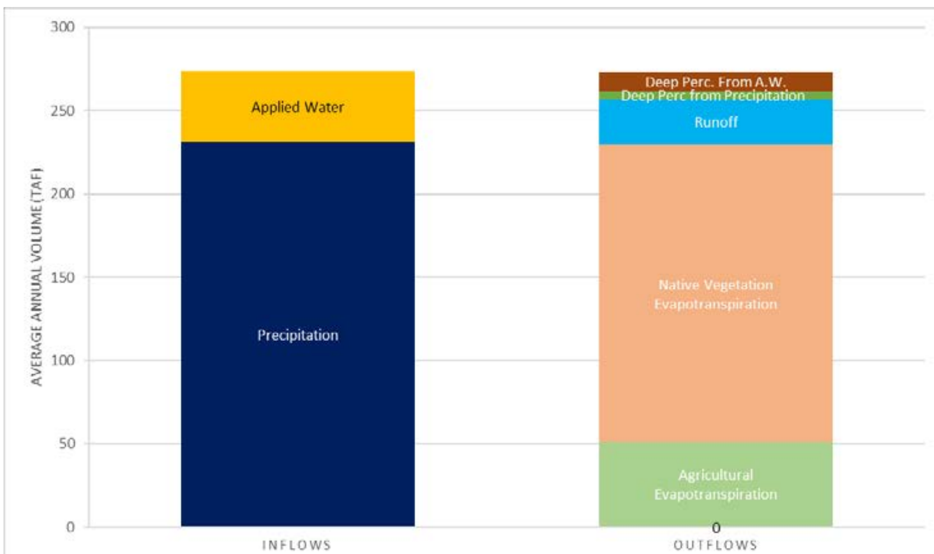


Figure 2-94: Historical Average Annual Land Surface Water Budget

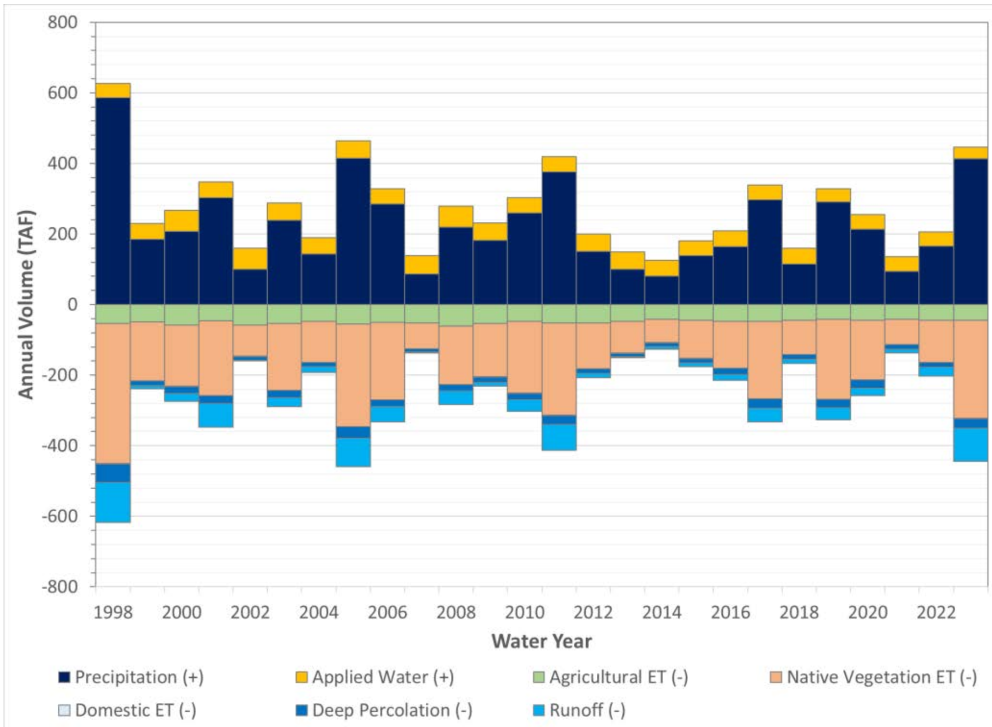


Figure 2-95: Historical Land Surface Water Budget Annual Time Series

The Basin experiences about 269,000 AF of land surface inflows each year, of which 224,000 AF is from precipitation and the remainder is from applied water. About 219,000 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 125,000 AF to a high of 626,000 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 108,000 to 345,000 AF.

Figure 2-96 summarizes the average annual historical groundwater inflows and outflows in the Basin. Figure 2-97 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 20,000 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 19,000 to 22,000 AF. The groundwater storage decreases consistently over time, despite year-to-year variability in groundwater inflows.

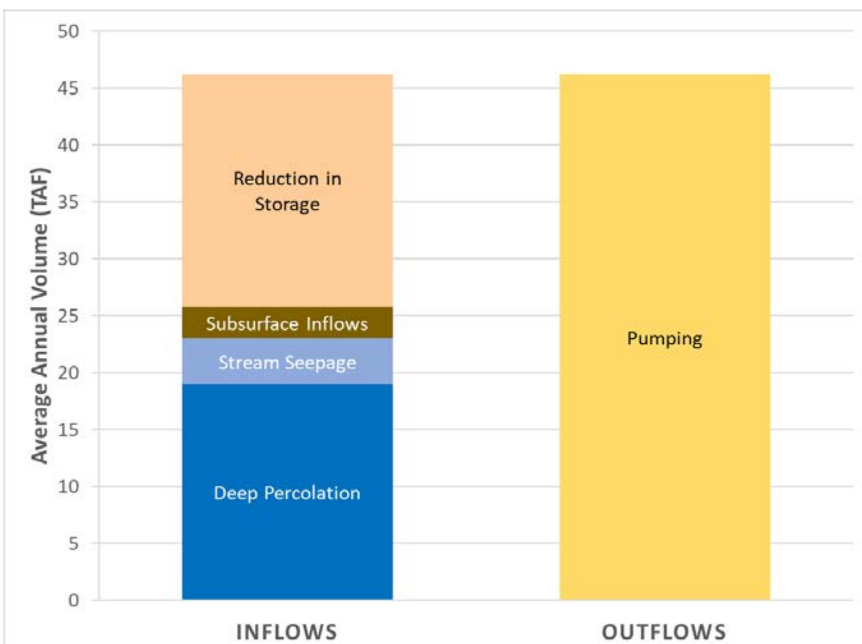


Figure 2-96: Historical Average Annual Groundwater Budget

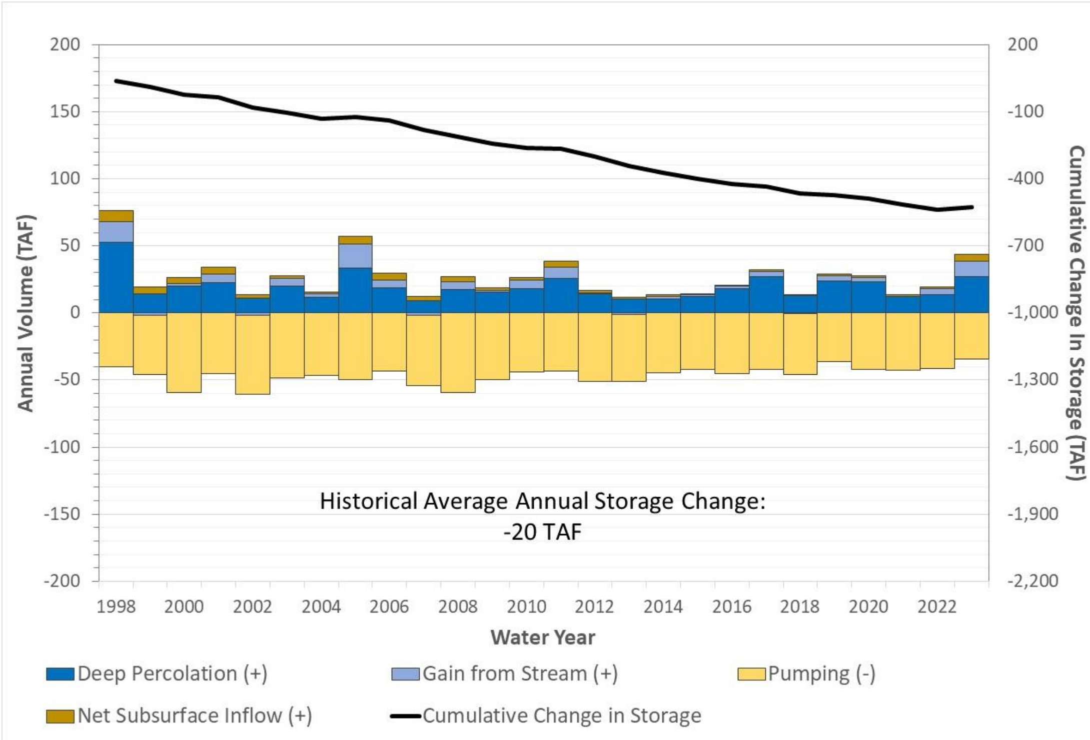


Figure 2-97: Historical Groundwater Budget Annual Time Series

2.3.6 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 2020 population, water use, and land use information.

Figure 2-98 summarizes the average annual current and projected land surface inflows and outflows in the Basin. Figure 2-99 shows the annual time series of current and projected land surface inflows and outflows.

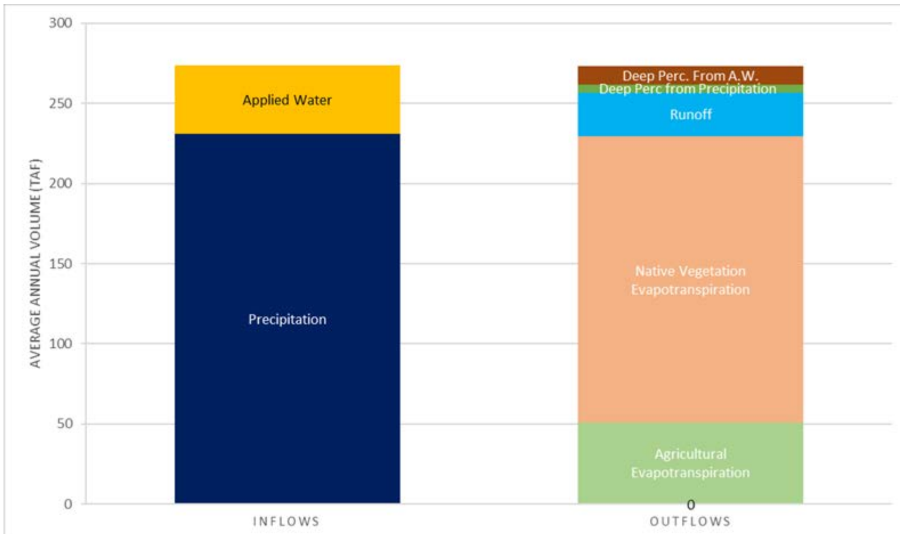


Figure 2-98: Current and Projected Average Annual Land Surface Water Budget

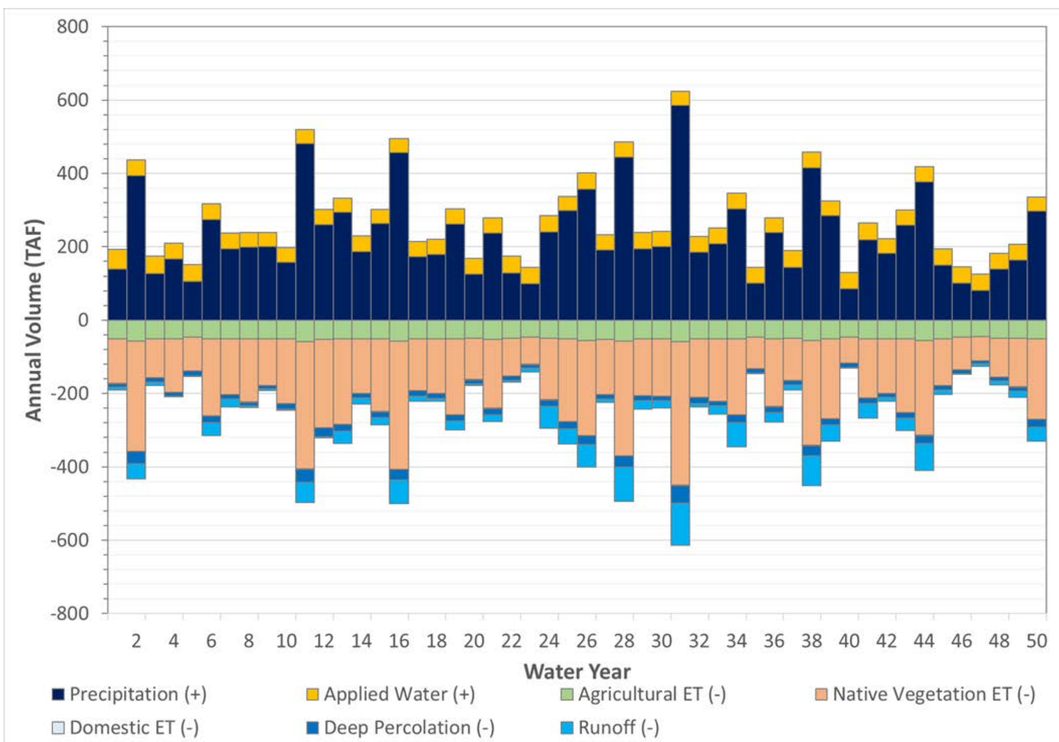


Figure 2-99: Current and Projected Land Surface Water Budget Annual Time Series

Under current and projected conditions, the Basin experiences about 274,000 AF of land surface inflows each year, of which 231,000 AF is from precipitation and the remainder is from applied water as shown in Table 2-5. About 230,000 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 126,000 AF to a high of 624,000 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 111,000 to 451,000 AF.

Figure 2-100 summarizes the average annual current and projected groundwater inflows and outflows in the Basin. Figure 2-101 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 18,000 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 17,000 to 20,000 AF. As with the historical conditions, the groundwater storage decreases consistently over time, despite year-to-year variability in groundwater inflows.

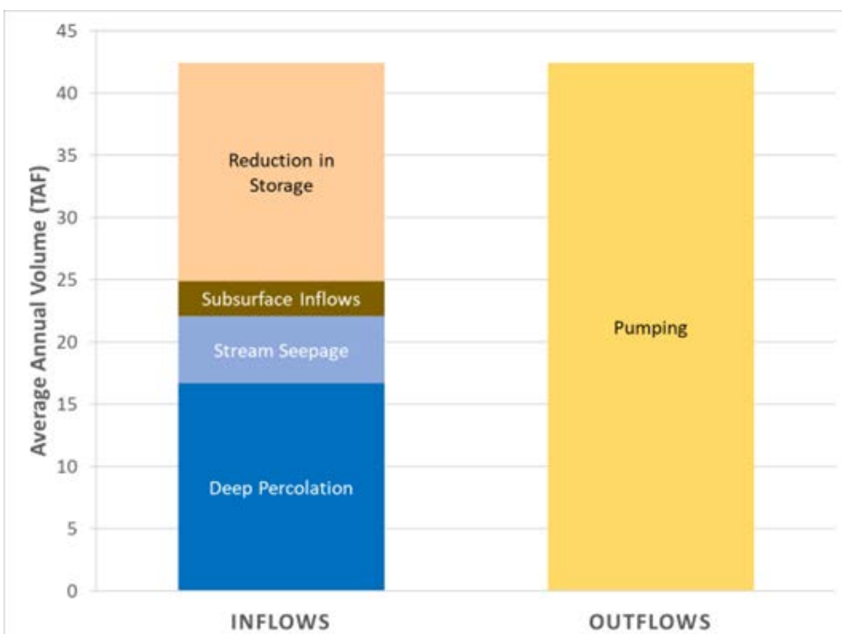


Figure 2-100: Current and Projected Average Annual Groundwater Budget

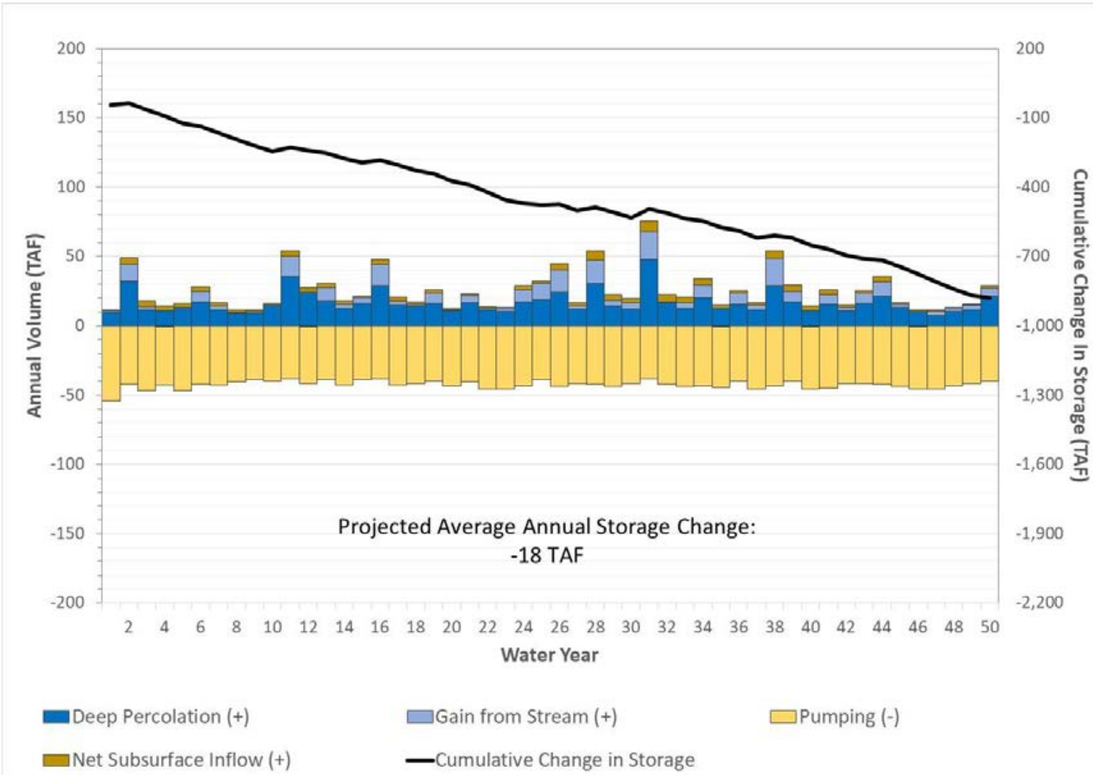


Figure 2-101: Current and Projected Groundwater Budget Annual Time Series

The current and projected water demand, water supply, and change in groundwater storage vary by water year type[10], as shown in Table 2-7. 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.

[10] 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 2-7: 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)	56,700	50,800	51,100	50,300	46,100
Domestic Use (AFY)	200	200	200	200	200
Total Demand	**56,900**	**51,000**	**51,300**	**50,500**	**46,300**
Water Supply					
Groundwater Pumping (AFY)	41,000	40,500	42,100	44,100	45,100
Total Supply	**41,000**	**40,500**	**42,100**	**44,100**	**45,100**
Change in Storage	**11,000**	**(12,300)**	**(23,100)**	**(28,100)**	**(32,000)**

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 2-102 summarizes the average annual current and projected land surface inflows and outflows in the Basin. Figure 2-103 shows the annual time series of current and projected land surface inflows and outflows.

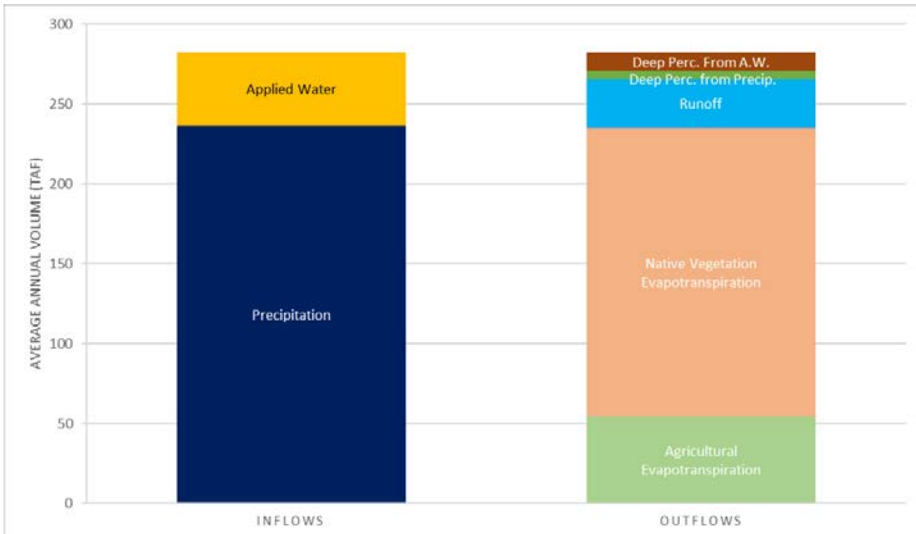


Figure 2-102: Projected Average Annual Land Surface Water Budget with Climate Change

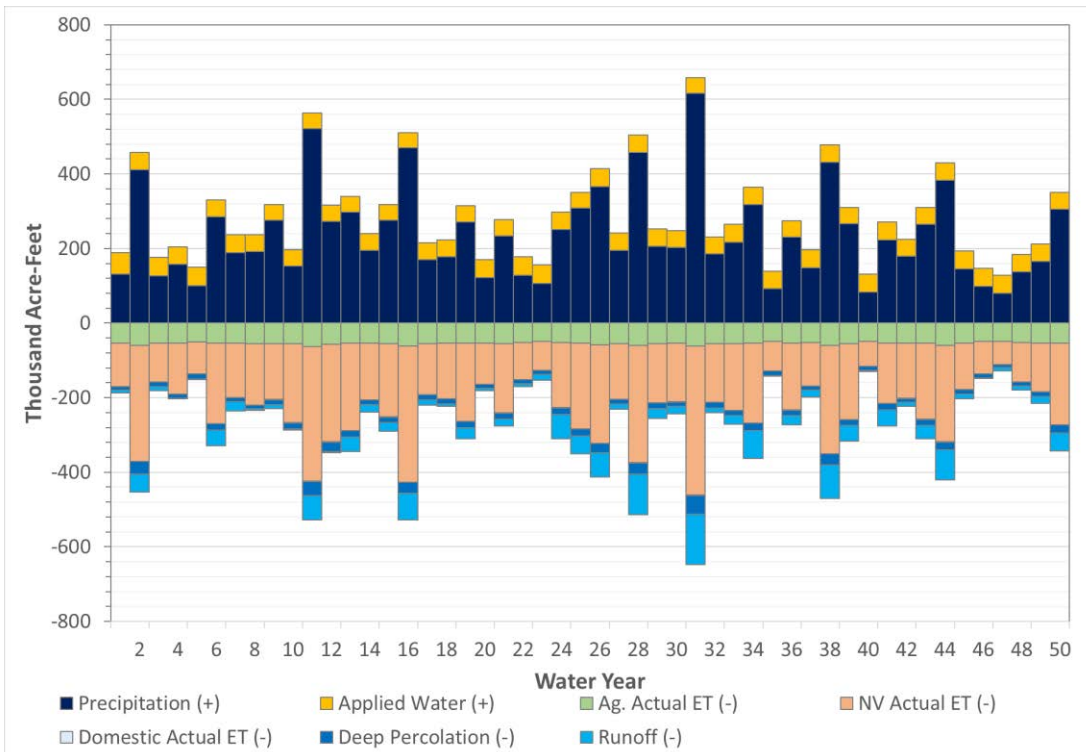


Figure 2-103: Projected Land Surface Water Budget with Climate Change Annual Time Series

Under projected conditions with climate change, the Basin experiences about 282,000 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 2-5. About 235,000 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 129,000 AF to a high of 658,000 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 112,000 AF to 462,000 AF.

Figure 2-104 summarizes the average annual projected groundwater inflows and outflows with climate change in the Basin.

Figure 2-105 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 20,000 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.

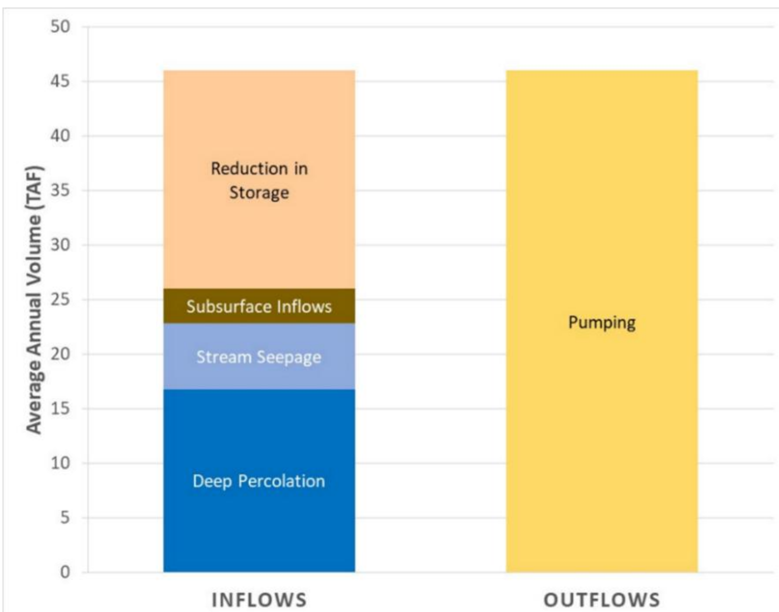


Figure 2-104: Projected Average Annual Groundwater Budget with Climate Change

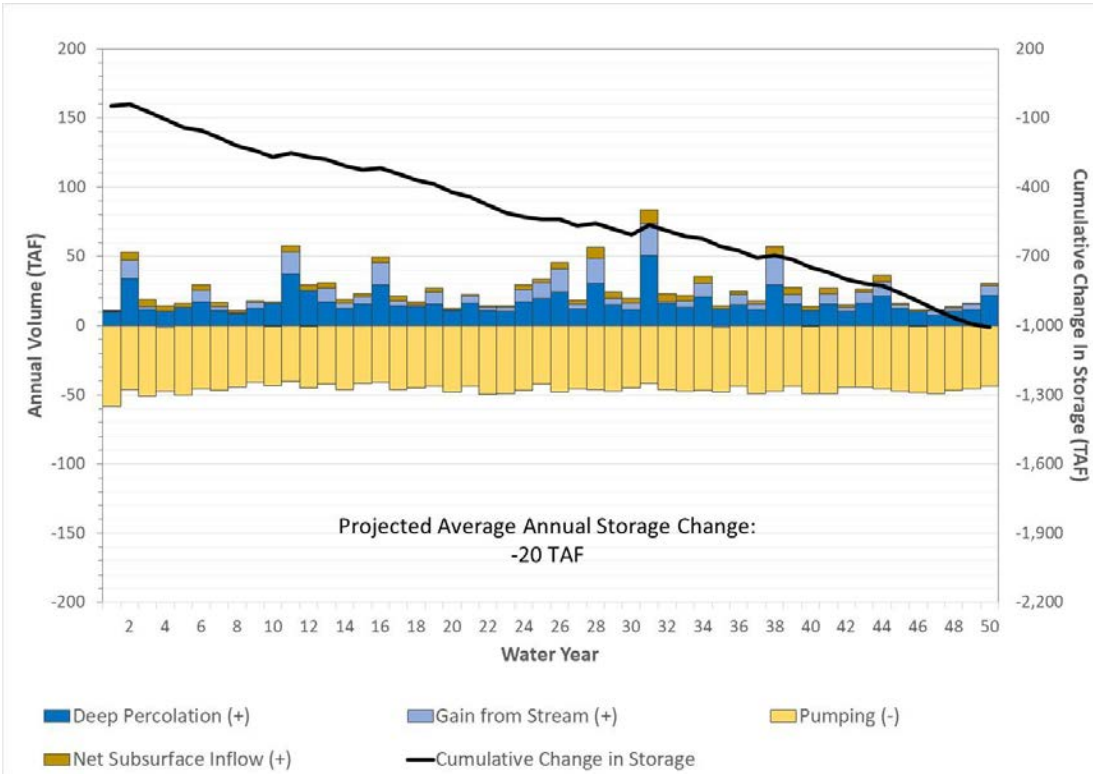


Figure 2-105: Projected Groundwater Budget with Climate Change Annual Time Series

2.3.8 Sustainable Yield Estimates

Four sustainability scenarios were analyzed 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

These estimates were developed using the current and projected conditions and projected conditions with climate change baseline models 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.

As noted above, the baseline models were developed using the best available data and information as of June 2024. 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 2-8 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. Without water supply projects, the Basin sustainable yield is estimated to be about 16,800 AFY without climate change (i.e., a 60 percent reduction in groundwater pumping compared to baseline) and about 17,700 AFY with climate change (i.e., a 62 percent reduction in groundwater pumping compared to baseline). With water supply projects, the Basin sustainable yield is estimated to be about 21,100 AFY without climate change and about 22,000 AFY with climate change.

Table 2-8: 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	8,700	8,700	10,000	10,000
Stream seepage	5,300	5,800	5,300	5,800
Boundary and Other	2,800	3,200	2,800	3,200
Recharge from Projects	0	0	3,000	3,000
Total Inflow	**16,800**	**17,700**	**21,100**	**22,000**
Outflows				
Groundwater pumping	16,800	17,700	21,100	22,000
Total Outflow	**16,800**	**17,700**	**21,100**	**22,000**
Change in Storage	**(0)**	**(0)**	**(0)**	**(0)**
Reduction in groundwater pumping relative to Baseline	**(25,600)**	**(28,300)**	**(21,300)**	**(24,000)**
Percent reduction	**-60%**	**-62%**	**-50%**	**-52%**
Notes: All sustainability scenarios are simulated using the 1968 to 2017 hydrologic period.				

2.4 References

2.4.1 HCM References

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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 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.

- 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., 15 of 47 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., 15 of 47 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., 9 of 29 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.

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.

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

The following content reflects what was included in the 2020 GSP. DWR is in the process of developing additional guidance documents to assist GSAs in addressing the interconnected surface waters sustainability indicator. At this time, those guidance documents have not been published, but the CBGSA plans to utilize those resources when they become available for future updates to the GSP and for future ISW implementation.

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 result is considered to occur during GSP implementation when 30 percent of representative monitoring wells (i.e., 3 of 9 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 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.

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., 14 of 47 wells) fall below their minimum groundwater elevation thresholds for two consecutive years (Section 3.2.1).

Chapter 5 discusses how minimum thresholds were selected. Appendix A of Chapter 5 presents the hydrographs of groundwater levels through 2024 and the established depth of the minimum threshold for each monitoring site. Of the 47 monitoring sites, three were below the minimum threshold in the latest measurement in 2024, which is six percent of representative monitoring wells (i.e., 3 of 47), 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.

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., 9 of 29 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 29 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 29), 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 was not yet available) was downloaded from UNAVCO[11] and the subsidence trend for CUHS was recalculated. Subsidence rates during 2021 and 2022 actually reflected a positive change in ground surface elevation, and current subsidence rates in the central portion of the Basin are 34.02 mm per year or 1.34 inches per year (for WY 2022). This rate is below the minimum threshold, and thus undesirable results for subsidence are not occurring in the Basin.

3.3.6 Depletions of Interconnected Surface Water

The following content reflects what was included in the 2020 GSP. DWR is in the process of developing additional guidance documents to assist GSAs in addressing the interconnected surface waters sustainability indicator. At this time, those guidance documents have not been published, but the CBGSA plans to utilize those resources when they become available for future updates to the GSP and for future ISW implementation.

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.

[11] https://www.unavco.org/data/web-services/documentation/documentation.html#!/GNSS47GPS/getPositionByStationId

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.

4. MONITORING NETWORKS

This chapter discusses the planned monitoring networks needed to guide the Cuyama Basin Groundwater Sustainability Agency (CBGSA) toward their sustainability goals. Monitoring networks need to be established for each sustainability indicator either directly or through monitoring through a proxy. This section satisfies Subarticle 4 of the Sustainable Groundwater Management Act (SGMA) regulations. This chapter also discusses the following:

- Monitoring network objectives
- Existing monitoring programs used to develop the network in the 2020 GSP
- Development of revised monitoring networks for the 2025 GSP Update
- Monitoring network establishment for each sustainability indicator
- Monitoring network data gaps, and a plan to fill data gaps if they are present for each monitoring network

4.1 Useful Terms

This chapter describes groundwater wells, water quality measurements, subsidence stations, and other related components. Technical terms are defined below. Figure 4-1 is a diagram of a monitoring well with well-related terms identified on the diagram. Terms are defined here to guide readers through this chapter, and are not a definitive definition of each term:

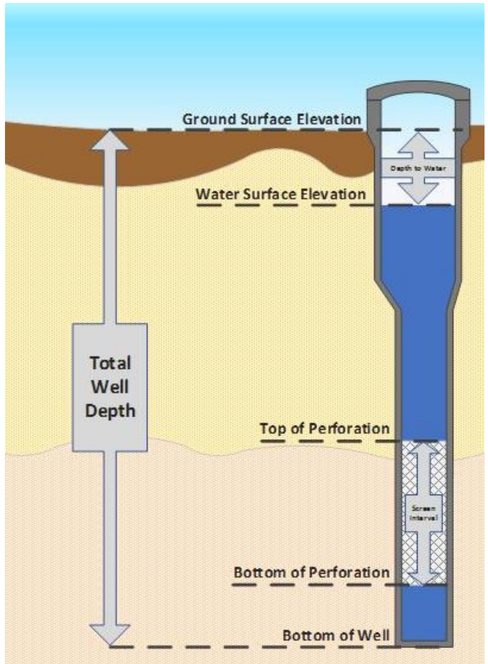

Figure 4-1: Well Completion Diagram

4.1.1 Well-Related Terms

- **Bottom perforation –** The distance to the bottom of the perforation from the ground surface elevation.
- **Depth to water –** The distance from the ground surface or the well' to where water is encountered inside the well
- **Ground surface elevation –** The elevation in feet above mean sea level at the well's location.
- **Screened interval** – The portion of a well casing that is screened to allow water from the surrounding soil into the well pipe. There can be several screened intervals within the same well. Screened interval is usually reported in feet below ground surface (bgs) for both the upper most limit and lower most limit of the screen.
- **Top perforation –** The distance to the top of the perforation from the ground surface elevation.
- **Total well depth** – The depth that a well is installed to. This is often deeper than the bottom of the screened interval.
- **Water surface elevation –** The elevation above mean sea level that water is encountered inside the well

4.1.2 Other Terms

- **Best management practice** – Refers to a practice, or combination of practices, that are designed to achieve sustainable groundwater management and have been determined to be technologically and economically effective, practicable, and based on best available science (Title 23 of the California Code of Regulations [CCR], Article 2).
- **Constituent** – Refers to a water quality parameter measured to assess groundwater quality.
- **Data gap** – Refers to a lack of information that significantly affects the understanding of the Basin setting or evaluation of the efficacy of Plan implementation and could limit the ability to assess whether a Basin is being sustainably managed (Title 23 of the CCR, Article 2).
- **Depth to groundwater –** This is the distance from the ground surface to groundwater typically reported at a well.
- **Historical high groundwater elevations –** This is the highest recorded measurement of static groundwater elevation (closest to the ground surface) in a monitoring well. Measurements of groundwater elevation are used to indicate the elevation of groundwater levels in the area near the monitored well.
- **Historical low groundwater elevations –** This is the lowest measurement of static groundwater elevation (furthest from the ground surface) in a monitoring well that was recorded. Measurements of groundwater elevation are used to indicate the elevation of groundwater levels in the area near the monitored well.
- **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.
- **Representative monitoring** – Refers to a monitoring site within a broader network of sites that typifies one or more conditions within the Basin or an area of the Basin (Title 23 of the CCR, Article 2).
- **Subsidence** – Refers to the sinking or downward settling of the earth's surface, not restricted in rate, magnitude, or area involved, and is often the result of over-extraction of subsurface water. For more information, see the Groundwater Conditions chapter.

4.2 Monitoring Network Objectives

This chapter describes the Cuyama Valley Groundwater Basin (Basin) monitoring networks for the five sustainability indicators that apply to the Basin. The objective of these monitoring networks is to detect undesirable results in the Basin, as described in Chapter 3, using the sustainability thresholds described in Chapter 5. Other related objectives of the monitoring network are defined via the SGMA regulations as follows:

- Demonstrate progress toward achieving measurable objectives described in the GSP

- Monitor impacts to the beneficial uses or users of groundwater
- Monitor changes in groundwater conditions relative to measurable objectives and minimum thresholds
- Quantify annual changes in water budget components

The monitoring network plan provided to the Basin is intended to monitor:

- Chronic lowering of groundwater levels
- Reduction in groundwater storage
- Degraded water quality
- Land subsidence
- Depletions of interconnected surface water

The monitoring networks described in this chapter were developed for the 2020 GSP using data provided by the California Department of Water Resources (DWR), the United States Geological Survey (USGS), participating counties, and private landowners. The monitoring network consisted of wells that are already being used for monitoring in the Basin. These monitoring networks have been revised for the 2025 GSP Update as described in the sections below.

4.2.1 Basin Conditions Relevant to Measurement Density and Frequency

This section summarizes key Basin conditions that influence the development of monitoring networks. These key conditions include hydrogeologic considerations, land use considerations, and historical groundwater conditions.

The Basin, as described in Section 2.1, is composed of one principal aquifer comprised of three geologic groups: Younger Alluvium, Older Alluvium, and Morales Formation. The majority of groundwater in the aquifer is stored in the Younger and Older alluvium. While there are many faults in the Basin, there are no major stratigraphic aquitards or barriers to vertical groundwater movement among the alluvium and Morales Formation. The aquifer has a wide range of thicknesses that vary spatially, with median reported hydraulic conductivity ranges from 1.22 to 72.1 feet per day (see Table 2-1 in Chapter 2 for detailed values). Figures 2-19 and 2-20 in Chapter 2 show the extent of these formations throughout the Basin.

The largest groundwater uses in the Basin are for irrigated agriculture. The figures shown in Chapter 1, Section 1.2, Plan Area show the extent of land used for irrigated agriculture in the Basin. Based on the most recent data from 2022, there are approximately 53 square miles of agricultural land in the Basin out of approximately 378 square miles, equaling approximately 14 percent of the Basin's land.

Data provided in Chapter 2, Section 2.2 shows the historical decline groundwater levels in the Basin's central portion. Groundwater elevations in this portion of the Basin have decreased by more than 400 feet from the 1940s to the present, as shown in Figure 4-2.

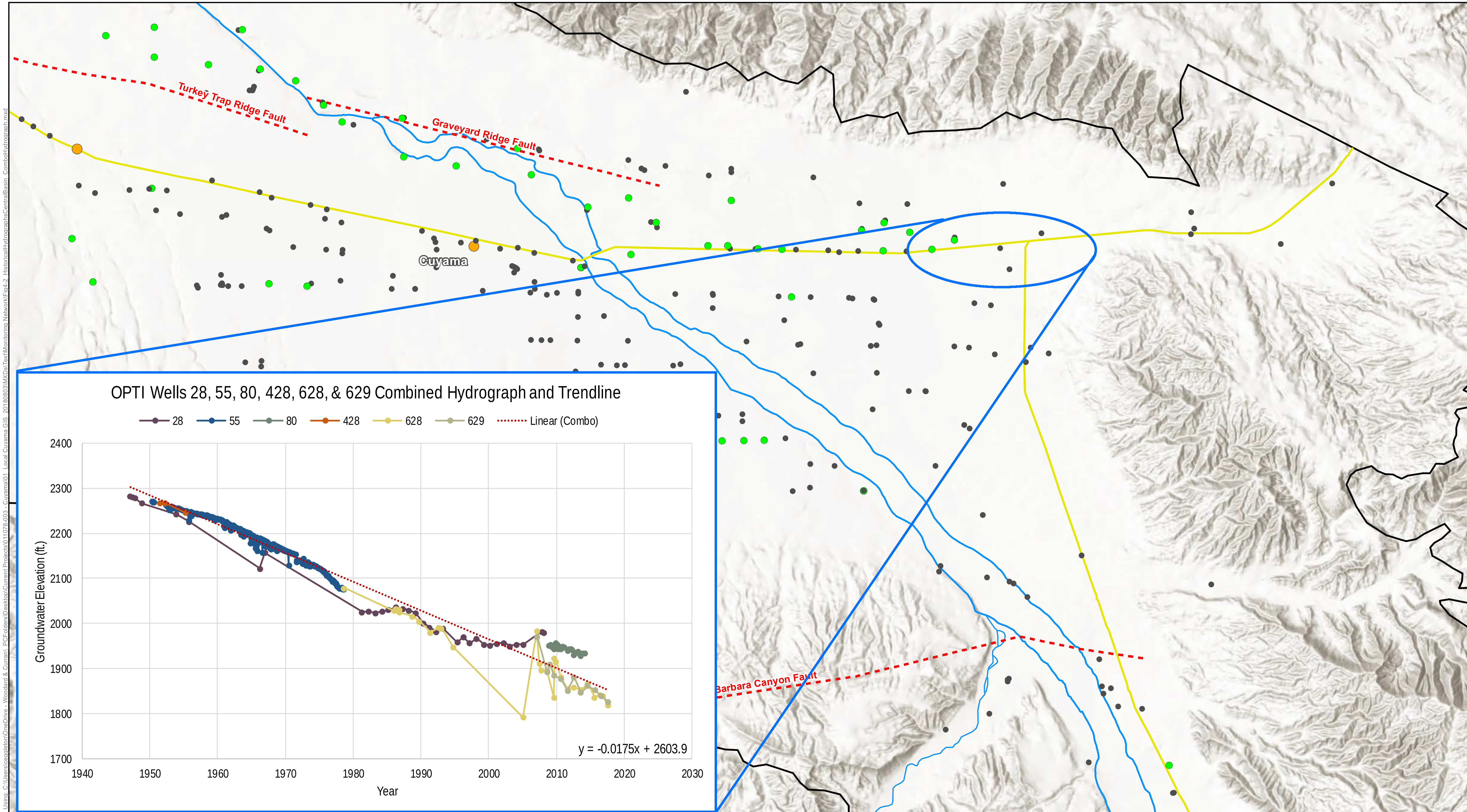

Figure 4-2: Cuyama GW Basin Central Basin with Combined Hydrograph

Cuyama Basin Groundwater Sustainability Agency

Cuyama Valley Groundwater Basin Groundwater Sustainability Plan

April 2019

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Legend

- Cuyama Basin
- Towns
- Highways
- Cuyama River
- Streams
- Faults
- Currently Monitored Wells
- Not Currently Monitored

4.3 Existing Monitoring Used Prior to 2020 GSP Adoption

4.3.1 Groundwater Level Monitoring

This section describes groundwater level monitoring conducted by agencies and private landowners in the Basin prior to GSP adoption in January 2020. Since 2020, the CBGSA has performed its own groundwater level monitoring using the monitoring network approved in the GSP.

DWR, Statewide Dataset/California Statewide Groundwater Elevation Monitoring (CASGEM)

The State of California has several water-related database portals accessible online. These include the following:

- CASGEM Program
- Water Data Library
- Groundwater Information Center Interactive Map Application

The data for these portals are organized and saved in one master database, where each portal accesses and displays data depending on the search criteria and portal used.

The CBGSA contacted DWR directly to acquire all available data related to the Basin. DWR provided a customized hyperlink for CBGSA representatives to download the State's database in whole. Cuyama Basin data were then extracted from this dataset.

Although the master dataset was used to collect initial data, the CASGEM portal was used throughout the planning process to verify that data (DWR CASGEM Online System, 2018). The CASGEM Program is tasked with tracking seasonal and long-term groundwater elevation trends in groundwater basins throughout the State. In 2009, Senate Bill x7-6 established collaboration between local monitoring parties and DWR, enabling DWR to collect groundwater elevation data, and ultimately establishing the CASGEM Program.

The CASGEM Program allows local agencies to be designated as CASGEM monitoring entities for groundwater basins throughout the State (CASGEM Brochure, 2018). CASGEM monitoring entities can measure groundwater elevations or compile data from other agencies to fulfill a monitoring plan, and each entity is responsible for submitting that data to DWR. Three monitoring entities operate as CASGEM monitoring entities in the Cuyama Basin as follows:

- Santa Barbara County Water Agency (SBCWA)
- Ventura County Watershed Protection District (VCWPD)
- San Luis Obispo Flood Control & Water Conservation District (SLOFC & WCD)

The CASGEM Program includes two kinds of wells in its database as follows:

- CASGEM wells, all of which include well construction information
- Voluntary wells that are included in the CASGEM database on a volunteer basis; well construction may not be identified or made public

The Basin has six CASGEM wells and 107 voluntary wells. Figure 4-3 shows the locations of these wells.

Most wells are measured on either a semi-annual or annual schedule. Summary statistics about these wells are listed below.

- Number of CASGEM wells: 6
- Number of voluntary wells: 107
- Total number of DWR and CASGEM wells: 222
- Earliest measurement year: 1946
- Longest period of record: 68 years
- Median period of record: 12 years
- Median number of records for a single well: 19

The greatest well density among current wells is in the central portion of the Basin and in the area around Ventucopa. There are also several monitoring wells in the southeastern portion of the Basin upstream of Ventucopa. CASGEM data are sparser along the north facing slopes of the main Cuyama Valley and the western portion of the Basin, as can be seen in Figure 4-3.

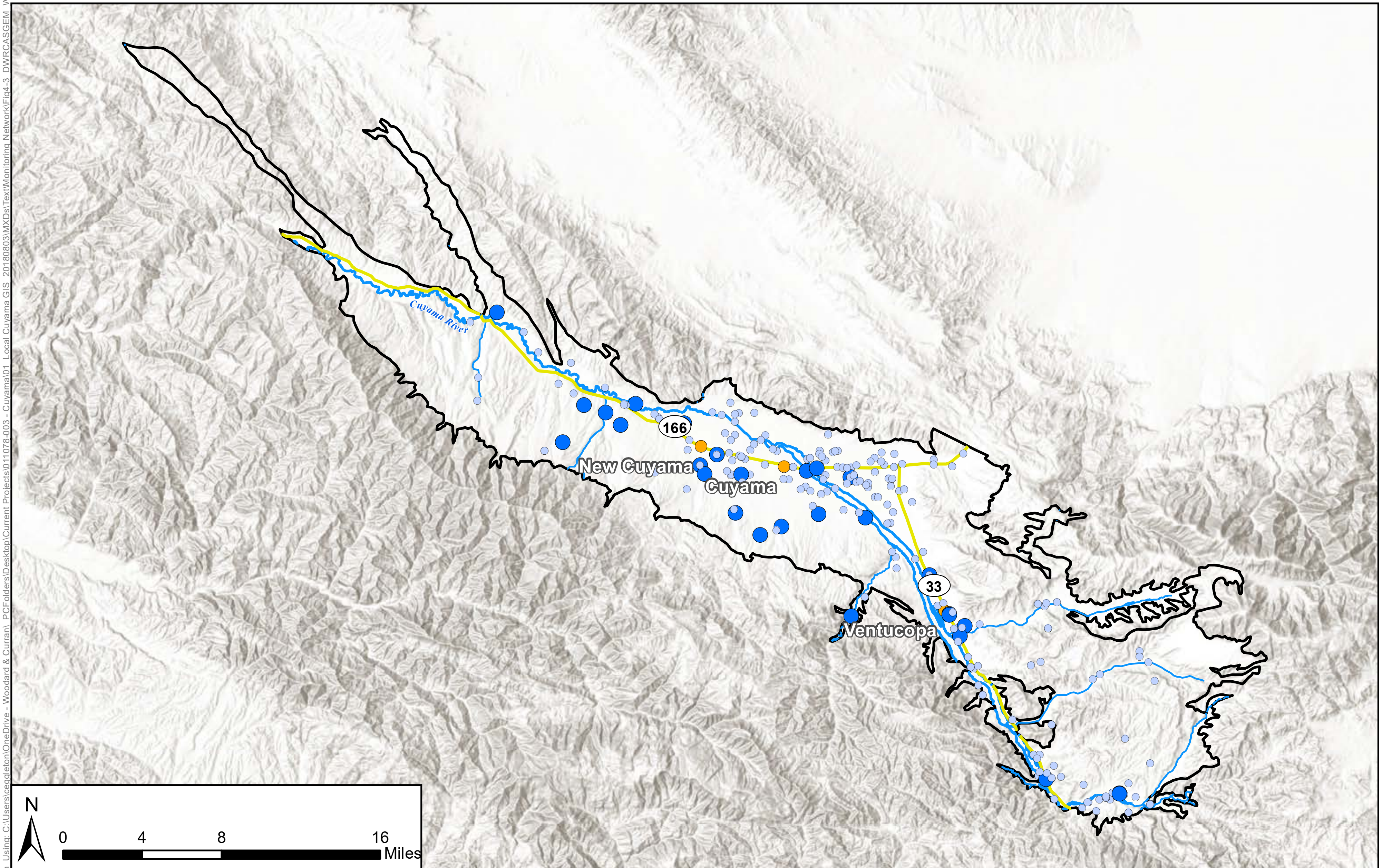

Figure 4-3: Cuyama GW Basin Wells with Monitoring Data Provided by DWR

Cuyama Basin Groundwater Sustainability Agency

Cuyama Valley Groundwater Basin Groundwater Sustainability Plan

April 2019

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Legend

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

Figure Exported: 1/25/2019 By: ceggleton Using: C:\Users\ceggleton\OneDrive - Woodard & Curran_PCFolders\Desktop\Current Projects\011078-003 - Cuyama\01_Local Cuyama GIS_20180803\MXDs\Text\Monitoring Network\Fig4-3_DWRCASGEM_Wells.mxd

United States Geological Survey

The USGS has the most groundwater elevation monitoring locations in the Basin. Many of these wells were installed for a 1966 groundwater study and have since been retired.

There are significant overlaps between the DWR provided datasets and the USGS provided datasets. Approximately 106 wells appear in both downloaded datasets. Overlapping data is discussed below.

USGS data may be accessed through their online portals for the National Ground-Water Monitoring Network, Groundwater Watch, and the National Water Information System (NWIS).

The USGS online data portals provide approved data that has been quality-assured and deemed fit to be published by USGS. The portals also provide provisional data that is unverified and subject to revision. The CBGSA contacted USGS directly and coordinated download of USGS monitoring records in the Basin. The CBGSA used the USGS URL Generation tool was used to download all provisional and approved data about the Basin.

USGS has approximately 476 wells in the Basin. Summary statistics about these wells are listed below.

- Total number of USGS wells: 476
- Earliest measurement date: 1946
- Longest period of record: 68 years
- Median period of record: 2 years
- Median number of records for a single well: 2 years

A significant portion of the wells included in the USGS dataset are located near the Cuyama River and are in the central portion of the Basin. Wells are also found along many of the tributaries that feed the Cuyama River, recording data during large precipitation events. Figure 4-4 shows well locations included in the USGS dataset.

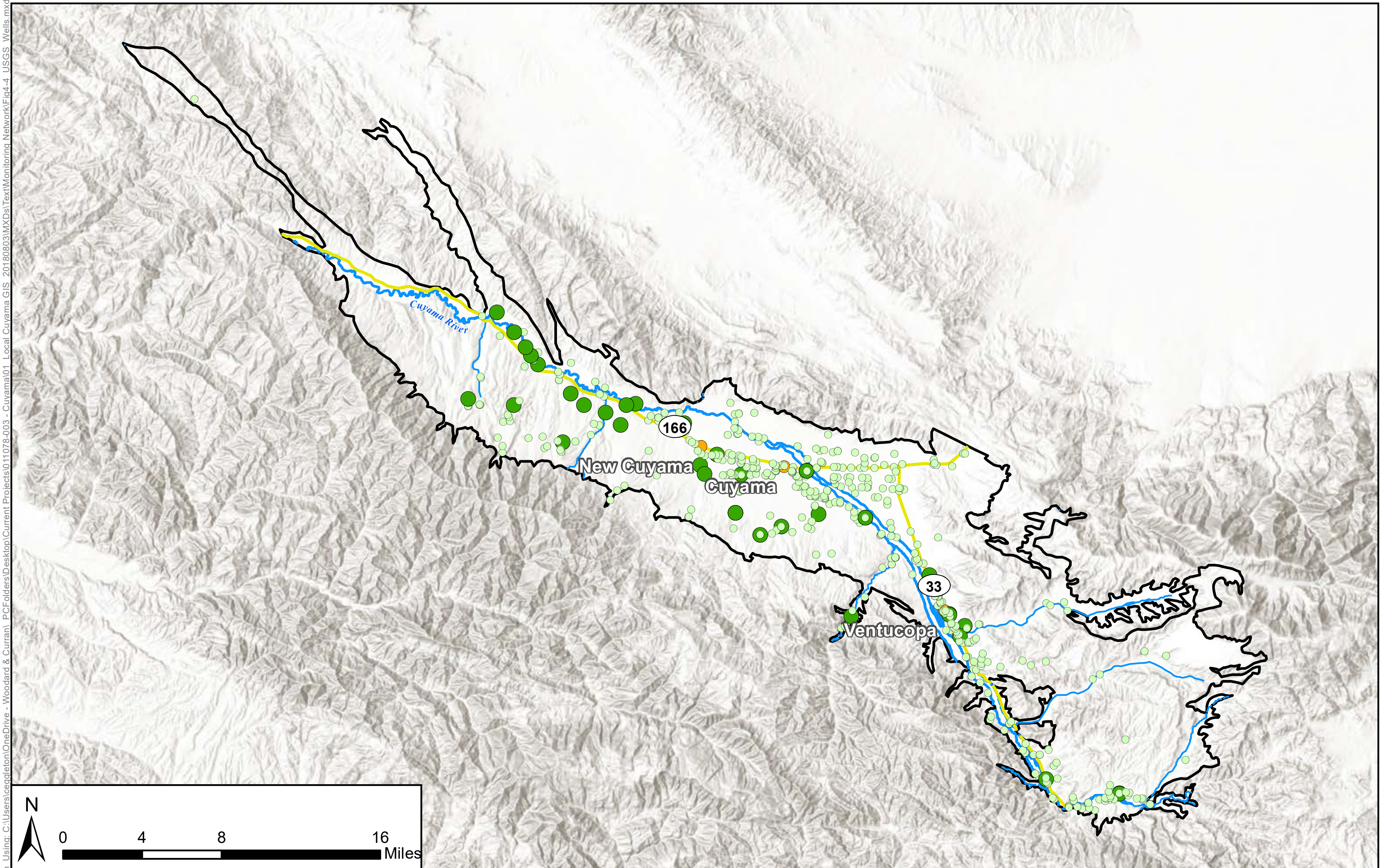

Figure 4-4: Cuyama GW Basin Wells with Monitoring Data Provided by USGS

Cuyama Basin Groundwater Sustainability Agency

Cuyama Valley Groundwater Basin Groundwater Sustainability Plan

April 2019

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Legend

- Cuyama Basin
- Towns
- Highways
- Cuyama River
- Streams
- USGS Database Wells Last Measured in 2017-2018
- USGS Database Wells Last Measured 2016 or Earlier

Figure Exported: 1/25/2019 By: ceggleton Using: C:\Users\ceggleton\OneDrive - Woodard & Curran_PCFolders\Desktop\Current Projects\011078-003 - Cuyama\01_Local Cuyama GIS_20180803\MXDs\Text\Monitoring Network\Fig4-4_USGS_Wells.mxd

Santa Barbara County Water Agency

SBCWA maintains data for 36 wells in the Cuyama Basin. Some of those wells are owned by private land owners, and others are owned by local agencies such as the California Department of Transportation and the California Department of Fish and Wildlife. Summary statistics about these wells are listed below.

- Number of SBCWA-monitored wells: 36
- Earliest measurement date year: 1950
- Longest period of record: 68 years
- Median period of record: 2 years
- Median number of records for a single well: 8

Wells included in the SBCWA dataset are in Santa Barbara County near the Cuyama River, and in the hills to the south of the river. Figure 4-5 shows the locations of these wells.

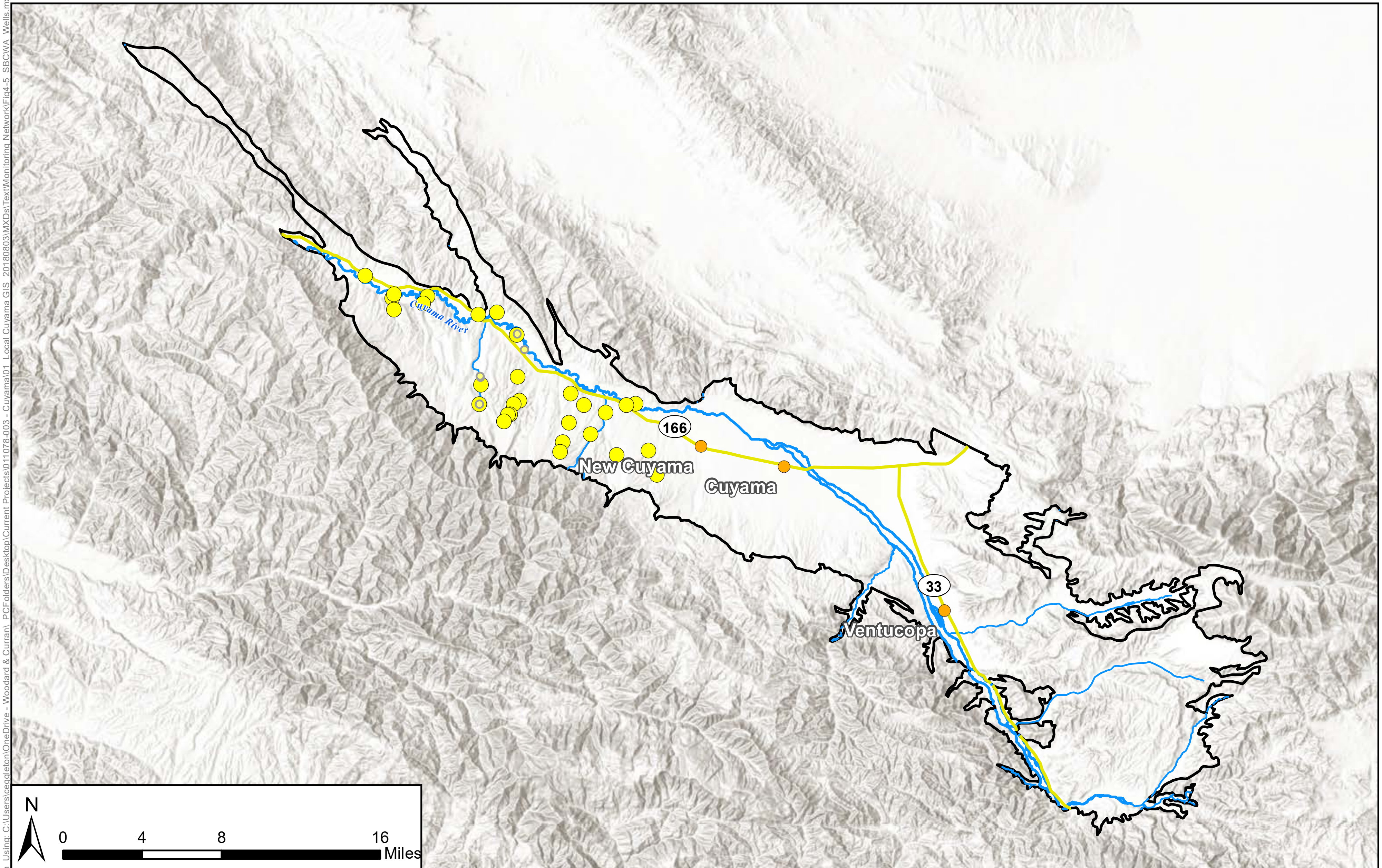

Figure 4-5: Cuyama GW Basin Wells with Monitoring Data Provided by SBCWA

Cuyama Basin Groundwater Sustainability Agency

Cuyama Valley Groundwater Basin Groundwater Sustainability Plan

April 2019

WOODARD & CURRAN

Legend

- Cuyama Basin
- Towns
- Highways
- Cuyama River
- Streams
- Santa Barbara County Database Wells Last Measured in 2017-2018
- Santa Barbara County Database Wells Last Measured 2016 or Earlier

San Luis Obispo County Flood Control & Water Conservation District

SLOCFC & WCD maintains data for two wells within the Basin. SLOCFC & WCD also reports these data to DWR; all data are for the wells is incorporated through the DWR CASGEM Program dataset.

These wells are in the central portion of the Basin, north of the Cuyama River and west of State Route (SR) 33. Both wells meet the minimum requirements for inclusion in the monitoring network, and summary statistics about these wells are listed below.

- Number of SLOCFC&WCD-monitored wells: 2
- Earliest measurement year: 1990
- Longest period of record: 28 years
- Median period of record: 18 years
- Median number of records for a single well: 35

Figure 4-6 show the well locations.

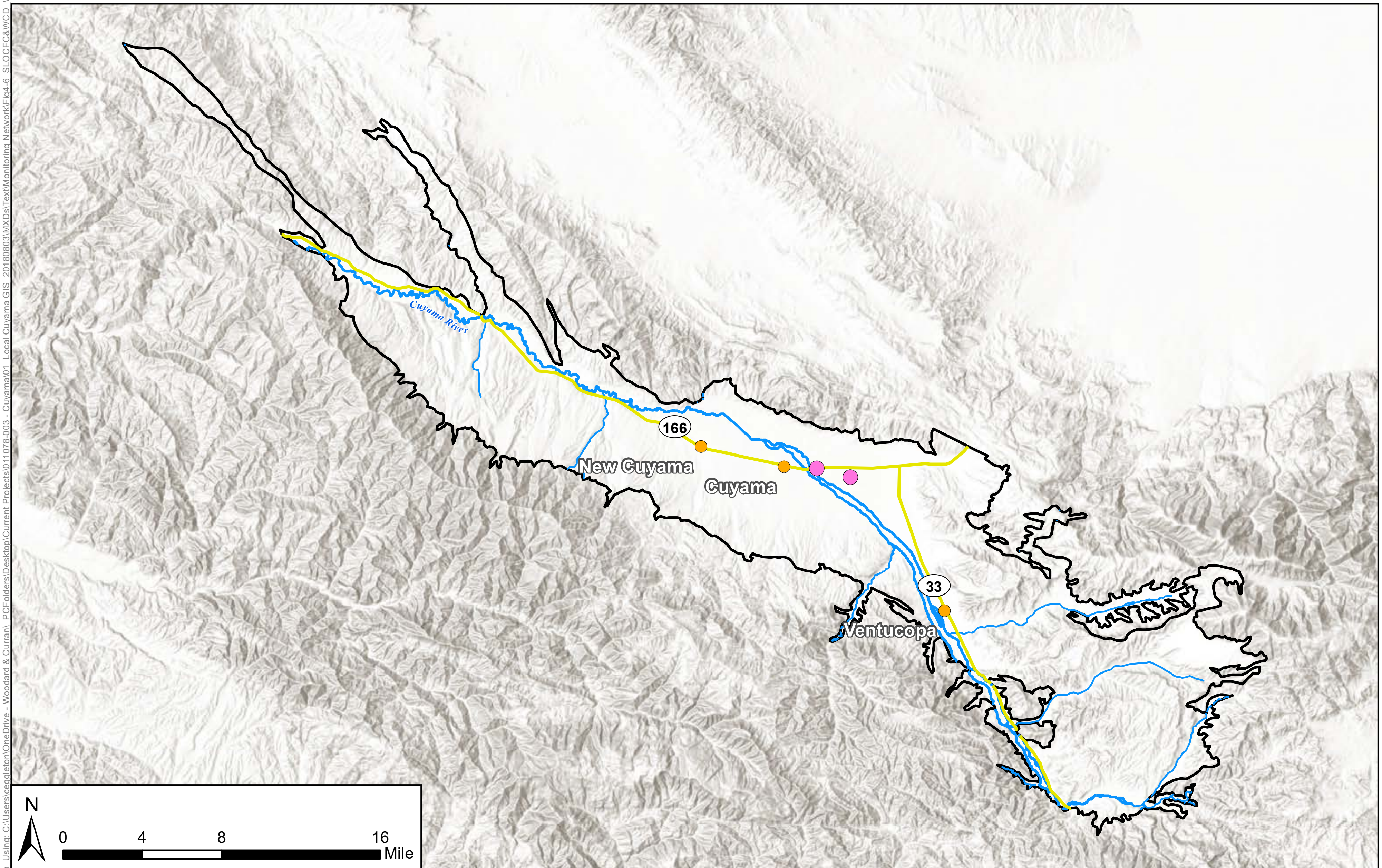

Figure 4-6: Cuyama GW Basin Wells with Monitoring Data Provided by SLOCFC&WCD

Cuyama Basin Groundwater Sustainability Agency

Cuyama Valley Groundwater Basin Groundwater Sustainability Plan

April 2019

WOODARD & CURRAN

Legend

- Cuyama Basin
- Towns
- Highways
- Cuyama River
- Streams
- San Luis Obispo County Wells Last Measured in 2017-2018

Ventura County Water Protection District

VCWPD manages 22 groundwater elevation monitoring wells in the Basin. A total of 20 wells are incorporated in the DWR CASGEM Program dataset.

The majority of wells managed by VCWPD are discontinued, and no longer measure groundwater elevations. Of the 22 wells, five have measured elevation data during the last decade. Summary statistics about these wells are listed below.

- Number of VCWPD-monitored wells: 22
- Earliest measurement year: 1971
- Longest period of record: 46 years
- Median period of record: 5.8 years
- Median number of records for a single well: 21.5

The wells included in the VCWPD dataset are in the southeastern portion of the Basin that intersects with Ventura County. The wells are primarily found near the Cuyama River close to agricultural land. Figure 4-7 shows well locations.

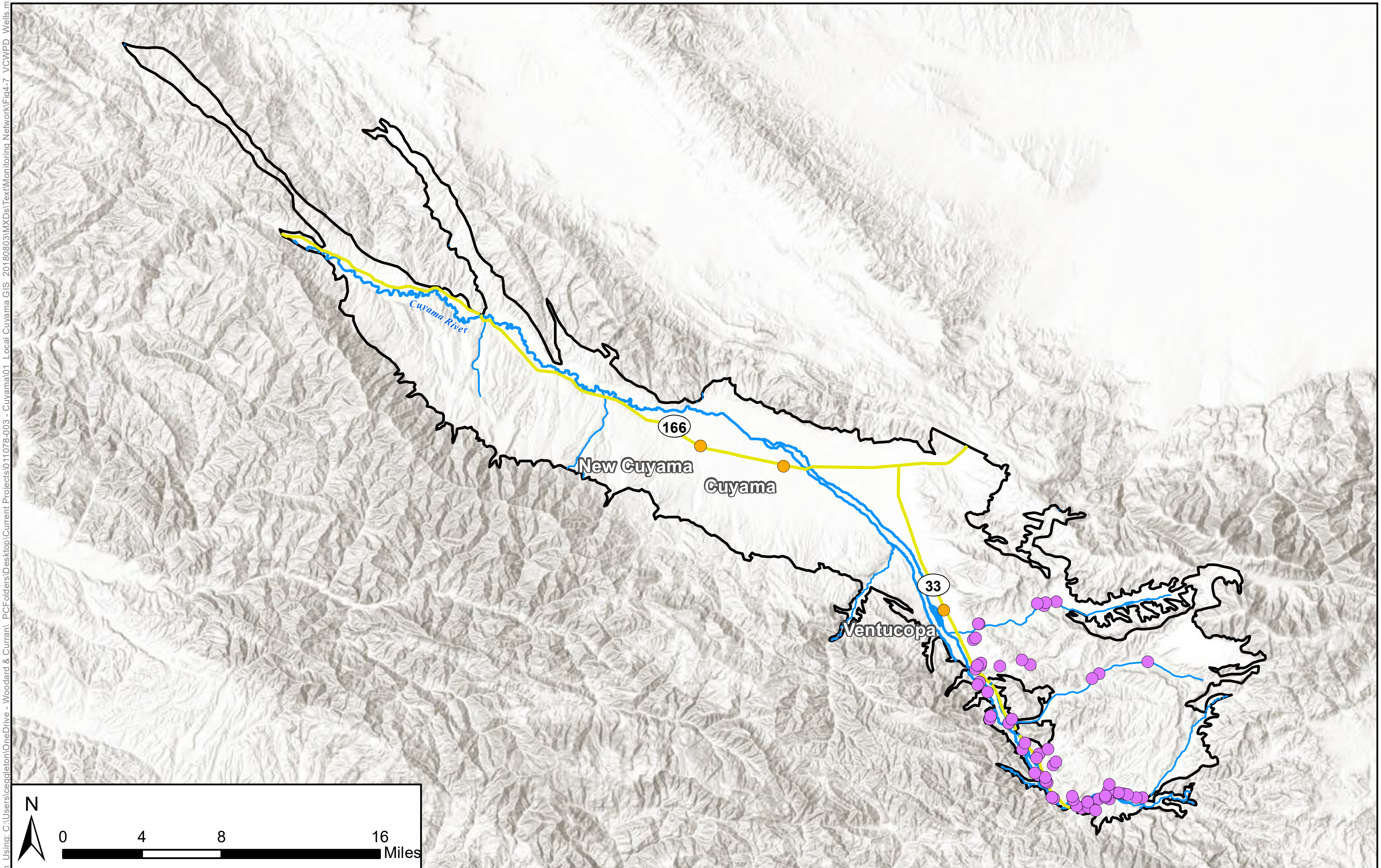

Figure 4-7: Cuyama GW Basin Wells with Monitoring Data Provided by VCWPD

Cuyama Basin Groundwater Sustainability Agency

Cuyama Valley Groundwater Basin Groundwater Sustainability Plan

April 2019

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Legend

- Cuyama Basin
- Ventura County Watershed Protection District
- Towns
- Highways
- Cuyama River
- Streams

Figure Exported: 1/25/2019 By: ceggleton Using: C:\Users\ceggleton\OneDrive - Woodard & Curran\ PCFolders\Desktop\Current Projects\011078-003 - Cuyama\01_Local Cuyama GIS_20180803\MXDs\Text\Monitoring Network\Fig4-7_VCWPD_Wells.mxd

Cuyama Community Services District

The Cuyama Community Services District (CCSD) performs monitoring on its two production wells, one of which has been retired. The CCSD wells are just south of the CCSD. Data for these wells are included in the SBCWA dataset, and in the DWR and USGS datasets. Summary statistics about these wells are listed below. Figure 4-8 shows the location of these wells.

- Number of CCSD-monitored wells: 2
- Earliest measurement year: 1981
- Longest period of record: 37 years
- Median period of record: 26.5 years
- Median number of records for a single well: 79

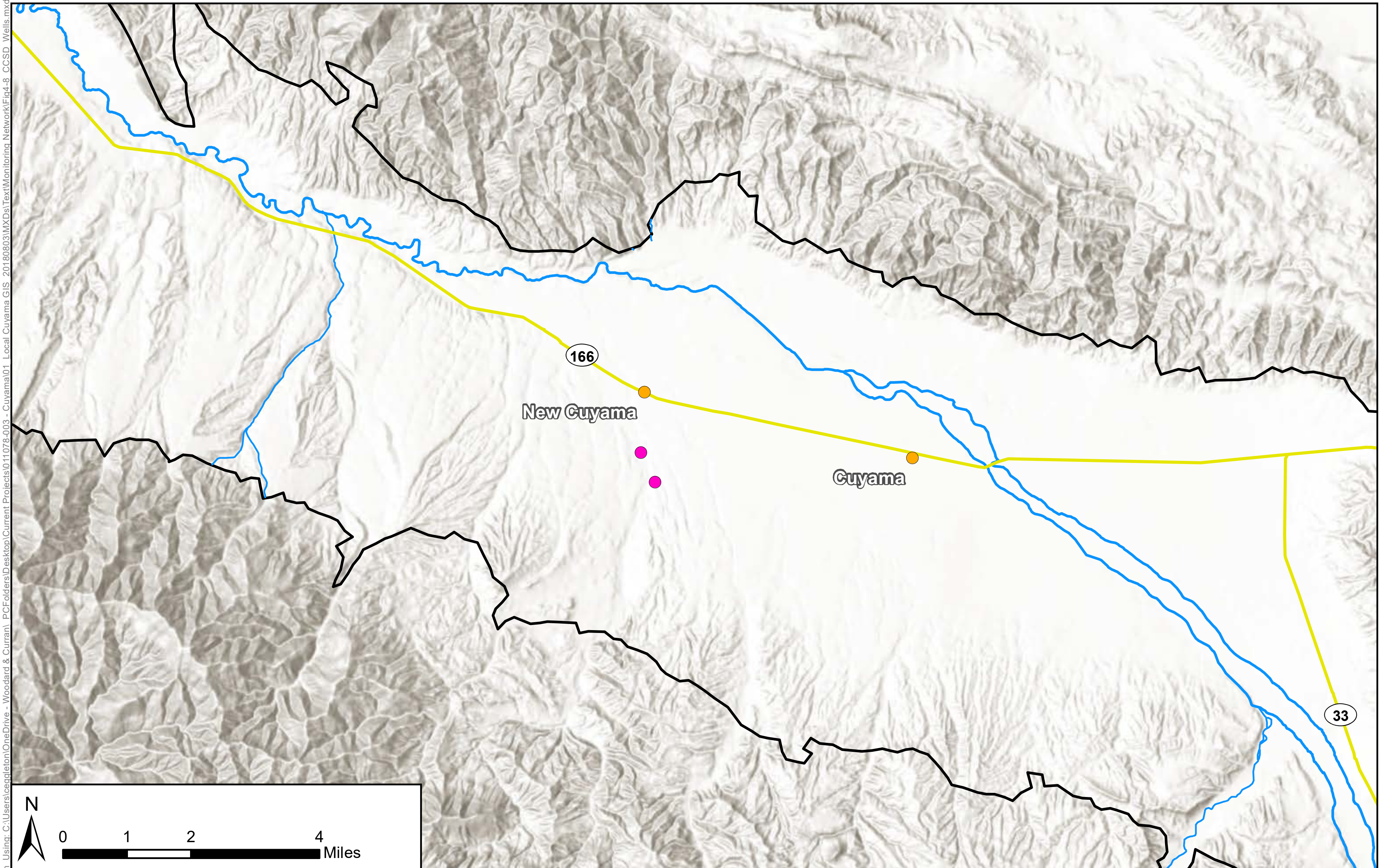

Figure 4-8: Cuyama GW Basin Wells with Data Provided by CCSD

Cuyama Basin Groundwater Sustainability Agency

Cuyama Valley Groundwater Basin Groundwater Sustainability Plan

April 2019

WOODARD & CURRAN

Legend

- Cuyama Basin
- CCSD Wells
- Towns
- Highways
- Cuyama River
- Streams

Private Landowners

Private landowners in the Basin own and operate large numbers of wells, primarily for irrigation and domestic use. Many wells owned by private landowners are included in the databases described above. In addition, and at the request of CBGSA, these landowners have provided additional monitoring data about 99 private wells. Summary statistics about these wells are listed below.

- Number of private landowner wells with monitoring data: 99
- Earliest measurement date year: 1975
- Longest period of record: 42 years
- Median period of record: 15 years
- Median number of records for a single well: 16

The private landowner wells are distributed throughout the Basin. The majority of wells are located in the central portion of the Basin near the Cuyama River and SR 166. There is an additional cluster of wells toward the western portion of the Basin running along the Cuyama River. Figure 4-9 shows private landowner wells.

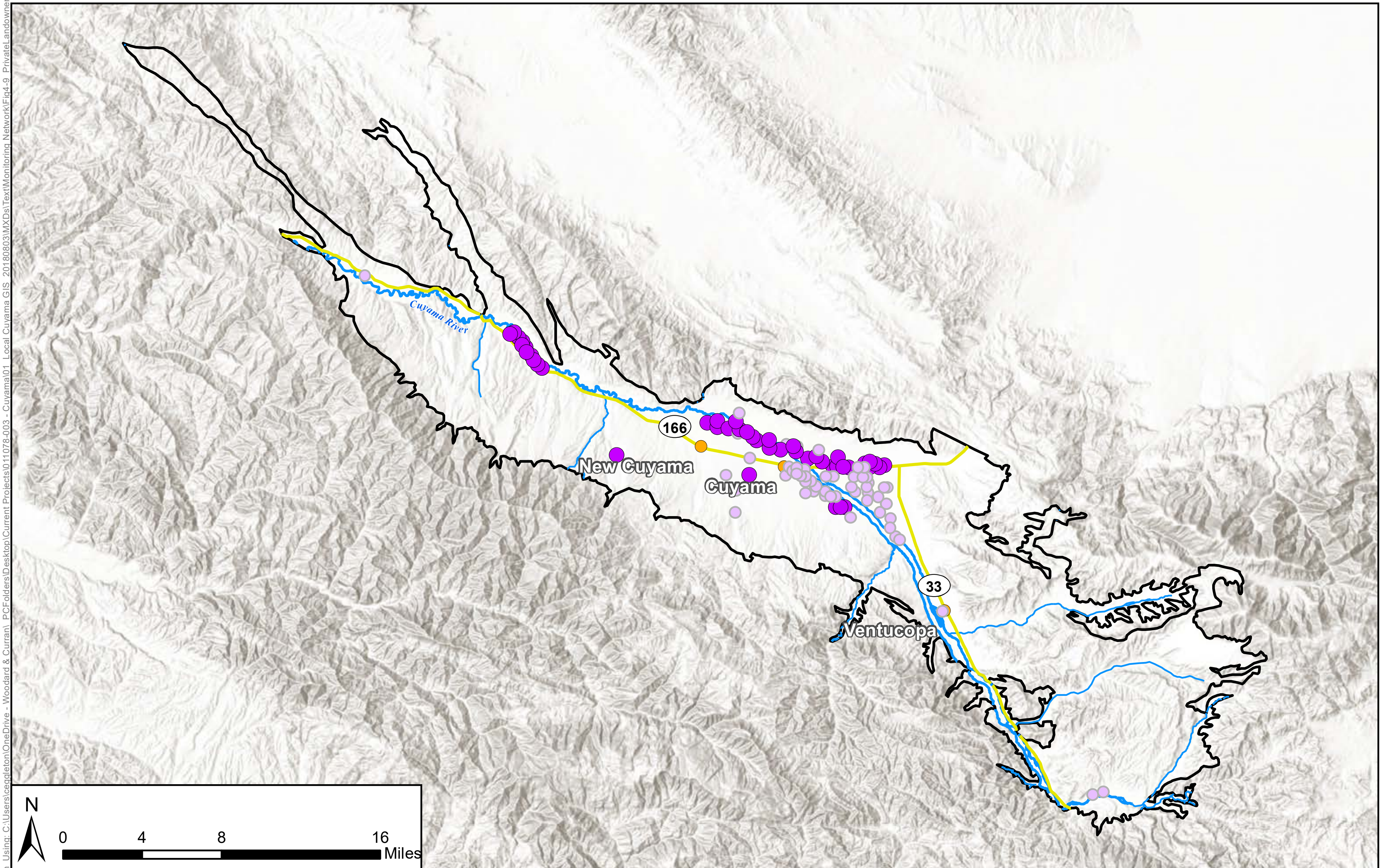

Figure 4-9: Cuyama GW Basin Wells with Monitoring Data Provided by Private Landowners

Cuyama Basin Groundwater Sustainability Agency

Cuyama Valley Groundwater Basin Groundwater Sustainability Plan

April 2019

WOODARD & CURRAN

Legend

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

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4.3.2 Overlapping and Duplicate Data

Many of the data sources used to compile and create the Cuyama Basin database contain duplicate entries for wells, metadata, groundwater level measurements, and groundwater quality measurements. Much of the well information managed by counties in the Basin is also provided and incorporated into the DWR dataset. Many of the USGS wells and DWR wells overlap between datasets.

To avoid duplicate entries when compiling the Cuyama Basin database, wells were organized by their State Well Number, Master Site Code, USGS identification number, local name, and name. Analysts identified duplicates and removed or combined entries as necessary. Each unique well was then assigned an OPTI ID which was used as the primary identification number for all other processes and mapping exercises. Additional information about the management of well data is provided in Chapter 6.

OPTI IDs were used to identify Basin wells in the database because not all data sources use similar identification methods, as shown in Table 4-1 below.

Table 4-1: Well Identification Matrix

Data Maintaining Entity	State Well Number	CASGEM ID	USGS ID	Master Site Code	Local Name	Name
DWR	✔ (all)	✔ (all)		✔ (all)		
USGS	✔ (some)		✔ (all)		✔ (few)	
SLOCFC&WCD	✔ (all)					
SBCWA	✔ (some)		✔ (few)		✔ (some)	
VCWPD	✔ (all)					
Private Landowners					✔ (some)	✔ (all)

✔ (green) = All wells had this information, ✔ (black) = Some wells had the information, ✔ (red) = Few wells had the information

4.3.3 Groundwater Quality Monitoring (Combined Existing Programs)

This section discusses existing groundwater quality monitoring programs in the Cuyama Basin.

National Water Quality Monitoring Council (NWQMC)/USGS/ Irrigated Land Regulatory Program (ILRP)

The NWQMC was created in 1997 to provide a collaborative, comparable, and cost-effective approach for monitoring and assessing the United States' water quality. Several organizations contribute to the database, including the Advisory Committee on Water Information, the United States Department of Agriculture's (USDA's) Agricultural Research Service, the United States Environmental Protection Agency (EPA), and USGS (NWQMC, 2018).

A single online portal provides access to data from the contributing agencies. Data are included from the USGS NWIS, the EPA Storage and Retrieval Data Warehouse, and the USDA's Agricultural Research

Service Program, Sustaining The Earth's Watersheds – Agricultural Research Database System. Data incorporates hundreds of different water quality constituents from the different contributing agencies. Initial water quality data for the Cuyama Basin was downloaded through NWQMC and included data about USGS monitoring sites and ILRP monitoring sites. ILRP was initiated in 2003 to prevent agricultural runoff from impairing surface waters, and in 2012, groundwater regulations were added to the program. ILRP water quality measurements are sampled from surface locations (DWR ILRP, 2018). There are currently five ILRP measurement sites in the Cuyama Basin. ILRP uses the California Environmental Data Exchange Network (CEDEN) to manage associate program data. CEDEN data are then integrated with USGS data, and then included in the NWQMC database (DWR CEDEN, 2018).

The NWQMC database provides TDS data about 180 water quality monitoring sites. This database also provides data for a variety of constituents not included here.

Summary statistics for the NWQMC, USGS, and ILRP monitoring sites is shown below.

- Number of measurement sites: 180
- Earliest measurement date year: 1940
- Longest period of record: 53 years
- Median period of record: less than 1 year
- Median number of records for a single site: 2

The majority of the water quality monitoring sites included in the NWQMC database are located in the central portion of the Basin and along the Cuyama River as it follows SR 33. Figure 4-10 shows these monitoring sites.

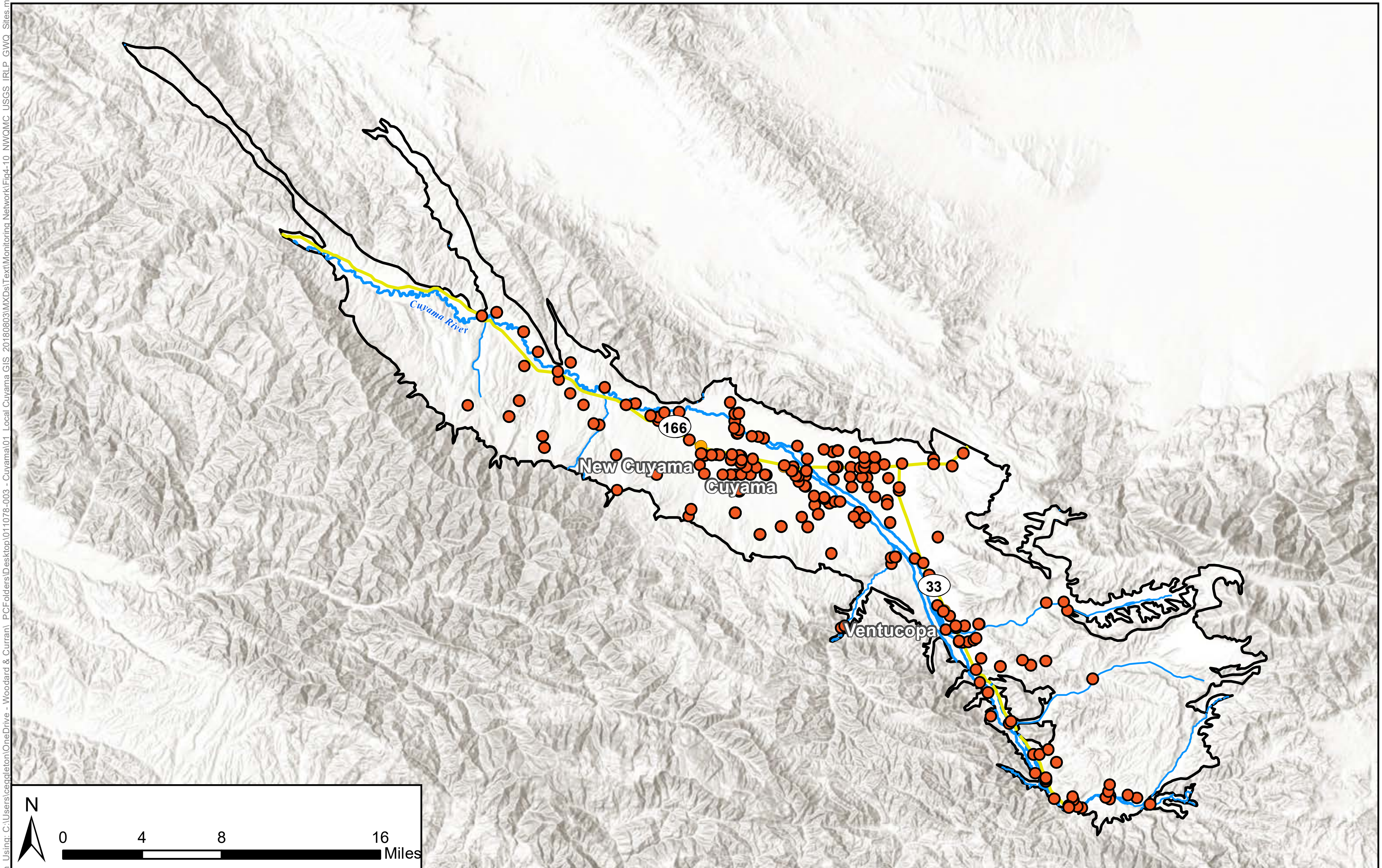

Figure 4-10: Cuyama GW Basin USGS/NWQMC/ IRLP Groundwater Quality Monitoring Sites

Cuyama Basin Groundwater Sustainability Agency

Cuyama Valley Groundwater Basin Groundwater Sustainability Plan

April 2019

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Legend

- Cuyama Basin
- USGS/NWQMC/IRLP Groundwater Quality Sites
- Towns
- Highways
- Cuyama River
- Streams

Groundwater Ambient Monitoring and Assessment (GAMA) Program/DWR

The GAMA Program is the State of California's groundwater quality monitoring program created by the State Water Resources Control Board in 2000. Assembly Bill 599 later expanded the Groundwater Quality Monitoring Act of 2001 (DWR GAMA, 2018). The purpose of GAMA is to improve statewide comprehensive groundwater monitoring and increase the availability of information to the general public about groundwater quality and contamination information. Additionally, the GAMA Program aims to establish groundwater quality on basin-wide scales, continue with groundwater quality sampling and studies, and centralize the information and data for the public and decision makers to enhance groundwater resource protection.

DWR also publishes statewide water quality data via the California Natural Resources Agency. Access to DWR and GAMA information and data are accessible through separate online portals.

There are 213 GAMA and DWR groundwater quality monitoring sites in the Basin. Summary statistics for these sites are shown below.

- Number of measurement sites: 213
- Earliest measurement date year: 1942
- Longest period of record: 41 years
- Median period of record: less than 1 year
- Median number of records for a single site: 2

The GAMA/DWR groundwater quality monitoring locations are spread throughout the Basin, loosely following the Cuyama River. There are 60 water quality monitoring sites per 100 square miles in the Basin. Figure 4-11 shows these locations.

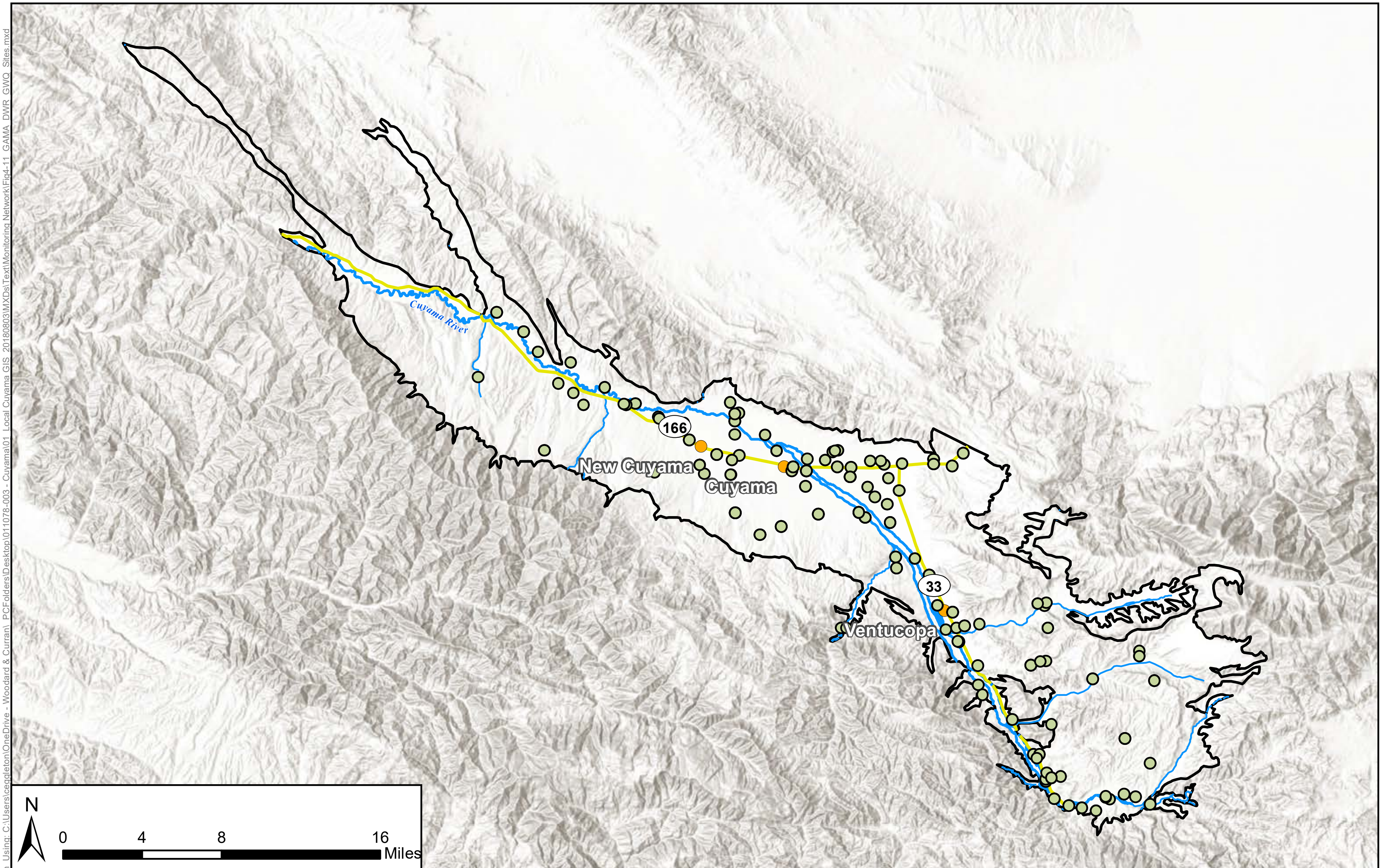

Figure 4-11: Cuyama GW Basin GAMA/DWR Groundwater Quality Monitoring Sites

Cuyama Basin Groundwater Sustainability Agency

Cuyama Valley Groundwater Basin Groundwater Sustainability Plan

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Legend

- Cuyama Basin
- GAMA/DWR Groundwater Quality Sites
- Towns
- Highways
- Cuyama River
- Streams

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Cuyama Community Services District

CCSD currently operates one production well for residential distribution in the Basin. Although some data for this well are included in the NWQMC dataset, annual Consumer Confidence Reports from 2011 to 2017 were processed for additional water quality data measurements. Summary statistics for the CCSD well are listed below and the well location is shown in Figure 4-12.

- Number of measurement sites: 1
- Earliest measurement date: 2008
- Period of record: 10 years
- Number of records: 21

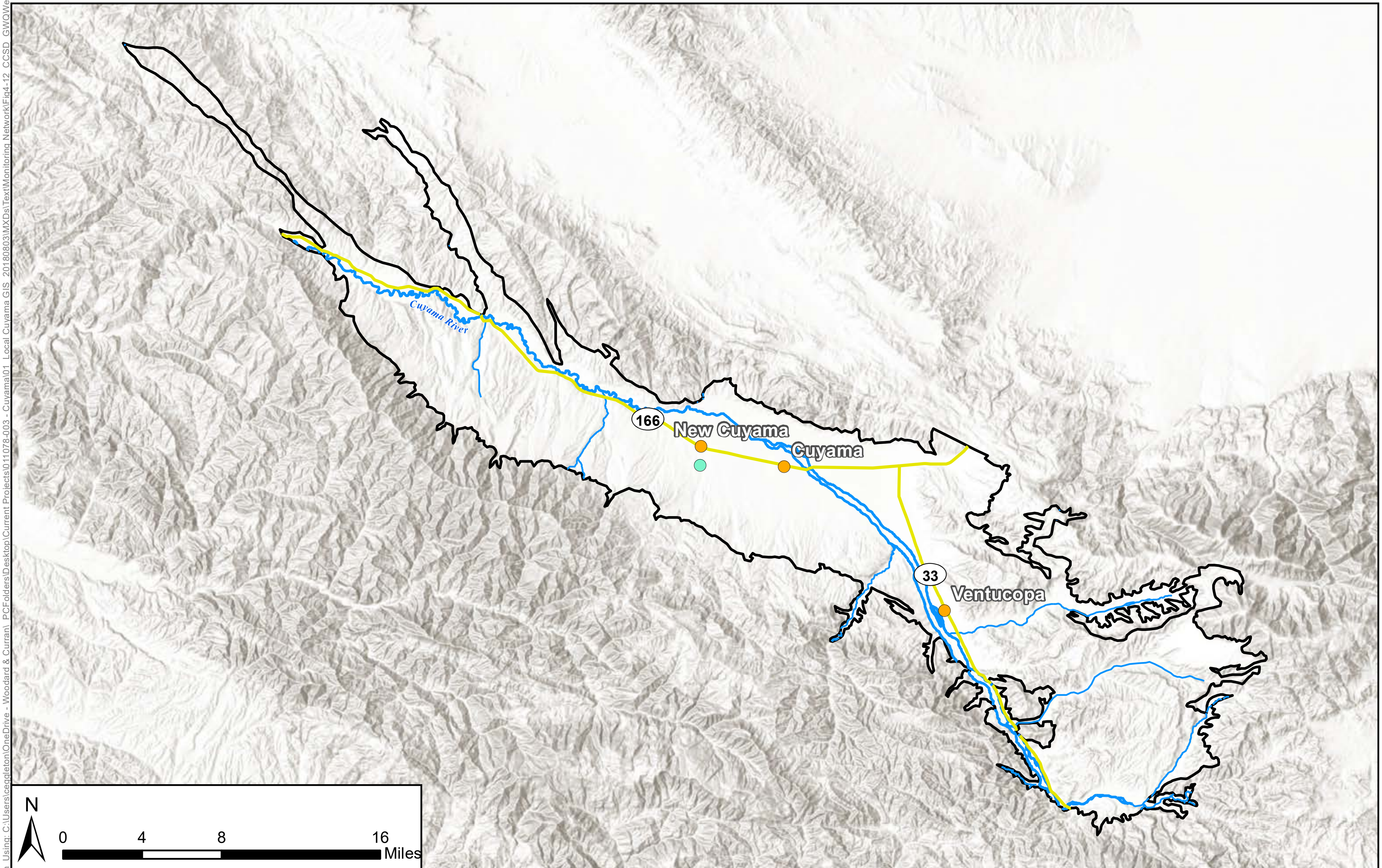

Figure 4-12: Cuyama GW Basin
CCSD Groundwater Quality Well

Cuyama Basin Groundwater Sustainability Agency

Cuyama Valley Groundwater Basin Groundwater Sustainability Plan

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Legend

- Cuyama Basin
- Towns
- Highways
- Cuyama River
- Streams
- Cumaya Community Services District Water Quality Monitoring Well

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Ventura County Water Protection District

VCWPD has 51 groundwater wells that are used for groundwater quality monitoring in the Basin. All of the wells are incorporated into the DWR, GeoTracker, or USGS datasets. Sampling data include numerous water quality constituents; however, this GSP only addresses TDS. Summary statistics for the wells are listed below, and locations of these wells are included in Figure 4-13.

- Number of measurement sites: 51
- Earliest measurement date: 1957
- Longest period of record: 45
- Median period of record: 7
- Median number of records for a single site: 5

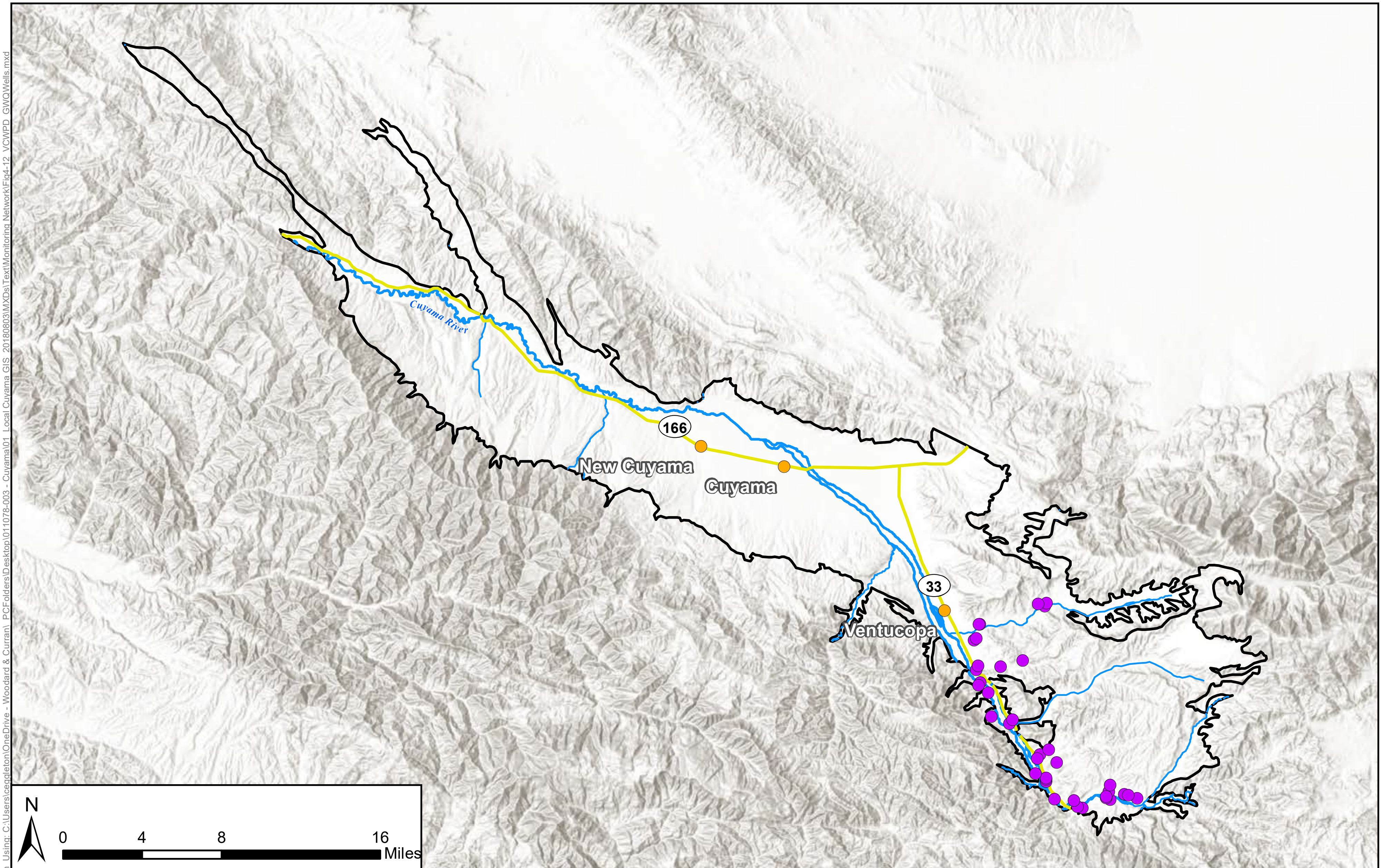

Figure 4-13: Cuyama GW Basin VCWPD Groundwater Quality Wells

Cuyama Basin Groundwater Sustainability Agency

Cuyama Valley Groundwater Basin Groundwater Sustainability Plan

April 2019

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Legend

- Cuyama Basin
- Towns
- Highways
- Cuyama River
- Streams
- Ventura County Watershed Protection District Groundwater Quality Monitoring Wells

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Private Landowners

Private landowners in the Basin conducted groundwater quality testing, which has been incorporated into this document and associated analysis. In 2015, 11 wells measured for TDS. Summary statistics about these wells are listed below, and locations are shown in Figure 4-14.

- Number of measurement sites: 11
- Earliest measurement date: January 12, 2015
- Longest period of record: Not applicable
- Median period of record: Not applicable
- Median number of records for a single site: 1

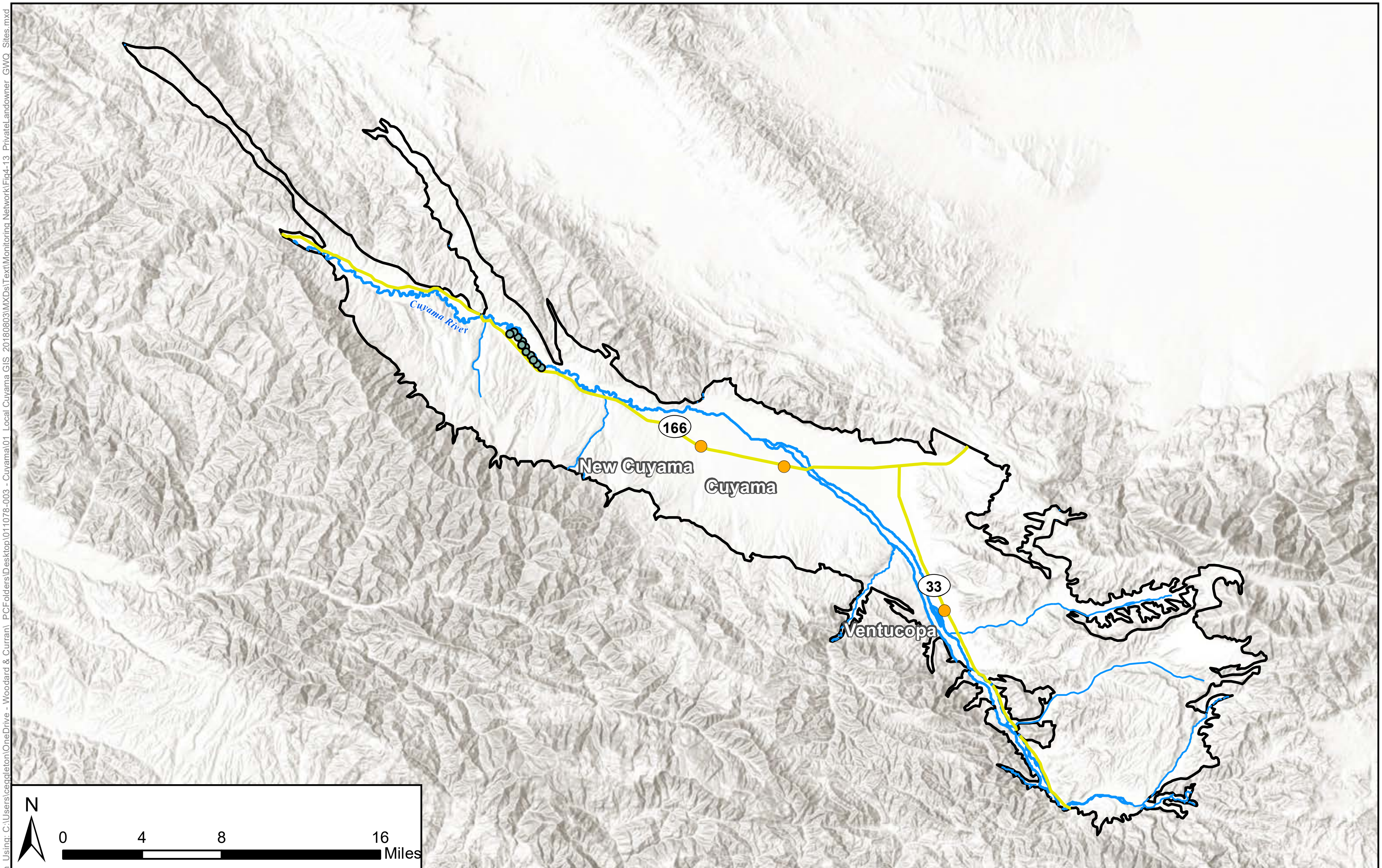

Figure 4-14: Cuyama GW Basin Private Land-owner Groundwater Quality Monitoring Sites

Cuyama Basin Groundwater Sustainability Agency

Cuyama Valley Groundwater Basin Groundwater Sustainability Plan

April 2019

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Legend

- Cuyama Basin
- Private Landowner Groundwater Quality Monitoring Sites
- Towns
- Highways
- Cuyama River
- Streams

4.3.4 Subsidence Monitoring

Subsidence is the sinking or downward settling of the earth's surface and is often the result of over-extraction of subsurface water. Subsidence can be directly measured using a few different methods, such as light detection and ranging (LiDAR), interferometric synthetic aperture radar (InSAR), continuous geographic positioning system (CGPS), extensometers, and spirit leveling. For more information, see Appendix B in Chapter 2, which contains further information about these methods and the physics behind land subsidence. The subsidence monitoring network described below assumes the use of extensometers to monitor subsidence in the Basin. However, the CBGSA should evaluate other methods, including LiDAR and InSAR during the implementation phase to identify an optimal approach.

The Basin hosts two CGPS stations, and three others are just outside the Basin's boundary. CGPS stations measure surface movement in all three axis directions (i.e., up, down, east, west, north, and south). CGPS stations are in the center of the Cuyama Valley, and measure subsidence, while others are placed on ridges around the valley to also measure tectonic movement.

4.3.5 Surface Water Monitoring

Surface water monitoring in the Basin is conducted through stream and river gages placed along the Cuyama River or one of its tributaries. USGS manages most flow gages in California and currently operates one active stream gage along Santa Barbara Creek. There is a gage (1136800) along the Cuyama River downstream of the Basin before Twitchell Reservoir; however, this gage also receives water from non-Cuyama Basin watershed areas. In 2021, the CBGSA worked with USGS to reactivate a gage on the Cuyama River near Ventucopa (11136500), which had previously been active from 1945-1958 and from 2009-2014, and to install a new gage on the Cuyama River near New Cuyama (11136710). Data for surface flow gages are obtained through the NWIS Mapping portal (USGS NWIS, 2023). Existing and discontinued gages are shown in Figure 4-15.

USGS had previously operated two additional gages in the Basin; however, those gages were discontinued in the 1970s.

Figure 4-15: Rivers, Streams, and Surface Flow Gages

Cuyama Valley Groundwater Basin

Legend

Cuyama Watershed
- Contributes to Cuyama GW Basin
- Does not Contribute to Cuyama GW Basin
- Active Flow Gages
- New Active Flow Gages
- Inactive
- Highway
- Local Road
- Town
- Cuyama River
- Creek
- Cuyama Basin

N

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CUYAMA BASIN GROUNDWATER SUSTAINABILITY AGENCY

0 1.75 3.5 7 Miles

Map Created: December 2023

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4.4 Monitoring Rationales

This section discusses the reasoning behind monitoring network selection. Monitoring networks in the CBGSA area were developed to ensure they could detect changes in Basin conditions so CBGSA could manage the Basin and ensure sustainability goals were met. Additionally, monitoring can help assure that no undesirable results are present after 20 years of sustainable management.

The monitoring networks were selected specifically to detect short-term, seasonal, and long-term trends in groundwater levels and storage. The monitoring networks were also selected to include information about temporal frequency and spatial density so the CBGSA can evaluate information about groundwater conditions necessary to evaluate project effectiveness and the effectiveness of any management actions undertaken by the CBGSA.

Chapter 8 describes how each monitoring network is being developed and implemented as individual projects by the GSA as part of GSP implementation. The schedule and costs associated with developing and implementing each monitoring network are discussed in Chapter 8.

4.5 Groundwater Level Monitoring Network

Groundwater level monitoring is conducted through a groundwater well monitoring network. This section will provide information about how the level monitoring network was developed for the 2020 GSP and subsequently revised for the 2025 GSP Update, the criteria for selecting representative wells, monitoring frequency, spatial density, summary protocols, and identification and strategies to fill data gaps.

4.5.1 Monitoring Wells Selected for Monitoring Network

The 2020 GSP utilized a tiering network to create the groundwater level monitoring well network. These well-tiering criteria were created to rank existing groundwater level measuring sites in the Basin, which were arranged into six different tiers that were defined based on the availability of metadata and consistent water elevation data that were operational and functional. The tiering allowed for different thresholds and requirements around well metadata and frequency of monitoring. All wells that were evaluated were active and functioning. This tiering protocol resulted in a monitoring network of 101 wells from the monitoring entities described earlier in this chapter. Utilizing these wells for monitoring purposes requires consent agreements with each well owner. Since 2020, the CBGSA has worked with local landowners and monitoring entities to reach consent agreements to sample the wells that were included in the monitoring network. The monitoring network from the 2020 GSP is shown in Figure 4-16.

Since the GSP adoption in 2020, the CBGSA has continued the process of refining and improving the groundwater monitoring network within the Basin. Monitoring has been ongoing in the Basin since August 2020, and the information gathered is continuously evaluated. Based on the information gathered to date, the CBGSA board determined at its January 2021 Board meeting to reduce the monitoring network to eliminate spatially redundant wells from the network. This revised the monitoring network to

62 wells at 50 locations, including six multi-completion wells. These included nine new wells at three multi-completion well locations installed as part of DWR's Technical Support Services (TSS) program. The refinement of the monitoring network decreased the spatial density to 16.4 wells per 100 square miles, still greater than the recommended threshold of 0.2-10 wells per 100 square miles. This monitoring network refinement is documented in the Annual Report for the 2019-2020 Water Year (CBGSA 2021).

To refine the monitoring network for the 2025 GSP Update, the CBGSA completed a comprehensive review of the groundwater levels network and the monitoring program for all representative and non-representative wells. The review included identification of field sampling issues at each well. These included a lack of landowner agreement for monitoring, access issues due to issues at the well site, and access issues due to winter flooding. Other factors were also considered, such as if the well is projected to go dry between now and 2030, whether the well is an active pumping well and the magnitude of pumping, and whether a nearby or similar well shows similar groundwater level changes and therefore makes the well redundant. Figure 4-17 shows the results of this analysis and the sampling analysis for each well. The review concluded that all issues related to onsite access and weather at the wellsite were temporary and did not preclude the well from continued inclusion in the monitoring network. In addition, no wells were identified for removal due to redundancy. However, there were three wells (98, 121, and 124) where the GSA was unable to obtain an access agreement with the landowner; therefore, these three wells have been removed from the monitoring network. Furthermore, monitoring wells that have been identified as active pumping wells are recommended for long-term replacement; this is discussed in the data gaps section below.

In addition, the CBGSA has worked to address the spatial gaps identified in the 2020 GSP. The CBGSA is using funding available from a SGMA implementation grant agreement with DWR to install three piezometers in the vicinity of groundwater dependent ecosystems (GDEs) as well as multi-completion wells at seven other locations within the Basin. The multi-completion wells are expected to have 2 to 3 completions at each location. Two existing wells have also been offered to the CBGSA by landowners for monitoring and have been added to the groundwater levels monitoring network. These additional wells are allowing the CBGSA to fill many of the data gaps identified in the 2020 GSP.

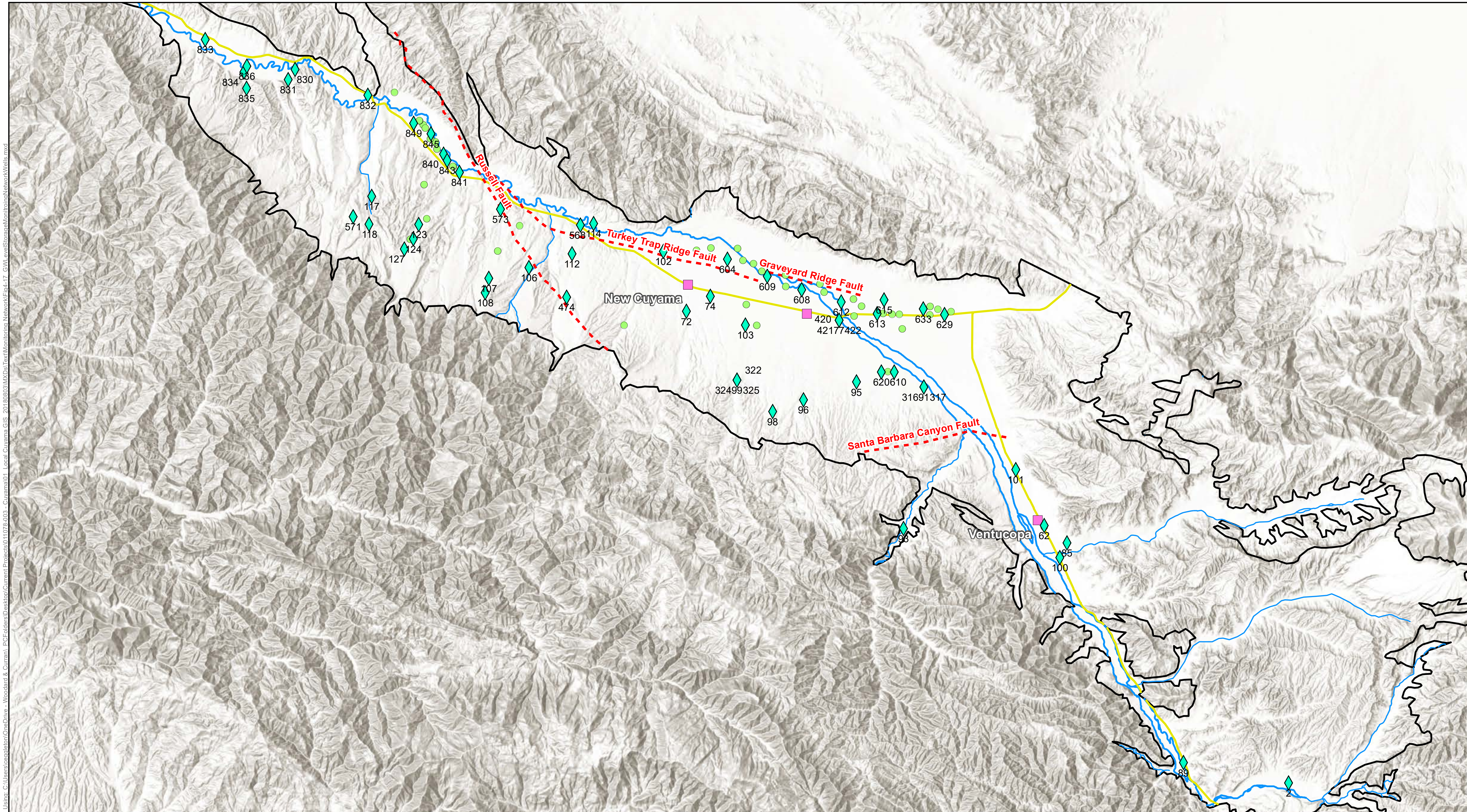

Figure 4-16: Cuyama GW Basin Groundwater Level Monitoring Network Wells (2020)

Cuyama Basin Groundwater Sustainability Agency

Cuyama Valley Groundwater Basin Groundwater Sustainability Plan

April 2019

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Legend

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

Monitoring Network Wells

- Representative Wells
- Monitoring Network Wells

N

0 1.75 3.5 7 Miles

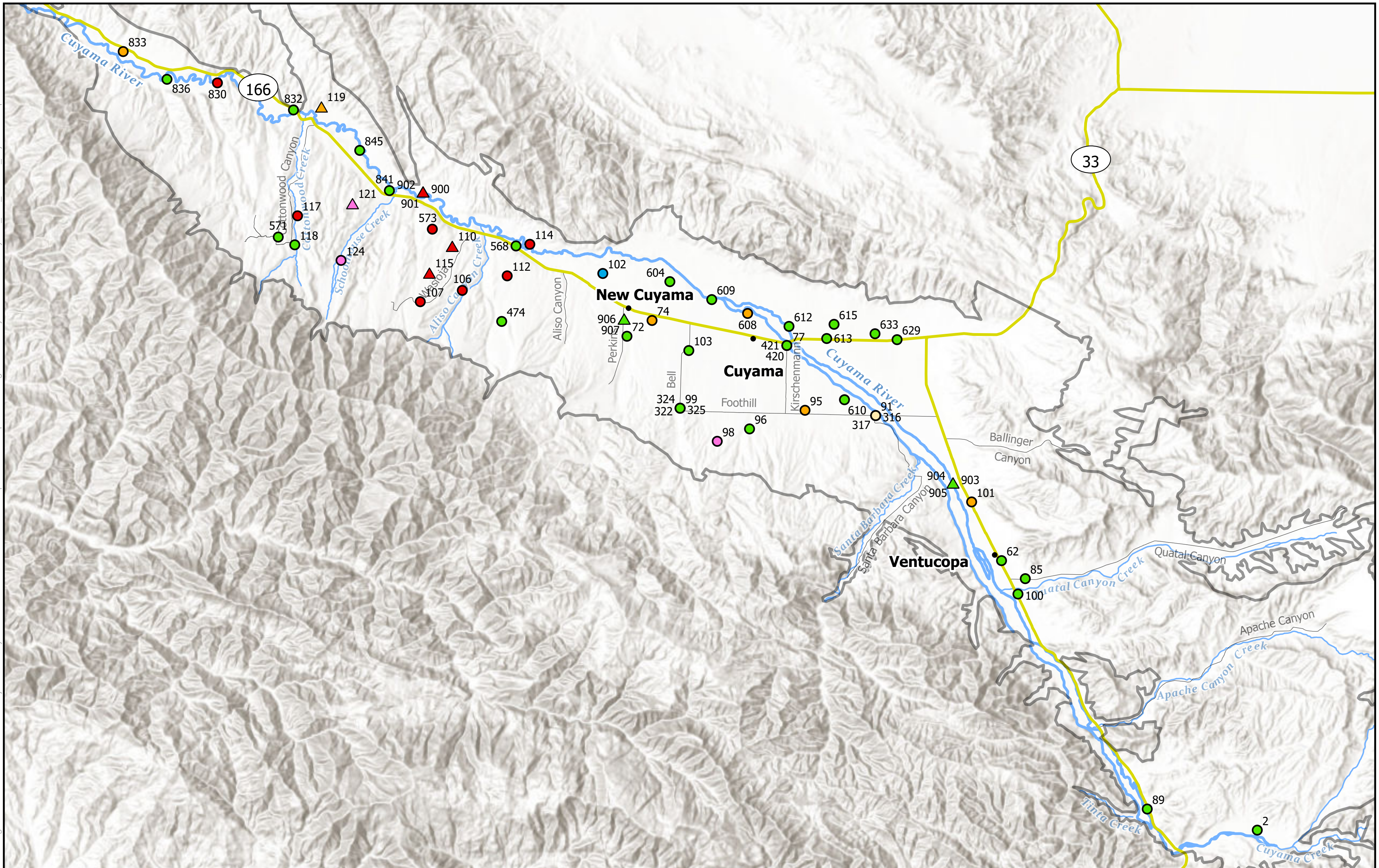

Figure 4-17: Groundwater Level Monitoring Network Review

Cuyama Valley Groundwater Basin

Legend

Representative
- No Issues
- Onsite Issues (Access)
- Onsite Issues (Flooding)
- Tranducer Issues
- Well Access Agreement
- At Risk of Going Dry

Non-Representative
- No Issues
- Onsite Issues (Access)
- Onsite Issues (Flooding)
- Well Access Agreement

- Highway
- Local Road
- Town
- Cuyama River
- Creek
- Cuyama Basin

N

0 1.25 2.5 5 Miles

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CUYAMA BASIN GROUNDWATER SUSTAINABILITY AGENCY

Map Created: December 2023

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4.5.2 Monitoring Frequency

A successful monitoring frequency and schedule should allow the monitoring network to adequately interpret fluctuations over time in the groundwater system based on shorter-term and longer-term trends and conditions. These changes may be the result of storm events, droughts, or other climatic variations, seasons, and anthropogenic activities such as pumping.

Monitoring frequency must, at a minimum, occur within the same designated time-period for all wells to ensure that measurements represent the same condition for the aquifer.

The *Monitoring Networks and Identification of Data Gaps Best Management Practices* (BMPs) published by DWR provides guidance for monitoring frequency based on the discussion presented in the *National Framework for Ground-water Monitoring in the United States* (Advisory Committee on Water Information, 2013). This analysis and discussion provide guidance on monitoring frequency based on aquifer properties and degree of use, as shown in Table 4-2.

The BMP guidance recommends that initial characterization of monitoring locations use frequent measurements to establish the dynamic range at each monitoring site and to identify external stresses affecting groundwater levels. An understanding of these conditions based on professional judgement should be reached before normal monitoring frequencies are followed.

Table 4-2: Monitoring Frequency Based on Aquifer Properties and Degree of Use

Aquifer Type	Nearby Long-Term Aquifer Withdrawals		
	Small Withdrawals	Moderate Withdrawals	Large Withdrawals
Unconfined Aquifer			
Low recharge (<5 inches/year)	Quarterly	Quarterly	Monthly
High recharge (>5 inches/year)	Quarterly	Monthly	Daily
Confined Aquifer			
Low hydraulic conductivity (<200 feet/day)	Quarterly	Quarterly	Monthly
High hydraulic conductivity (>200 feet/day)	Quarterly	Monthly	Daily

The Basin is an unconfined aquifer with large withdrawals, with a low recharge rate of less than 5 inches per year. According to the data in Chapter 2, provided by DWR, the Basin's groundwater monitoring frequency should be monthly. The 2020 GSP recommended monthly monitoring of the groundwater level network initially and consideration of reducing monitoring frequency to quarterly measurements after allowing time for the monitoring program to be evaluated. Monthly monitoring was conducted for two years from August 2020 through July 2022, with a quarterly monitoring schedule starting in October 2022. Each quarterly sampling event for groundwater levels is routinely completed within 2-3 days.

4.5.3 Spatial Density

Spatial density of the monitoring network was considered both for the selection of the entire monitoring network, and for the selection of representative wells (Section 4.5.4). The goal of the groundwater level monitoring network is to provide adequate coverage of the entire Basin aquifer. This includes the ability to monitor and identify groundwater changes across the Basin over time. Consideration of the spatial location of monitoring wells should include proximity to other monitoring wells and ensure adequate coverage near other prominent features, such as faults or production wells. Monitoring wells in close proximity to active pumping wells could be influenced by groundwater withdrawals, thus skewing static level monitoring.

The *Monitoring Networks and Identification of Data Gaps BMP* published by DWR provides different sources and condition dependent densities to guide monitoring network implementation (Table 4-3). This information was adapted from the *CASGEM Groundwater Elevation Monitoring Guidelines* (DWR, 2010). While these estimates provide guidance to monitoring well site spatial densities, monitoring points should primarily be influenced by local geology, groundwater use, and GSP-defined undesirable results. Professional judgment is essential when determining final locations.

Table 4-3: Monitoring Well Density Considerations

Reference	Monitoring Well Density (wells per 100 square miles)
Heath (1976)	0.2-10
Sophocleous (1983)	6.3
Hopkins (1994)	
Basins pumping more than 10,000 acre-feet per year per 100 square miles	4.0
Basins pumping between 1,000 and 10,000 acre-feet per 100 square miles	2.0
Basins pumping between 250 and 1,000 acre-feet per year per 100 square miles	1.0
Basins pumping between 100 and 250 acre-feet per year per 100 square miles	0.7

The Basin has 378 square miles of area. According to Hopkins (1994) well density estimate guidelines, the Basin should have four monitoring wells per 100 square miles. Sophocleous (1983) recommends 6.3 monitoring wells per 100 square miles. According to Heath (1976), the Basin should have between 0.2 and 10 monitoring wells per 100 square miles. Due to geologic and topographic variability in the Basin, the severity of groundwater declines, and hydrogeologic uncertainty in various portions of the Basin, this GSP recommends a density greater than the most conservative estimate of 10 wells per 100 square miles, which is over 38 monitoring wells. The current monitoring network is comprised of 79 wells equating to a well density of 20 wells per 100 square miles. This exceeds the GSP recommended density.

4.5.4 Representative Monitoring

There are two categories of wells identified within the monitoring network as follows:

- **Representative Wells.** These wells will be used to monitor sustainability in the Basin. Minimum thresholds and measurable objectives will also be calculated for these wells.
- **Non Representative wells.** Other wells are included in the monitoring network to provide redundancy for representative wells, and to maintain a robust network for evaluation as part of five-year GSP updates.

Representative monitoring wells were selected as part of monitoring network development. Representative monitoring wells are wells that represent conditions in the Basin and are in locations that allow monitoring to indicate long-term, regional changes in its vicinity.

Representative groundwater level and groundwater storage sites were selected by several different criteria. These criteria include the following:

- **Adequate Spatial Distribution –** Representative monitoring does not require the use of all wells that are spatially grouped together in a portion of the Basin. Adequately spaced wells will provide greater Basin coverage with fewer monitoring sites.
- **Robust and Extensive Historical Data –** representative monitoring sites with longer and more robust historical data provide insight into long-term trends that can provide information about groundwater conditions through varying climatic periods such as droughts and wet periods. Historical data may also show changes in groundwater conditions through anthropogenic effects. While some sites chosen may not have extensive historical data, they may still be selected because there are no wells nearby with longer records.
- **Increased Density in Heavily Pumped Areas –** Selection of additional wells in heavily pumped areas such as in the central portion of the Basin and other agriculturally intensive areas will provide additional data where the most groundwater change occurs.
- **Increased Density near Areas of Geologic, Hydrologic, or Topologic Uncertainty** – Having a greater density of representative wells in areas of uncertainty, such as around faults or large elevation gradients may provide insightful information about groundwater dynamics to improve management practices and strategies.
- **Wells with Multiple Depths** – The use of wells with different screen intervals is important for collecting data about groundwater conditions at different elevations in the aquifer. This can be achieved by using wells with different screen depths that are close to one another, or by using multi-completion wells.
- **Consistency with BMPs –** Using published BMPs provided by DWR will ensure consistency across all basins and ensure compliance with established regulations.

- **Adequate Well Construction Information –** Well information such as perforation depths, construction date, and well depth should be considered and encouraged when considering wells to be included.
- **Professional Judgment** – Professional judgment is used to make the final decision about each well, particularly when more than one suitable well exists in an area of interest.
- **Maximum Coverage** – Any monitoring network well that was suitable for use in the representative network was used to maximize spatial and vertical density of monitoring.

4.5.5 Groundwater Level Monitoring Network

Figure 4-18 shows the updated groundwater level monitoring network, including representative and non-representative wells. Existing wells are labeled with their Opti identification (ID) number. Locations of wells currently being installed with grant funding are labeled on the map either as a GDE well or as a multi-completion monitoring (MW) well.

Table 4-4 lists the wells in the updated groundwater level monitoring network. Representative wells, which include those with sufficient data and representative trends within the Basin to develop sustainability criteria, are identified with the asterisk (*) next to the OPTI ID and are sorted first. Metadata for the wells are also included. With the removal of the three wells identified above and the addition of the newly installed wells, the revised network includes 79 wells, 47 of which are representative wells. However, the table does not currently include the wells that will be installed with the DWR grant funding as Opti ID numbers have not been assigned for these wells.

This network of 79 wells, including the wells that are planned to be drilled, equates to a well density of 20 wells per 100 square miles. This monitoring network provides a spatial density that adequately covers the primary aquifer in the Basin and is useful for determining flow directions and hydraulic gradients, as well as changes in storage calculations for use in future water budgeting efforts in portions of the Basin with significant land use.

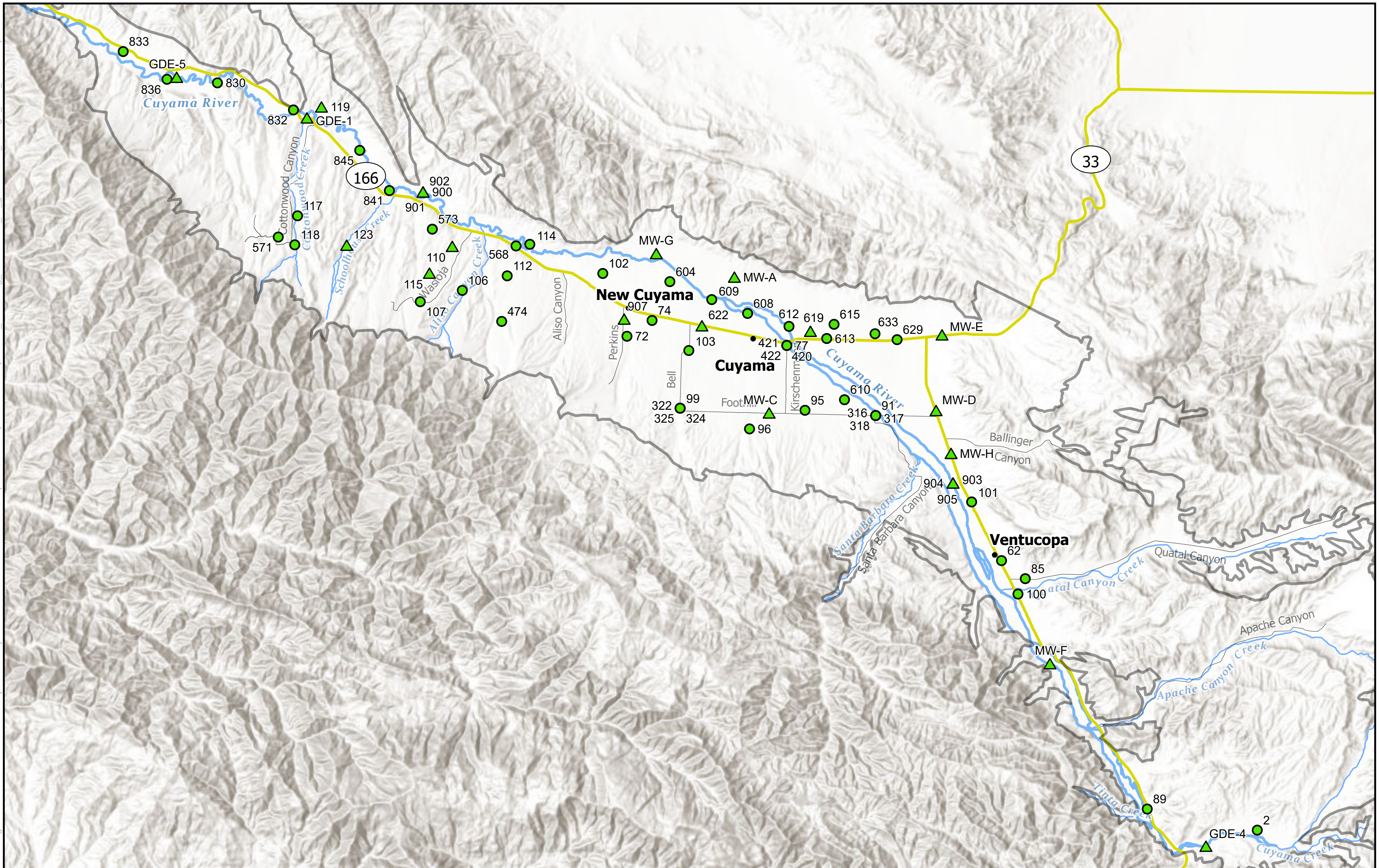

Figure 4-18: Updated Groundwater Level Monitoring Network

Cuyama Valley Groundwater Basin

Legend

Network Well

- Representative Monitoring
- Non-representative Monitoring

- Highway
- Local Road
- Town
- Cuyama River
- Creek
- Cuyama Basin

N

0 1.25 2.5 5 Miles

Map Created: December 2023

Woodard & Curran

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. Monitoring well data available in the Opti data catalog: https://opti.woodardcurran.com/cuyama/login.php**

Table 4-4: Groundwater Level and Storage Monitoring Network

OPTI ID	Well Construction Date	Well Depth (Feet)	Hole Depth (Feet)	Screen Interval (Feet)	Well Elevation (Feet above mean sea level)	Transducer
2*	-	73	-	-	3720	No
62*	-	212	-	-	2920	Yes
72*	1/1/1980	790	820	350-340	2172	No
74*		-	-	-	2193	No
77*	12/4/2008	980	1003	980-960	2283	Yes
85*	1947	233	-	-	3049	No
89*	1/1/1965	125	-	-	3456	No
91*	9/29/2009	980	1000	980-960	2478	Yes
95*	4/9/2009	805	825	-	2458	No
96*	2/1/1980	500	-	-	2609	No
99*	9/10/2009	750	906	750-730	2503	No
100*	11/1/1988	284	302	-	3009	No
101*	-	200	220	-	2749	No
102*	-	-	-	-	2044	No
103*	7/23/2010	1030	1040	-	2288	Yes
106*	-	228	-	-	2319	No
107*	1/1/1950	200	-	-	2494	No
112*	-	441	-	-	2131	No
114*	1/1/1947	58	-	-	1927	No
117*	-	212	-	-	2,098	No
118*	-	500	-	-	2264	No
316*	9/29/2009	830	1000	-	2478	Yes
317*	9/29/2009	700	1000	-	2478	Yes
322*	4/9/2009	850	906	-	2503	No
324*	9/10/2009	560	906	-	2503	No
325*	9/10/2009	380	906	-	2503	No
420*	12/4/2008	780	1003	-	2283	Yes
421*	12/4/2008	620	1003	-	2283	Yes

OPTI ID	Well Construction Date	Well Depth (Feet)	Hole Depth (Feet)	Screen Interval (Feet)	Well Elevation (Feet above mean sea level)	Transducer
474*	-	213	-	-	2367	No
568*	1/1/1948	188	188	-	1914	No
571*	1/1/1951	280	-	-	2317	Yes
573*	-	404	-	404-100	2084	No
604*	-	924	-	924-470	2118	No
608*	6/10/1905	745	-	745-305	2215	No
609*	6/15/1905	970	-	970-494	2168	No
610*	-	780	--	780-352	2442	No
612*	-	1070	-	1070-413	2273	No
613*	-	830	-	830-500	2329	No
615*	-	865	-	865-385	2324	No
629*	-	1000	-	1000-500	2380	No
633*	-	1000	-	1000-500	2365	No
830*	-	77	-	-	1562	No
832*	-	132	-	-	1641	No
833*	-	504	-	-	1457	No
836*	-	325	-	-	1510	No
841*	11/21/2014	600		580-170	1764	Yes
845*	7/17/2015	380		360-100	1713	Yes
110	1/1/1948	603	-	560-224	2052	No
115	-	1200	-	-	2278	No
119	1949	92	-	-	1702	No
123	7/10/1976	138	-	-	2165	No
619	1920	1040	-	1040-471	2306	No
622	1947	1200	-	1200-400	-	No
900	7/15/2021	605	-	60-50	-	Yes
901	7/15/2021	605	-	205-165	-	Yes
902	7/15/2021	605	-	365-325	-	Yes
903	7/23/2021	587	-	305-265	-	Yes

OPTI ID	Well Construction Date	Well Depth (Feet)	Hole Depth (Feet)	Screen Interval (Feet)	Well Elevation (Feet above mean sea level)	Transducer
904	7/23/2021	587	-	400-360	-	Yes
905	7/23/2021	587	-	570-540	-	Yes
906	8/27/2021	670	-	150-130	-	Yes
907	8/27/2021	670	-	525-515	-	Yes
908	8/27/2021	670	-	60-650	-	Yes

4.5.6 Monitoring Protocols

Monitoring protocols will use DWR's *Monitoring Networks and Identification of Data Gaps BMP*, which sites the DWR's 2010 publication *California Statewide Groundwater Elevation Monitoring (CASGEM) Program Procedures for Monitoring Entity Reporting* (Appendix A) for the groundwater level sampling protocols. This publication includes protocols for equipment selection, setup, use, field evaluation, and sample collection techniques.

4.5.7 Data Gaps

The 2020 GSP identified data gaps in the groundwater level monitoring network. As noted above, the CBGSA has installed new wells to address many of these data gaps using funding from DWR's TSS and SGMA grant programs. These new wells have filled all of the spatial data gaps identified in the 2020 GSP. However, there continue to be some data gaps that should be addressed by the CBGSA in the future:

- Several wells that are currently included in the monitoring network are active pumping wells, some of which are used for a significant level of pumping each year; these wells should be replace with dedicated monitoring wells
- Well construction information is not available for many wells in the Basin. Monitoring wells with construction information featuring total depth and screened interval are preferred for inclusion in the monitoring network, because that information is useful in understanding what monitoring measurements mean in terms of Basin conditions at different depths.

4.5.8 Plan to Fill Data Gaps

This GSP identifies some ways to refine the groundwater level monitoring network and improve reporting:

- Seek additional grant funding to install monitoring wells to replace active pumping wells that are currently included in the monitoring network. Alternatively, transducers could be installed in these wells to better understand the temporal effects of pumping on groundwater levels.
- Apply for additional assistance from DWR's Technical Support Services (TSS), which provides support to GSAs as they develop GSPs. TSS opportunities include help installing new monitoring wells, and downhole video logging services.
- Improve understanding of well construction information through digital entry of data from well completion reports into the data management system.

4.6 Groundwater Storage Monitoring Network

Groundwater in storage is monitored through the measurement of groundwater levels. Therefore, the groundwater storage monitoring network will use the groundwater level monitoring network. Thresholds for groundwater storage are discussed in Chapter 5.

4.7 Seawater Intrusion Monitoring Network

The Basin is geographically and geologically isolated from the Pacific Ocean and any other large source of saline water. As a result, the Basin is not at risk for seawater intrusion. Salinity (i.e., total dissolved solids, or TDS) is monitored as part of the groundwater quality network, but seawater intrusion is not a concern for the Basin.

4.8 Groundwater Quality Monitoring Network

Salinity (measured as TDS), arsenic, and nitrates have all been identified by local stakeholders as potentially being of concern for water quality in the Basin. However, in contrast to salinity, there is no evidence to suggest a causal nexus between potential actions under the CBGSA's authority and arsenic or nitrates. In the case of arsenic, the high concentration measurements have been taken either at CCSD Well 2, which is no longer in operation, or at groundwater depths of greater than 700 feet, which is outside of the range of pumping for drinking water. Because arsenic occurs in the subsurface at different elevations and densities throughout the Basin, arsenic issues are localized and different at each well location. Since the CBGSA is only granted authority to affect the amount of water pumped across portions of the Basin, it is not possible for the CBGSA to successfully manage arsenic levels, and setting thresholds on an unmanageable constituent could cause unnecessary intervention by the California State Water Resources Control Board (SWRCB). Therefore, the groundwater quality network included in the 2020 GSP was established to monitor for salinity but did not consider arsenic or nitrates at that time.

The CBGSA began collecting groundwater quality data in early 2021 and collects TDS measurements once a year. In addition, nitrate and arsenic measurements were also collected in 2022 to establish a baseline understanding of nitrate and arsenic concentrations in the Basin. It is the intent of the CBGSA to continue to collect TDS measurements in monitoring network wells on an annual basis. For nitrate and arsenic, the CBGSA intends to download and utilize data that is collected by other monitoring entities on an ongoing basis. The CBGSA will cooperate with other agencies that may perform monitoring of other constituents to the extent possible. In addition, the CBGSA will collect nitrate and arsenic data in conjunction with the collection of TDS measurements once every five years.

4.8.1 Management Areas

Management Areas were not used for the 2025 GSP update. Management Areas could allow flexibility in establishing monitoring networks both spatially and temporally to match conditions and use in the Management Area. The CBGSA will utilize the same monitoring network selection criteria across the entire groundwater Basin. This allows the Basin to be managed together to meet Basin-wide sustainability thresholds.

4.8.2 Monitoring Sites Selected for Monitoring Network

Salinity (Measured as TDS)

As part of the 2020 GSP, the CBGSA created a TDS monitoring network using wells that other entities had monitored from 2008-2018. These entities included NWQC, USGS, IRLP, GAMA, DWR, BCWPD, and private landowners. It was assumed that wells that had previously been monitored for salinity prior to 2008 were unlikely to be monitored again by that monitoring agency. There were 64 selected groundwater-quality network wells. The utilization of these wells for monitoring purposes requires consent agreements with each landowner. Since the 2020 GSP, the CBGSA has dedicated significant time reaching out to landowners via emails, phone conversations, and site visits to reach agreements to conduct sampling. The 2020 water quality monitoring network is shown on Figure 4-19.

The CBGSA has collected three years of annual sampling data and conducted an evaluation of the existing network to see if any refinement or improvements could be made as part of this GSP 2025 update. A comprehensive review was conducted on the monitoring network with respect to the following issues: lack of landowner agreements for monitoring, access issues at the well sites, access issues due to weather. Furthermore, analysis was conducted to determine if the wells were projected to go dry between now and 2030 and if any wells are spatially redundant with other wells in the network. The result of this analysis is shown on Figure 4-20, which shows the sampling flags for each well. Based on this analysis, 32 wells were removed from the network; in most cases because the CBGSA had been unable to secure an agreement with the landowner. In November of 2023, the CBGSA board approved a revised monitoring network, which will include 58 wells, 27 of which are representative wells. This includes nine new TSS wells that were installed under the DWR's Technical Support Services (TSS) program and will be equipped by DWR with permeant transducers to provide electroconductivity measurements for TDS. In addition, new monitoring wells are currently being installed at 10 locations using grant funding from DWR with 1-3 completions per well. These wells will also be equipped with transducers and be included in the TDS water quality network as non-representative wells.

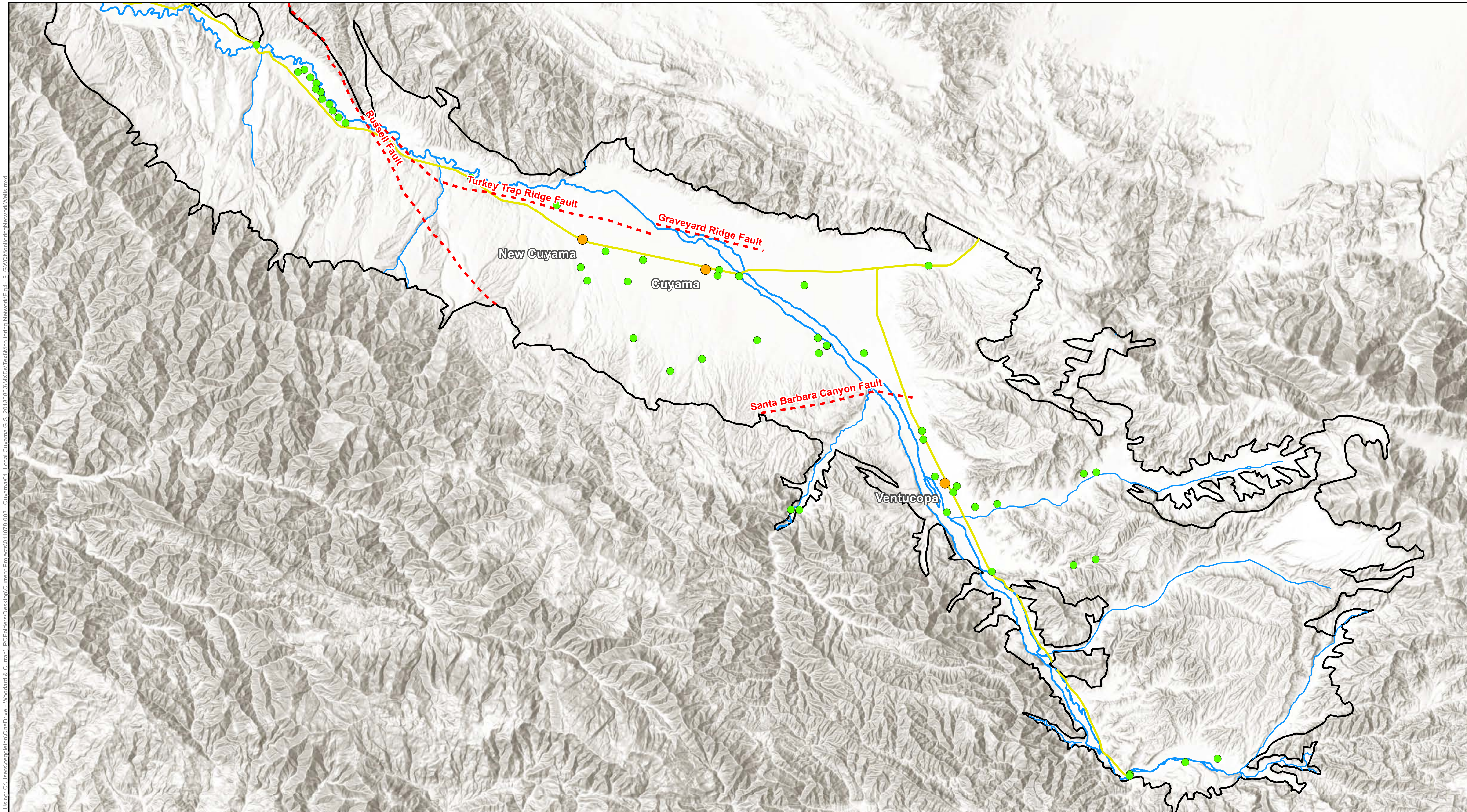

Figure 4-19: Cuyama GW Basin Groundwater Quality Monitoring Network Wells (2020)

Cuyama Basin Groundwater Sustainability Agency

Cuyama Valley Groundwater Basin Groundwater Sustainability Plan

April 2019

WOODARD & CURRAN

All wells included in the Groundwater Quality Monitoiring Network have been measured since 1/1/2008. Wells measured prior to 2008 are not included.

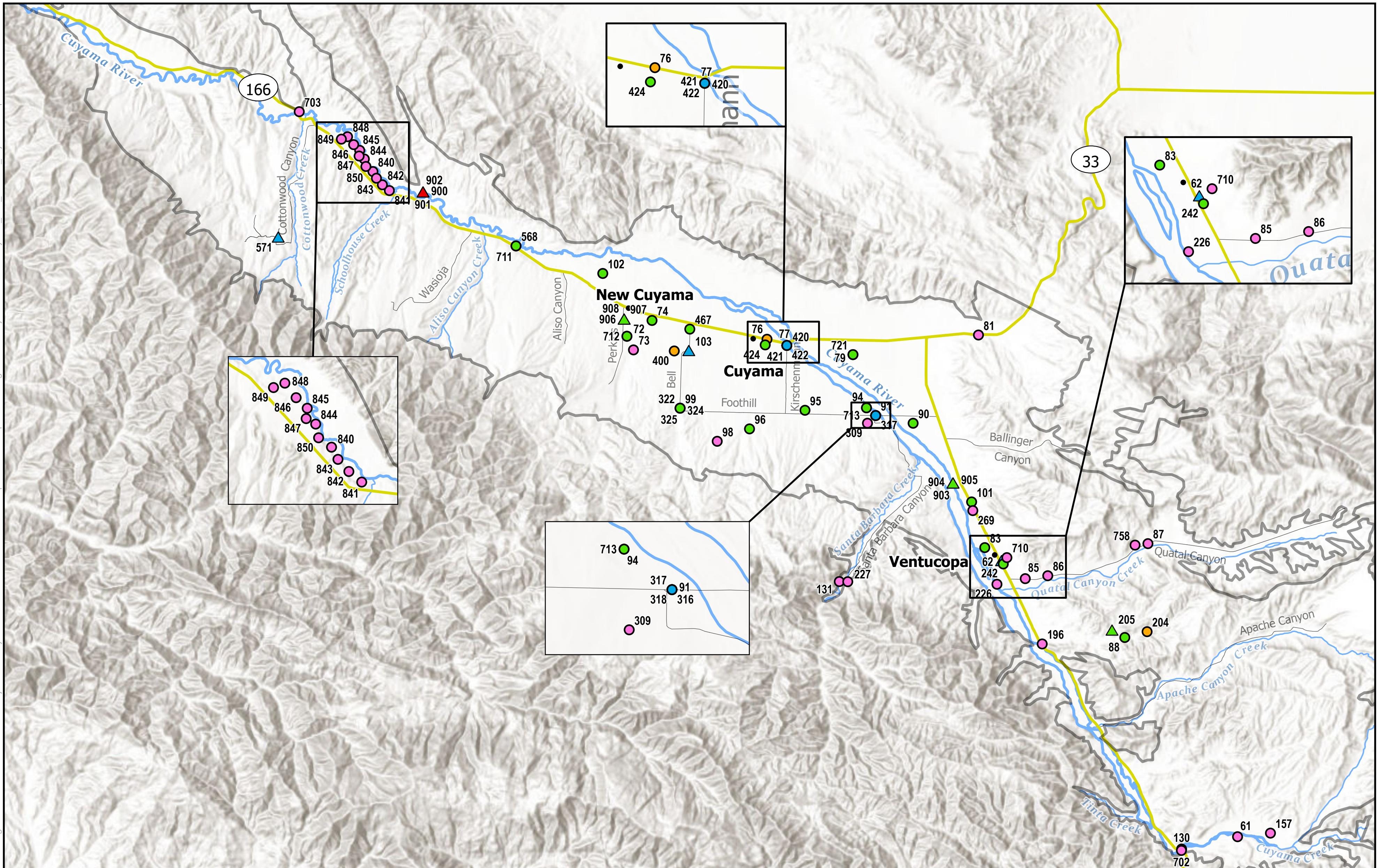

Figure 4-20: Groundwater Quality Monitoring Network Review

Cuyama Valley Groundwater Basin

Legend

Representative	Monitoring
No Access Agreement	Access Issue (weather)
No Issues	No Issues
Onsite Access Issue	Transducer
Transducer	

Highway
Local Road
Town
Cuyama River
Creek
Cuyama Basin

N

0 1.25 2.5 5 Miles

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CUYAMA BASIN GROUNDWATER SUSTAINABILITY AGENCY

Map Created: December 2023

Nitrate

Nitrate measurements will be taken by the CBGSA at water quality monitoring network wells once every five years.

In addition, to gain a better understanding of nitrate in the Basin, the CBGSA will download arsenic monitoring measurements collected by third party sources, especially SWRCB GAMA Database, on an annual basis. The GAMA database includes data collected by USGS, California Natural Resources Agency, National Quality Monitoring Council Water Quality Portal, as well as other sources as shown in Table 4-5.

Table 4-5: GAMA Databases and Frequency of Updates

Data Set Name	Dataset Abbreviation	Update Frequency (Approximate)
Department of Pesticide Regulation	DPR	Yearly
Department of Water Resources	DWR	Yearly
Division of Drinking Water	DDW	Quarterly
GAMA Domestic Well	GAMA_DOM	No longer updated
GAMA Local Groundwater Projects	GAMA_LOCALGW	Various
GAMA Special Studies	GAMA_SP-STUDY	No longer updated
GAMA US Geological Survey	GAMA_USGS	Quarterly
Local Groundwater Projects	LOCALGW	Monthly
US Geological Survey - National Water Information System	USGS_NWIS	Quarterly
Water Board Cleanup and Permitted Sites	WB_CLEANUP	Monthly
Water Board Irrigated Lands Regulatory Programs	WB_ILRP	Monthly
Water Replenishment District	WRD	Yearly

Figure 4-21 shows the locations where nitrate monitoring has occurred over the past 10- and 5-year Periods. A total of 104 wells were sampled over the 10-year period from 2013-2023. The majority of Nitrate data is collected through the California Central Coast Water Board Irrigated Lands Regulatory Program (ILRP). The Central Coast Water Board regulates discharges from irrigated agricultural lands to protect surface water and groundwater through Order 4.0 (RE-2021-0040). In 2023, in the Cuyama Basin, the ILRP program had 16 operations and 88 ranches enrolled in the program reporting Nitrate data. Parties enrolled in the program are required to monitor and report results for the primary irrigation wells to GeoTracker annually, which is updated to GAMA.

Arsenic

Arsenic measurements will be taken by the CBGSA at water quality monitoring network wells once every five years.

In addition, to gain a better understanding of arsenic in the Basin, the CBGSA will download arsenic monitoring measurements collected by third party sources, especially SWRCB GAMA Database, on an annual basis. The GAMA database includes data collected by USGS, California Natural Resources Agency, National Quality Monitoring Council Water Quality Portal, as well as other sources as shown in Table 4-5 above. Most arsenic monitoring is conducted by public water systems on municipal supply wells. Arsenic is a regulated chemical for drinking water sources with monitoring and compliance requirements under Title 22 Section 64431.

The CBGSA will utilize the GAMA database to monitor arsenic water quality in the Basin. Arsenic samples are taken at seven wells, all municipal and domestic. These samples are from DDW, GAMA USGS, and USGS NWIS. The Cuyama Groundwater Basin has two public water systems according to the System Area Boundary Layer (SABL) tool developed by the SWRCB. The first public water system is called the Cuyama Community Services District water system number CA4210009, which serves a population of 700. This public water system is classified as a community water system. The second is Cuyama Mutual Water Company water system number CA4200514, which serves a population of 48 and is classified as a transient noncommunity water system. All wells were sampled in the past five years. These two water systems provide 87% of the sampling results for arsenic in the Basin taken over the 10-year period from 2013-2023. There have been 87 samples from these 7 wells taken over the past 10 years. These locations are shown in Figure 4-22.

4.8.3 Monitoring Frequency

The CBGSA will collect salinity samples once a year and nitrate and arsenic samples once every five years. In addition, nitrate and arsenic data will be downloaded from GAMA on an annual basis.

Although DWR does not provide specific recommendations on the frequency of monitoring in relationship to the described groundwater characteristics, concentrations of groundwater quality, especially salinity, do not fluctuate significantly over a year to require multiple samples per year. CBGSA will therefore continue to monitor its water quality network at the same frequency.

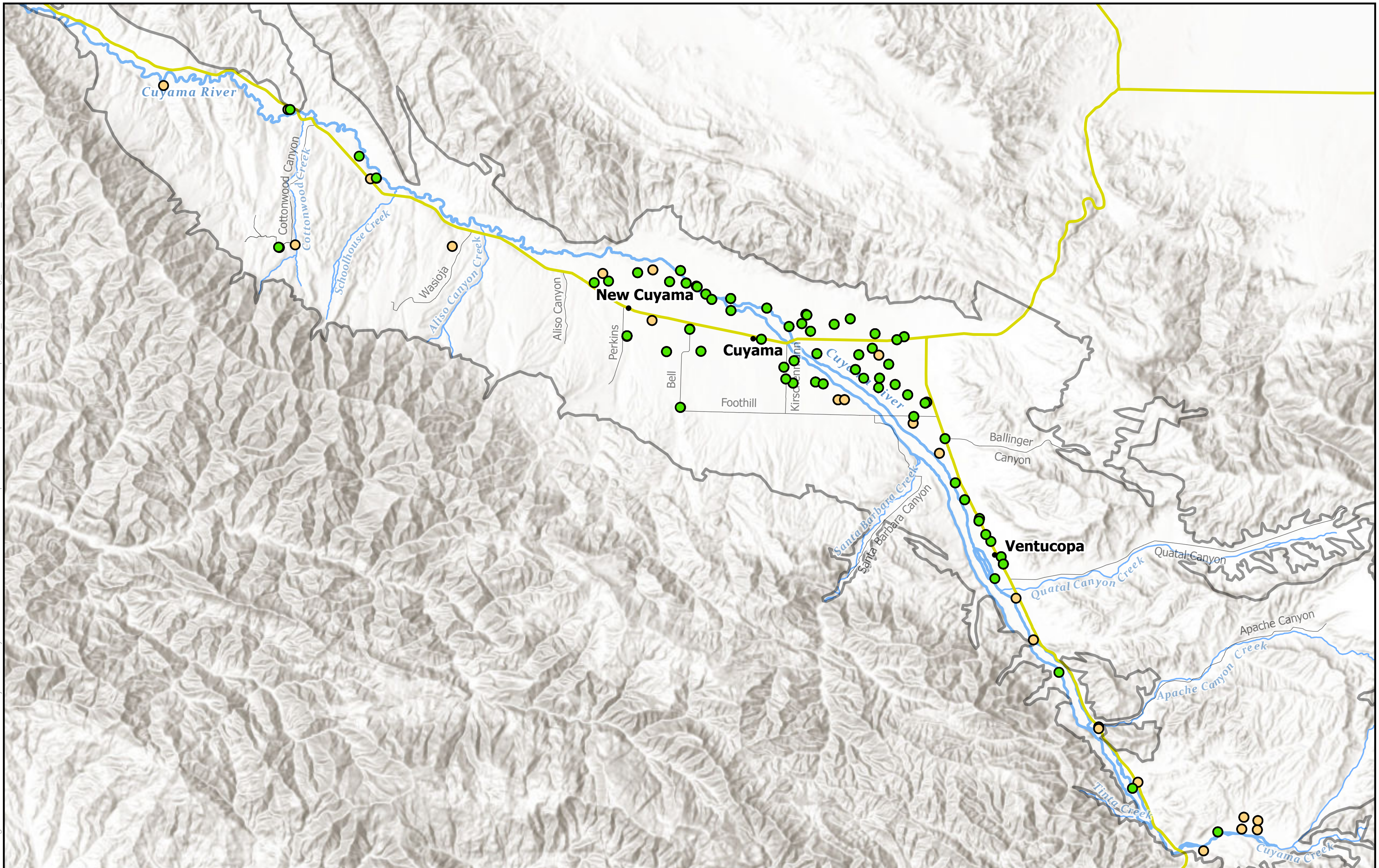

Figure 4-21: Nitrate Monitoring Locations

Years 2013 - 2023

Cuyama Valley Groundwater Basin

Legend

Well Record
- Sampled since 2022
- Sampled in the last 10 years

Highway
Local Road
Town
Cuyama River
Creek
Cuyama Basin

N

0 1.25 2.5 5 Miles

Map Created: December 2023

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Figure 4-22: Arsenic Monitoring Locations

Years 2013 - 2023

Cuyama Valley Groundwater Basin

Legend

Well Record
- Sampled since 2013
- Highway
- Local Road
- Town
- Cuyama River
- Creek
- Cuyama Basin

N

0 1.25 2.5 5 Miles

Map Created: December 2023

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Cuyama Basin Groundwater Sustainability Agency

Figure Exported: 12/28/2023 By: DHunt Using: \\woodardcurran.net\shared\Projects\CA Cuyama Basin GSA\0011078.01 GSP\wip\Z. GIS\2. Maps\2025 GSP Update\04_Monitoring_Networks\nitrate_arsenic\nitrate_arsenic.aprx

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4.8.4 Spatial Density

DWR's *Monitoring Networks and Identification of Data Gaps BMP* states "The spatial distribution must be adequate to map or supplement mapping of known contaminants." Using this guidance, professional judgment was used to identify representative wells in each management area. Heavily pumped areas, such as the central portion of the Basin, require additional monitoring sites, while areas of lower pumping or less agricultural or municipal groundwater use need less monitoring.

The selected groundwater quality representative and monitoring wells provide adequate coverage of the Basin's aquifer. The TDS groundwater quality monitoring network is composed of 58 wells in the Basin, which provides a monitoring site density of 17 sites per 100 square miles. This exceeds the density recommended by reference materials for groundwater level density shown in Table 4-3.

4.8.5 Representative Monitoring

Representative monitoring sites were selected in the 2020 GSP for groundwater quality using the criteria used to select representative groundwater level monitoring wells (Section 4.5.4). Due to the uncertainty of monitoring frequency, all monitoring network wells were selected as representative wells in the monitoring network. For the 2025 GSP Update, existing representative monitoring sites continue to be representative; newly installed sites are considered non-representative because they do not include enough historical data to reliably develop sustainability criteria.

4.8.6 Groundwater Quality Monitoring Network

Figure 4-23 shows the monitoring network, and representative and monitoring sites. Table 4-6 shows the wells in the groundwater quality monitoring network. Representative wells, which include those with sufficient data and representative trends within the Basin to develop sustainability criteria, are identified with the asterisk (*) next to the OPTI ID and are sorted first. Metadata for the wells are also included. The revised network includes 58 wells, 27 of which are representative wells. However, the table does not currently include the wells that are currently being installed with the DWR grant funding as Opti ID numbers have not been assigned for these wells.

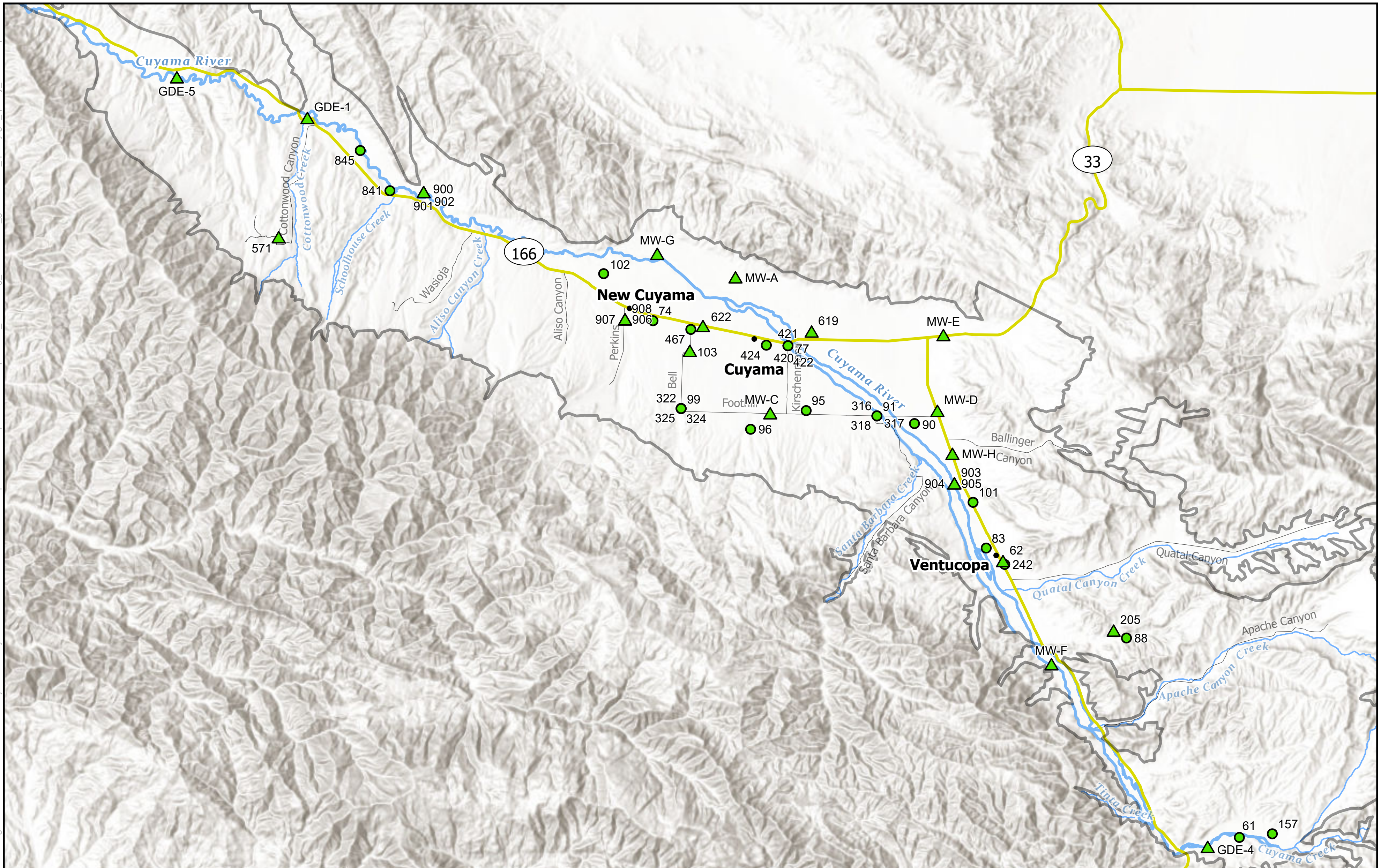

Figure 4-23: Updated Groundwater Quality Monitoring Network

Cuyama Valley Groundwater Basin

Legend

Network Well
- Representative Monitoring
- Non-representative Monitoring

- Highway
- Local Road
- Town
- Cuyama River
- Creek
- Cuyama Basin

N

0 1.25 2.5 5 Miles

Map Created: December 2023

Woodard & Curran

Cuyama Basin Groundwater Sustainability Agency

Figure Exported: 12/27/2023 By: DHunt Using: \\woodardcurran.net\shared\Projects\CA Cuyama Basin GSA\0011078.01 GSP\wip\Z. GIS\2. Maps\2025 GSP Update\04_Monitoring_Networks\21_groundwater_quality\gw_quality_network.aprx

Table 4-6: Groundwater Quality Monitoring Network

OPTI ID	Well Construction Date	Well Depth (Feet)	Hole Depth (Feet)	Screen Interval (Feet)	Well Elevation (Feet above mean sea level)	Transducer
61*	-	357	-	-	3681	No
62*	-	212	-	-	2920	Yes
74*	-	-	-	-	2193	No
77*	12/4/2008	980	1003	980-960	2283	Yes
83*	1/1/1972	198	-	-	2,858	No
88*	9/4/2007	400	400	-	3549	No
90*	8/8/2006	800	800	-	2552	No
91*	9/29/2009	980	1000	980-960	2478	Yes
96*	2/1/1980	500	500	-	2609	No
99*	9/10/2009	750	906	750-73	2503	No
101*	-	200	220	-	2749	No
102*	-	-	-	-	2044	No
157*	-	71	-	-	3755	Yes
242*	-	155	187	-	2933	No
316*	9/29/2009	830	1000	-	2478	Yes
317*	9/29/2009	700	1000	-	2478	Yes
318*	9/29/2009	610	1000	-	2474	No
322*	4/9/2009	850	906	-	2503	No
324*	9/10/2009	560	906	-	2503	No
325*	1947	380	906	-	2503	No
420*	12/4/2008	780	1003	-	2283	Yes
421*	12/4/2008	620	1003	-	2283	Yes
422*	12/4/2008	460	1003	-	2286	No
467*	1/1/1948	1140	1215	-	2229	No
619*	-	1040	-	1040-471	2306	No
622*	-	1200	-	1200-400	-	No
841*	12/12/2014	600	-	580-170	1764	Yes
845*	7/12/2015	380	-	360-100	1713	Yes

OPTI ID	Well Construction Date	Well Depth (Feet)	Hole Depth (Feet)	Screen Interval (Feet)	Well Elevation (Feet above mean sea level)	Transducer
103	-	1030	1040	-	2288	Yes
205	-	435	440	-	-	No
571	-	280	-	-	2317	Yes
900	7/15/2021	605	-	50-60	-	Yes
901	7/15/2021	605	-	165-205	-	Yes
902	7/15/2021	605	-	325-365	-	Yes
903	7/23/2021	587	-	265-305	-	Yes
904	7/23/2021	587	-	360-400	-	Yes
905	7/23/2021	587	-	540-570	-	Yes
906	8/27/2021	670	-	130-150	-	Yes
907	8/27/2021	670	-	515-525	-	Yes
908	8/27/2021	670		650-660	-	Yes

4.8.7 Monitoring Protocols

The monitoring protocols will use DWR's *Monitoring Networks and Identification of Data Gaps BMP*, which sites the USGS's 1995 publication *Ground-Water Data-Collection Protocols and Procedures for the National Water-Quality Assessment Program: Collection and Documentation of Water-Quality Samples and Related Data* (Appendix B) for the groundwater quality sampling protocols. This publication includes protocols for equipment selection, setup, use, field evaluation, sample collection techniques, sample handling, and sample testing.

4.8.8 Data Gaps

Groundwater quality monitoring data gaps have three components as follows:

- Spatial distribution of the wells
- Well/measurement depths for three-dimensional constituent mapping
- Temporal sampling

With the addition of new wells installed through DWR's TSS program and with grant funding, the spatial distribution of the groundwater quality monitoring network now provides coverage of all of the spatial data gaps that were identified in the 2020 GSP.

With the newly constructed wells, there will now be multiple locations within the Basin that can provide water quality information at multiple depths. This will allow the monitoring network to collect additional information about how salinity may change at different depths in the aquifer. This information needs to be evaluated to determine if additional multi-completion wells will be required to adequately understand three-dimensional constituent mapping within the Basin.

Water quality sampling historically has been inconsistently performed throughout the Basin; as a result, the Basin itself was identified in the 2020 GSP as a groundwater quality monitoring temporal data gap. Since adoption of the GSP, the CBGSP has undertaken its own annual sampling effort, which addressed this previously identified data gap.

4.8.9 Plan to Fill Data Gaps

The CBGSA has filled the temporal and spatial data gaps identified in the 2020 GSP by implementing its own salinity sampling program and has filled the three-dimensional constituent mapping knowledge gap at least partially through installation of new multi-completion monitoring wells.

The CBGSA will evaluate the data collected by the monitoring program going forward to assess whether additional three-dimensional monitoring is needed. This includes an assessment of nitrate and arsenic data collected from GAMA and other data sources.

4.9 Land Subsidence Monitoring Network

4.9.1 Management Areas

Subsidence is managed Basin-wide; as a result, no management areas are used.

4.9.2 Monitoring Sites Selected for Monitoring Network

There are two subsidence monitoring stations in the Basin and three outside of the Basin. Figure 4-24 shows the locations of existing subsidence monitoring stations, which make up the current subsidence monitoring network. The two stations in the Basin, sites CUHS and VCST, are both included in the monitoring network because they are active and provide Basin-specific data. The three stations located outside of the Basin, sites P521, BCWR, and OZST, are also included in the monitoring network. These stations are important for understanding general dynamic movement trends in the Basin because they detect tectonic movement in the Basin.

4.9.3 Monitoring Frequency

Subsidence monitoring frequencies should capture long-term and seasonal fluctuations in ground level changes. DWR's *Monitoring Networks and Identification of Data Gaps BMP* does not provide specific monitoring frequency or interval guidance. However, CGPS stations allow for data sampling several times a minute, which is sufficient for seasonal fluctuations to be captured in the data. Long-term trends are compiled from continuous data. Therefore, the CBGSA will use the same monitoring frequency currently used by the CGPS stations.

4.9.4 Spatial Density

Because there are only two monitoring stations, the current spatial density of subsidence monitoring in the Basin is 0.5 stations per 100 square miles. DWR's *Monitoring Networks and Identification of Data Gaps BMP* does not provide specific spatial density guidelines for subsidence monitoring networks, and thus relies on professional judgment for site identification. Current stations, both in and outside of the Basin, do not adequately cover the Basin for capturing subsidence variations. Potential areas for new stations are discussed below.

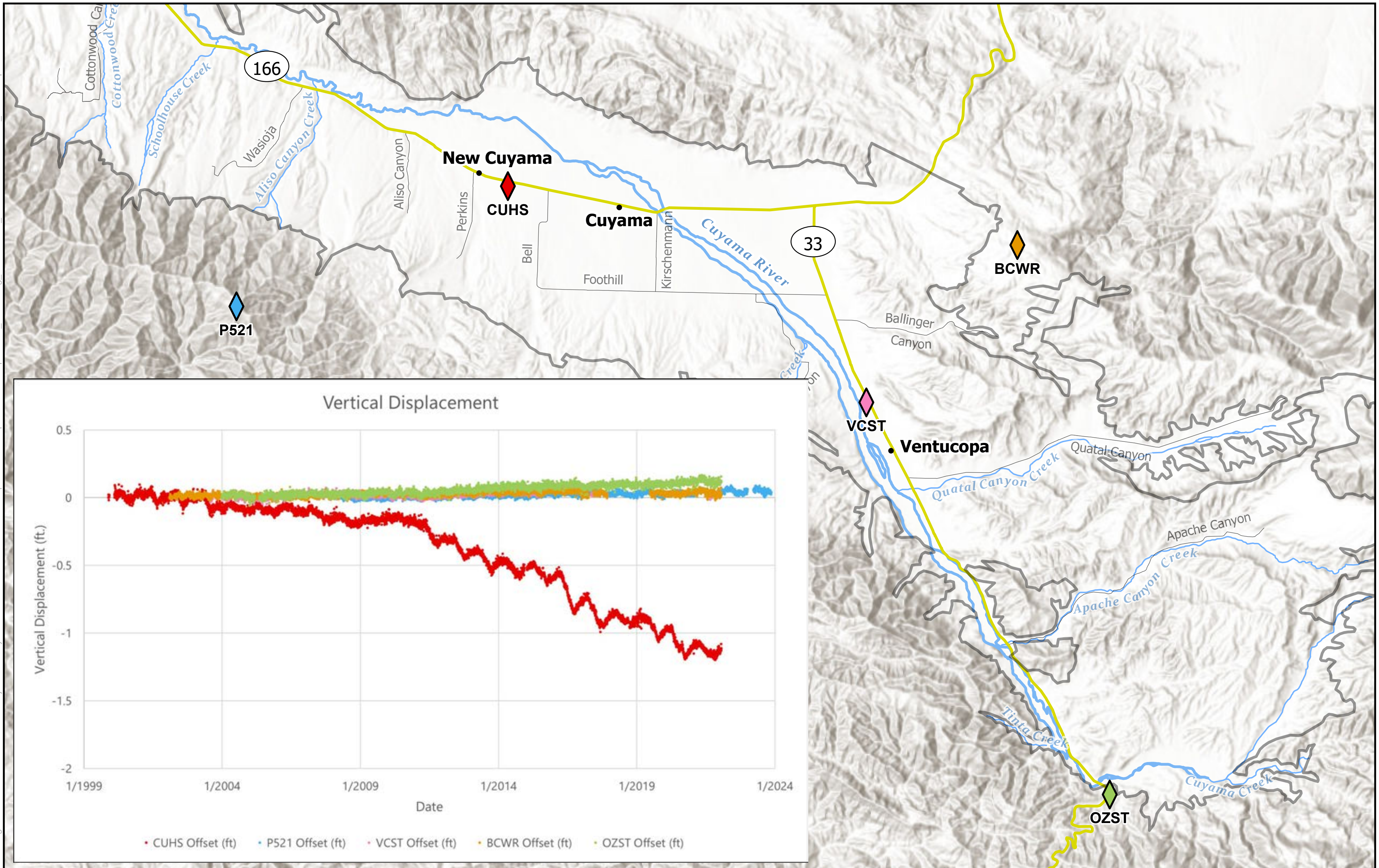

Figure 4-24: Subsidence Monitoring Network

Cuyama Valley Groundwater Basin

Legend

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

N

0 1 2 4 Miles

Map Created: December 2023

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Cuyama Basin Groundwater Sustainability Agency

4.9.5 Monitoring Protocols

DWR's provided *Monitoring Networks and Identification of Data Gaps BMP* does not provide specific monitoring protocols for subsidence monitoring networks. CGPS station measurements are logged digitally, and depending on the station and network setup, either require downloading at the physical station site or are uploaded automatically to a server. Data management will also depend on the monitoring agency. Current operating stations will continue to be managed by their current entity, and the CBGSA will be responsible for downloading data on a fixed schedule. The addition of new stations will require developing procedures for downloading and storing data, and for a quality assurance review of the data.

Data should be saved in the Cuyama Basin data management system on a regular annual schedule. All data should be reviewed for quality and logged appropriately.

4.9.6 Data Gaps

New subsidence monitoring sites should be chosen to provide data on areas most at risk for land subsidence. Six potential new locations were identified in the Basin, as shown in Figure 4-25. These locations were identified by focusing on areas with significant or new groundwater pumping that did not have subsidence monitoring nearby. Criteria for selection are as follows:

- Identified as an area with relatively new and increased agricultural activity and pumping with no nearby stations.
- Identified because there are currently no nearby stations and the Russell Fault bisects this area
- Identified because of the CCSD and proximity to the heavily pumped central portion of the Basin
- Identified because this is the most heavily pumped portion of the Basin and there are currently no nearby stations
- Identified because of its proximity to the heavily pumped portion of the Basin, on the north facing slop of the valley; additionally, there are currently no stations nearby
- Identified because this is the transition into the heavily pumped central portion of the Basin near current agricultural pumping; this is also an area with faults

4.9.7 Plan to Fill Data Gaps

New monitoring sites should be located near areas with the greatest groundwater pumping, or where pumping is new. This is because pumping is the driving force for subsidence in the Basin. Although there are multiple ways to measure subsidence, CGPS stations are likely the best option for the Basin. CGPS stations are relatively low cost when compared to gathering data via labor-intensive land surveys, construction of borehole extensometers, and frequent satellite data processing. CGPS stations require comparatively little maintenance and provide continuous information allowing detailed land subsidence analysis.

Increasing data collection about subsidence for the Basin requires addition of several new CGPS stations. These stations could be managed solely by the CBGSA or could be incorporated into the Continuously Operating Reference Station (CORS) via coordination with USGS. Site selection, equipment, and management will require coordination with USGS.

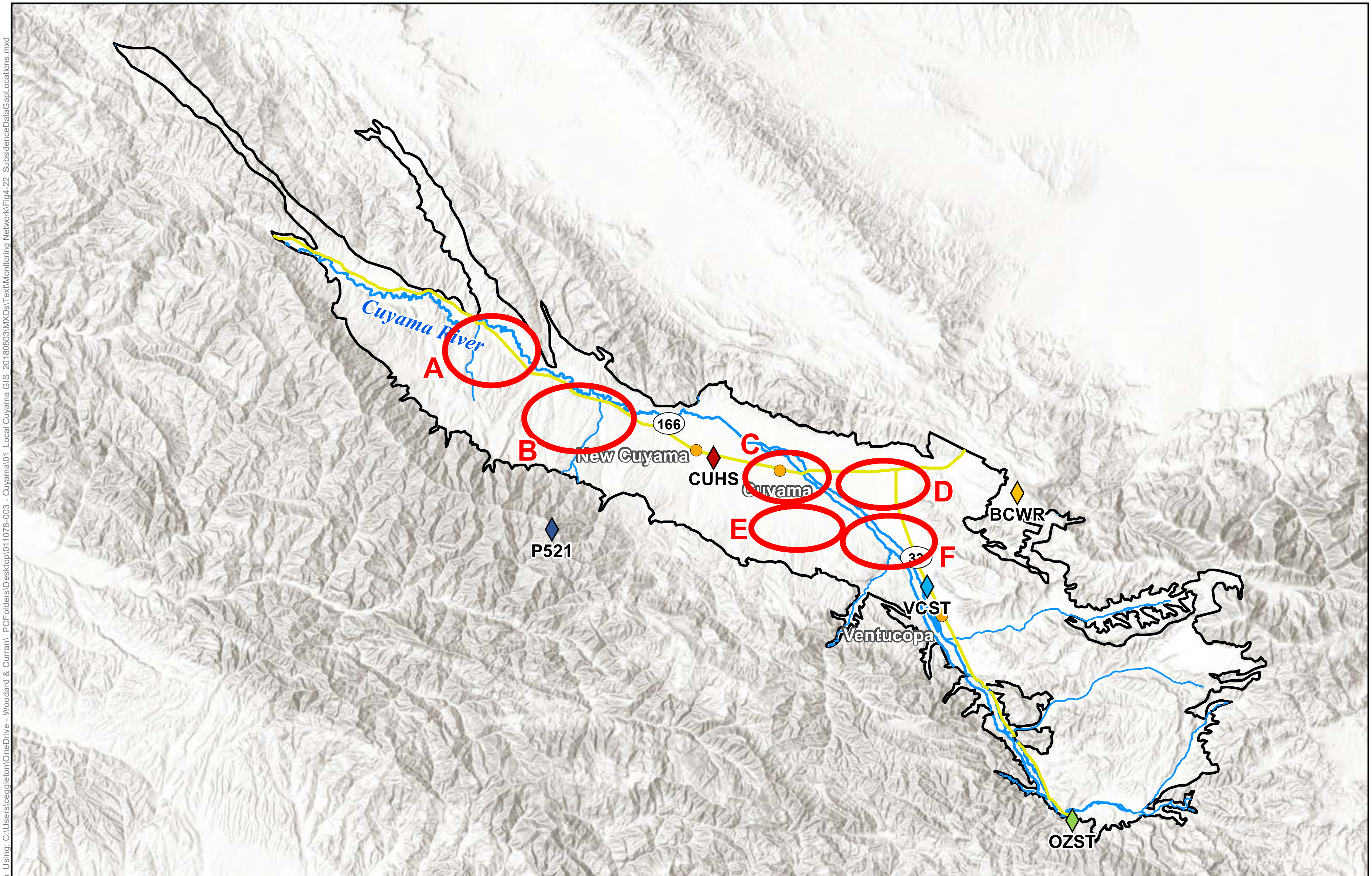

Figure 4-25: Subsidence Monitoring Location Data Gap Areas

Cuyama Basin Groundwater Sustainability Agency

Cuyama Valley Groundwater Basin Groundwater Sustainability Plan

April 2019

WOODARD & CURRAN

Figure Exported: 9/18/2018 By: ceggleton Using: C:\Users\ceggleton\OneDrive - Woodard & Curran\ PCFolders\Desktop\0011078-003 - Cuyama\01 Local Cuyama GIS_20180803\MXDs\Text\Monitoring Network\Fig4-22_SubsidenceDataGapLocations.mxd

4.10 Depletions of Interconnected Surface Water Monitoring Network

The following content reflects what was included in the 2020 GSP. DWR is in the process of developing additional guidance documents to assist GSAs in addressing the interconnected surface waters sustainability indicator. At this time, those guidance documents have not been published, but the CBGSA plans to utilize those resources when they become available for future updates to the GSP and for future ISW implementation.

The CBGSA identified a subset of groundwater level representative monitoring wells to use for ISW monitoring and provided a rationale for their selection addressed the monitoring of ISW. Depletions of ISW are related to chronic lowering of groundwater levels via changes in the hydraulic gradient and piezometric surface elevation. Therefore, declines in groundwater elevations in portions of the river system that are hydrologically connected to the river system can lead to increased stream losses and depletion of surface water flows. The primary areas of concern for ISW are on stretches of the Cuyama River upstream of Ventucopa and downstream of the Russell Fault, and on the four major contributing streams to the Cuyama River, including Aliso Creek, Santa Barbara Creek, Quantal Canyon Creek, and Cuyama Creek.

The Cuyama River does not flow during most days of the year and therefore the river is not subject to environmental flow regulations, the primary beneficial uses of Cuyama River streamflows are GDEs and water users who utilize water that may flow into Lake Twitchell downstream of the Basin boundary. Lowering groundwater levels could result in reduced streamflows for beneficial use by these users. Therefore, the intent of the ISW monitoring network and sustainability criteria are to ensure that long-term groundwater level declines do not occur in the vicinity of these interconnected surface water flow reaches of the Cuyama River system.

4.10.1 Management Areas

Depletions of interconnected surface waters is managed Basin-wide; as a result, no management areas are used.

4.10.2 Monitoring Sites Selected for Monitoring Network

To develop an ISW monitoring network, a subset of wells from the groundwater levels representative monitoring network has been used to create a depletion of ISW representative monitoring network. Wells not included in the groundwater levels monitoring network were also considered; but no additional wells were identified that would be suitable for ISW monitoring. After consulting DWR's BMPs for Monitoring Networks and Identification of Data Gaps, the following criteria were used to select wells to be included in the ISW representative network:

1. Wells that are within 1.5-miles of the Cuyama River and/or 1-mile of one of the four major contributing streams to the Cuyama River, including Aliso Creek, Santa Barbara Creek, Quantal Canyon Creek, and Cuyama Creek,

2. Wells that have screen intervals within 100 feet below ground surface (bgs). In some cases, wells without screen interval information but with well depths greater than 100 feet bgs were included, under the assumption that the top of the screen interval was likely to be less than 100 feet bgs. In many of these wells, recent groundwater depth to water measurements were 40 feet bgs or less.

The wells shown in Table 4-7 are the proposed ISW monitoring network. Representative wells are marked with an *. The ISW monitoring network can be found in Figure 4-26. Additionally, the CBGSA was awarded a DWR SMGA grant for installation of piezometers to help monitor groundwater levels. These are also shown in Figure 4-26 as wells 909, 910, and 911.

Table 4-7: Proposed ISW Monitoring Network

Opti ID	Well Depth (Feet bgs)	Screen Interval
2*	73	Unknown
89*	125	Unknown
114*	58	Unknown
568*	188	Unknown
830*	77	Unknown
832*	132	Unknown
833*	504	Unknown
836*	325	Unknown
906*	670	150-130
101	200	Unknown
102	Unknown	Unknown
421	620	Unknown

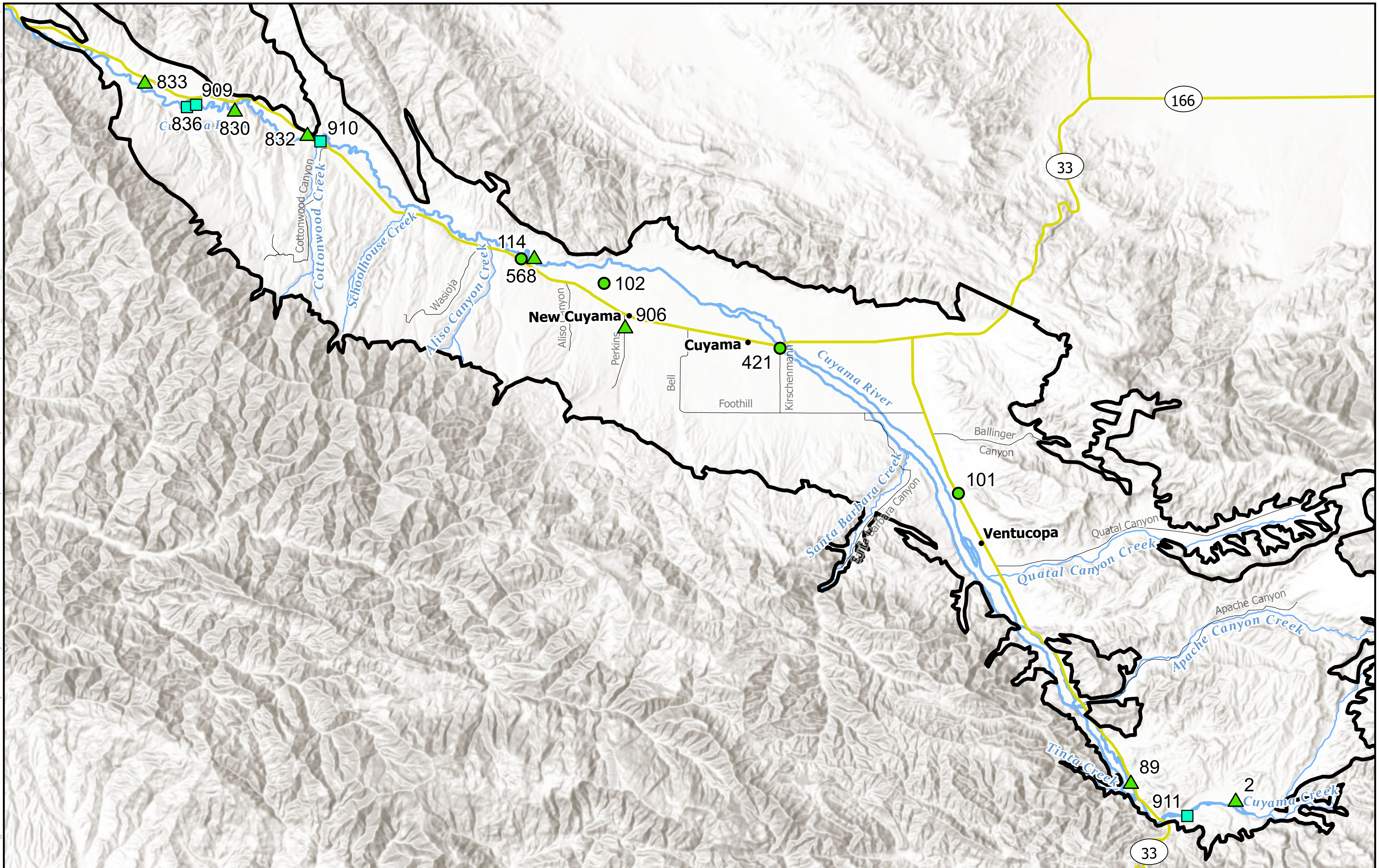

Figure 4-26: Interconnected Surface Water Monitoring Network

Cuyama Valley Groundwater Basin

Legend

- Representative Monitoring Well
- Non-representative Monitoring Well
- GDE Monitoring Well
- Highway
- Local Road
- Town
- Creek
- Cuyama River
- Cuyama Basin

N

0 1.25 2.5 5 Miles

Map Created: August 2024

4.10.3 Monitoring Frequency

A successful monitoring frequency and schedule should allow the monitoring network to adequately interpret fluctuations over time in the groundwater system based on shorter-term and longer-term trends and conditions. These changes may be the result of storm events, droughts, or other climatic variations, seasons, and anthropogenic activities such as pumping.

ISW uses a subset of groundwater level monitoring wells as a proxy, and therefore utilizes the same monitoring frequency established under the groundwater level monitoring network.

4.10.4 Spatial Density

ISW uses a subset of groundwater level monitoring wells as a proxy, and monitoring sites were chosen based on their suitability in monitoring potential interconnected surface waters based on known groundwater conditions. After consulting DWR's BMPs for Monitoring Networks and Identification of Data Gaps, the following criteria were used to select wells to be included in the ISW representative network:

1. Wells that are within 1.5-miles of the Cuyama River and/or 1-mile of one of the four major contributing streams to the Cuyama River, including Aliso Creek, Santa Barbara Creek, Quantal Canyon Creek, and Cuyama Creek,
2. Wells that have screen intervals within 100 feet below ground surface (bgs). In some cases, wells without screen interval information but with well depths greater than 100 feet bgs were included, under the assumption that the top of the screen interval was likely to be less than 100 feet bgs. In many of these wells, recent groundwater depth to water measurements were 40 feet bgs or less.

4.10.5 Monitoring Protocols

DWR's emergency regulations Section 354.28 (c)(6) states that "The minimum threshold for depletions of interconnected surface water shall be the rate or volume of surface water depletions caused by groundwater use that has adverse impacts on beneficial uses of the surface water and may lead to undesirable results. The minimum threshold established for depletions of interconnected surface water shall be supported by the following: (A) The location, quantity, and timing of depletions of interconnected surface water, and (B) A description of the groundwater and surface water model used to quantify surface water depletion."

4.10.6 Data Gaps

DWR BMP Monitoring Networks and Identification of Data Gaps, provides the following guidance for well selection: "Identify and quantify both timing and volume of groundwater pumping within approximately 3 miles of the stream or as appropriate for the flow regime." However, the CBGSA has chosen to use a 1.5-mile buffer around the Cuyama River and a 1-mile buffer around the major contributing streams because the Basin's unique and variable geology and topography require a narrower window so that the ISW monitoring network wells would cover just the portion of the Valley in the vicinity of the River system (and not extend into foothill areas with significant topographic relief and no alluvial aquifers).

Since the emergency regulations require a numerical model to estimate the depletions of interconnected surface water, there is no functional monitoring network that can be used to measure depletions of interconnected surface water. Therefore, the monitoring networks for depletions of interconnected surface water will include two components as follows:

- Groundwater level monitoring to serve as monitoring by proxy of depletions of interconnected surface water
- Pursuit of additional surface water gage stations to improve numerical model accuracy

4.10.7 Plan to Fill Data Gaps

This GSP identifies some ways to refine the groundwater level monitoring network, which in part is used for depletions of interconnected surface waters monitoring, which are described above. Additionally, the CBGSA plans to utilize DWR ISW resources when they become available for future updates to the GSP and for future ISW implementation.

4.11 References

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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.
- **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 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, threshold regions are no longer being used.

5.2.2 Minimum Thresholds, Measurable Objectives, and Interim Milestones

This section describes how MTs, MOs, and IMs were established for each representative well and explains the rationale behind the selected methodologies.

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**: 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 utilize the same data type (points instead of polygons) in the processing required for the protection depth calculation.

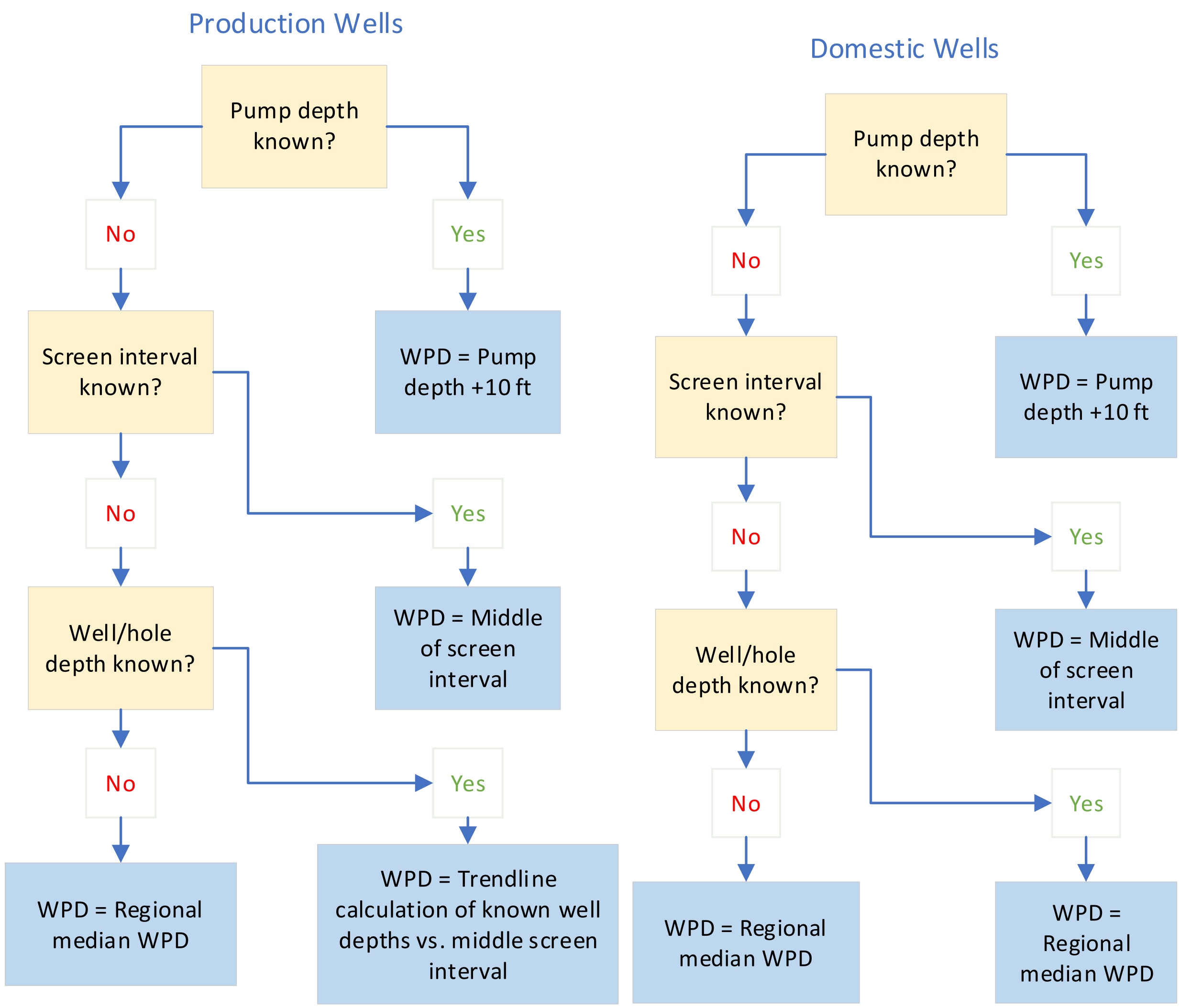

Figure 5-1: Well Protection Depth Stepwise Diagram for Production and Domestic Wells

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.

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.

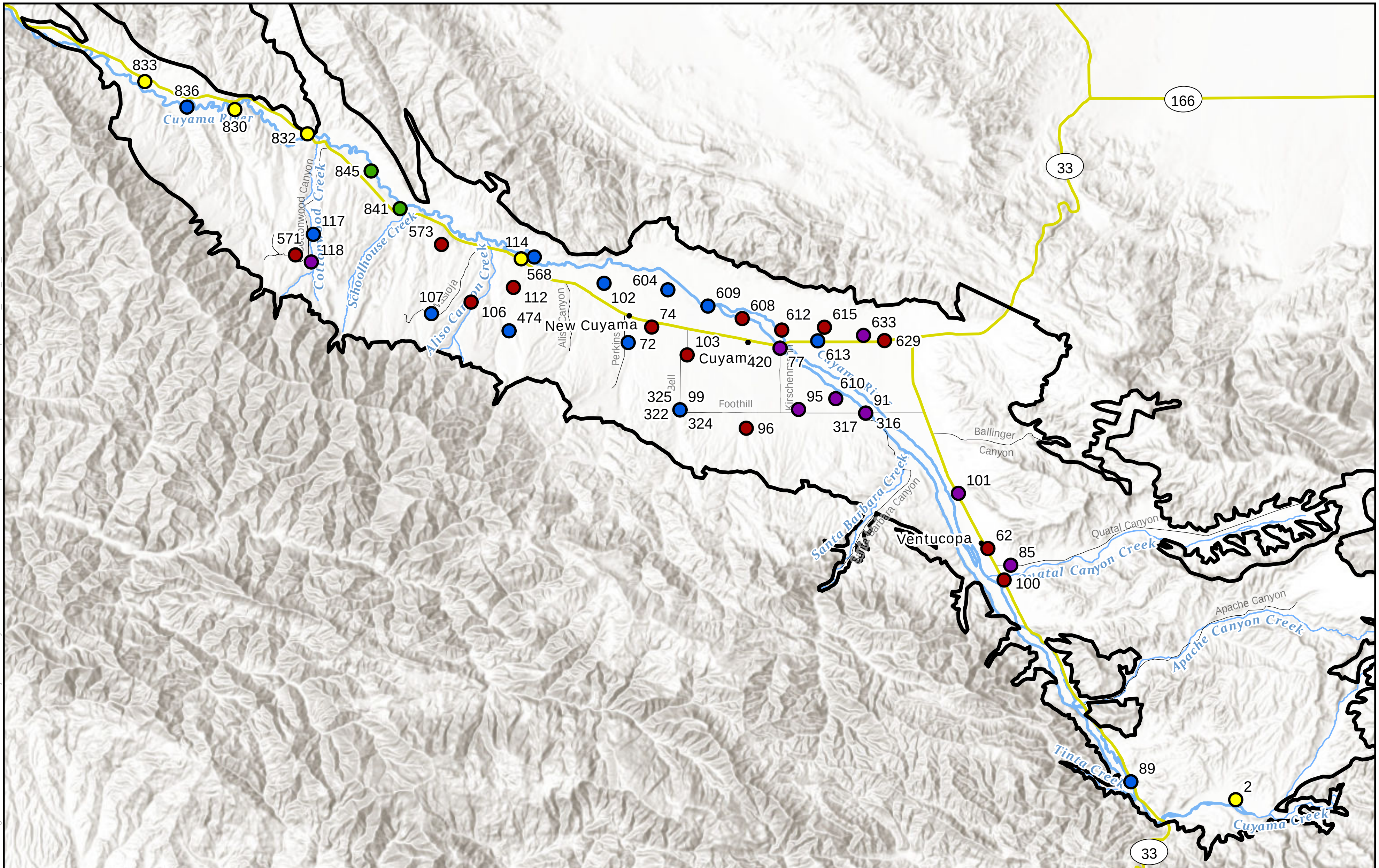

Figure 5-2: Minimum Threshold Calculation Method

Cuyama Valley Groundwater Basin

Map Created: April 2024

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. Since the only significant groundwater pumping in the Western and Northwestern regions occurs from a group of wells that are located approximately between Opti Wells 841 and 845, this analysis reflects a worst case condition that may result from anticipated pumping in this area of the Basin, and therefore is instructive as to whether the MTs in this region are protective of beneficial uses and users of water. 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.

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.

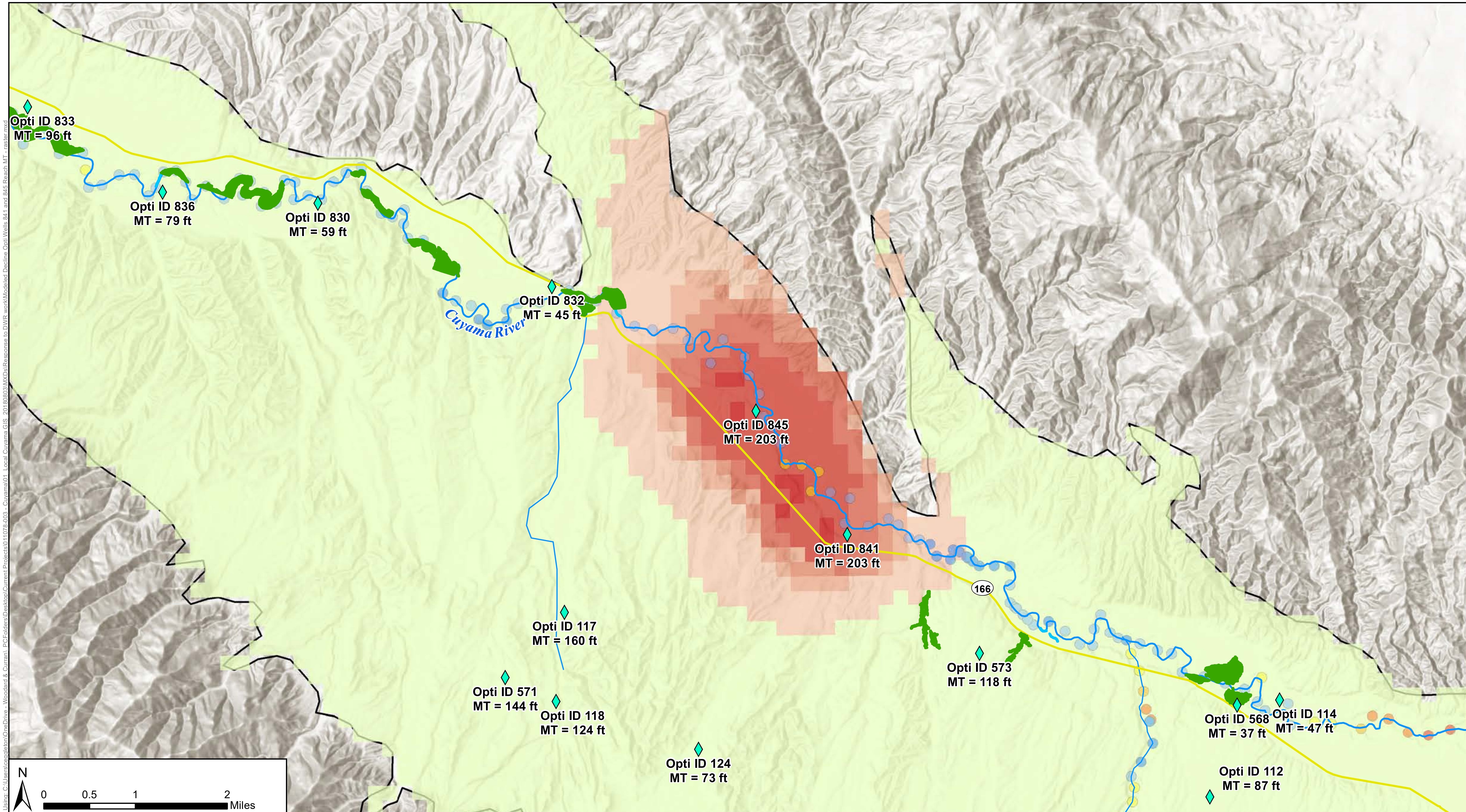

Figure 5-3: Change in GWLs in the Northwestern Region from CBRWM Test Simulations

Cuyama Basin Groundwater Sustainability Agency

Cuyama Valley Groundwater Basin Groundwater Sustainability Plan

September 2021

WOODARD & CURRAN

Legend

Cuyama Basin

GWL Representative Network

Probable GDE Vegetation from GSP*

Probable GDE Vegetation from GSP*

Cuyama River

Streams

Modeled change in GWLs if Opti Wells 845 and 841 reach their MTs (baseline - change)

No Change
<0 - 15 ft.
15 - 30 ft.
30 - 50 ft.
50 - 100 ft.
100 - 150 ft.
150 - 200 ft.

Modeled Depth to Groundwater for January 1, 2015

-55 - -10 ft DTW
-9 - 0 ft DTW
1 - 30 ft DTW
31 - 50 ft DTW
51 - 100 ft DTW
101 - 200 ft DTW
201 - 700 ft DTW

*Note that areas shown for probable GDEs has been given a large buffer to be seen at this extent. Actual GDE area is much smaller than what is shown.

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 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.

Table 5-1 shows the representative monitoring network and the numerical values for the MT, MO, and IM for each representative well.

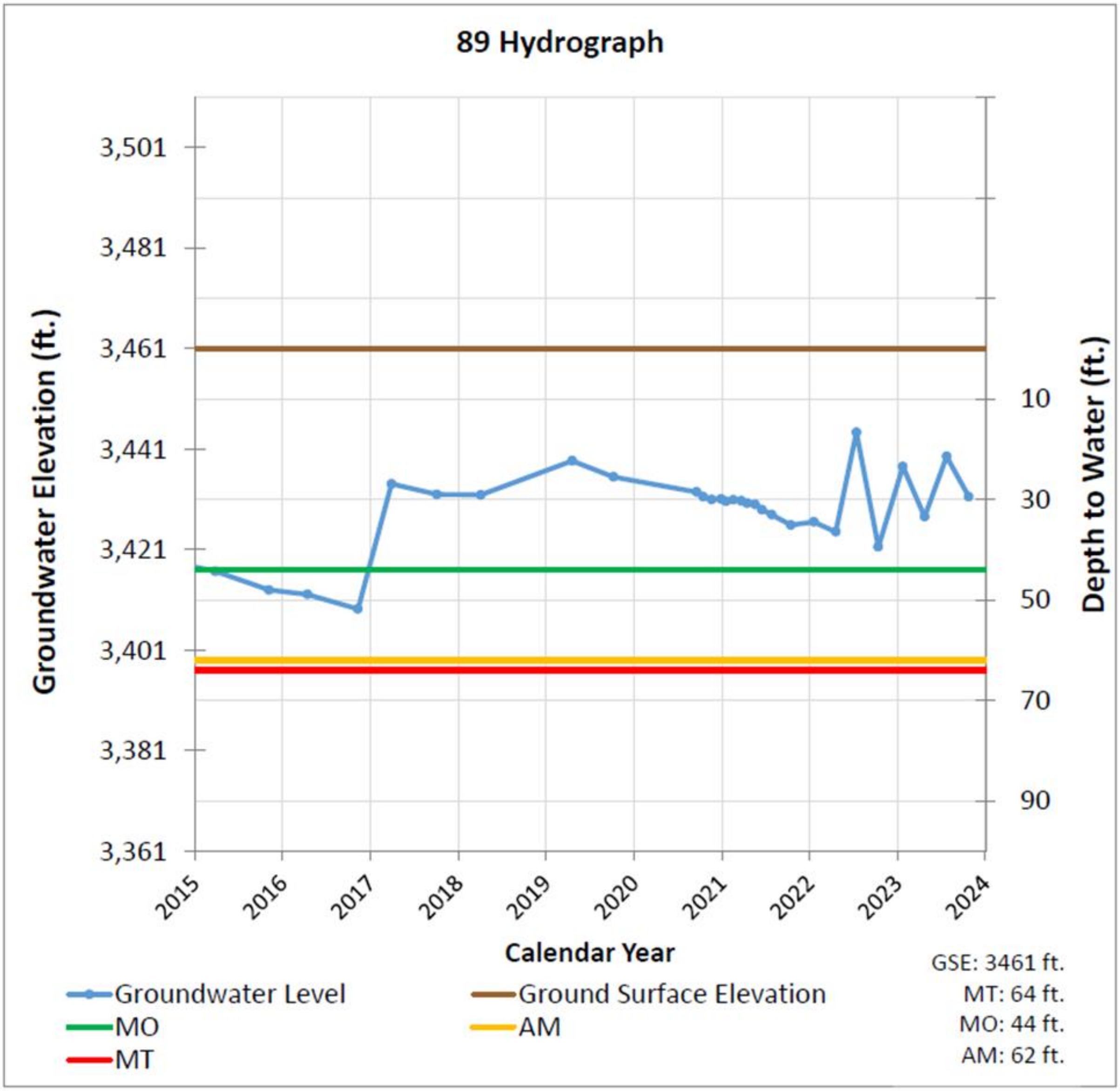

Figure 5-4: Example Hydrograph

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	373	328	362	350	339	790	340	350	2,171
74	Central	322	309	319	316	312	--	--	--	2,193
77	Central	514	464	501	489	476	980	960	980	2,286
91	Central	730	681	718	705	693	980	960	980	2,474
95	Central	597	562	588	580	571	805	--	--	2,449
96	Central	369	361	367	365	363	500	--	--	2,606
99	Central	379	368	377	374	371	750	730	750	2,513
102	Central	470	432	461	451	442	--	--	--	2,046
103	Central	379	324	365	351	338	1,030	--	--	2,289
112	Central	102	100	101	101	100	441	--	--	2,139
114	Central	58	56	58	57	57	58	--	--	1,925
316	Central	731	682	719	706	694	830	--	--	2,474
317	Central	700	650	688	675	663	700	--	--	2,474
322	Central	387	378	385	383	381	850	--	--	2,513
324	Central	365	353	362	359	356	560	--	--	2,513
325	Central	331	323	329	327	325	380	--	--	2,513
420	Central	514	464	501	489	476	780	--	--	2,286
421	Central	514	466	502	490	478	620	--	--	2,286
474	Central	197	178	192	188	183	213	--	--	2,369
568	Central	47	46	47	47	46	188	--	--	1,905
604	Central	544	505	534	524	515	924	454	924	2,125
608	Central	504	475	497	490	483	745	440	745	2,224
609	Central	499	462	490	480	471	970	476	970	2,167
610	Central	557	527	549	542	534	780	428	780	2,442
612	Central	513	490	507	502	496	1,070	657	1070	2,266
613	Central	578	550	571	564	557	830	330	830	2,330
615	Central	588	556	580	572	564	865	480	865	2,327
629	Central	613	581	605	597	589	1,000	500	1000	2,379

OPTI Well	Region	Final MT	Final MO	2025 IM	2030 IM	2035 IM	Well Depth (feet)	Screen Top (feet)	Screen Bottom (feet)	GSE (feet)
633	Central	605	551	591	578	564	1,000	500	1000	2,364
62	Eastern	212	187	206	199	193	212	--	--	2,921
85	Eastern	200	176	194	188	182	233	--	--	3,047
100	Eastern	186	157	179	172	164	284	--	--	3,004
101	Eastern	138	115	133	127	121	200	--	--	2,741
841	Northwestern	203	153	191	178	166	600	170	580	1,761
845	Northwestern	203	153	191	178	166	380	100	360	1,712
2	Southeastern	52	35	48	44	39	73	--	--	3,720
89	Southeastern	62	42	57	52	47	125	--	--	3,461
106	Western	164	152	161	158	155	227.5	--	--	2,327
107	Western	122	103	117	113	108	200	--	--	2,482
117	Western	163	154	161	158	156	212	--	--	2,098
118	Western	40	10	24	7	-10	500	--	--	2,270
571	Western	142	118	136	130	124	280	--	--	2,307
573	Western	93	42	80	68	55	404	--	--	2,084
830	Far-West Northwestern	63	60	62	62	61	77.2	--	--	1,571
832	Far-West Northwestern	50	35	46	43	39	131.8	--	--	1,630
833	Far-West Northwestern	48	10	30	12	-6	503.55	--	--	1,457
836	Far-West Northwestern	49	10	38	28	17	325	--	--	1,486

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 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 identified during the development of the 2020 GSP as potential constituents of concern. However, recent data analysis has led the CBGSA to conclude that thresholds for TDS are warranted and thresholds for nitrate and arsenic are not aligned with the CBGSAs role within the Subbasin.

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.

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.

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 2-81, 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 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.

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.

5.5.1 Proxy Monitoring

Proxy monitoring is not used for groundwater quality monitoring in the Basin.

5.5.2 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.

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 90^{th} 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 90^{th} percentile for Opti Well 72 is 1,010 mg/L. The MT is then calculated by taking the 90^{th} 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 have 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)	MO (mg/L)	MT (mg/L)	2025 IM (mg/L)	2030 IM (mg/L)	2035 IM (mg/L)
61	357	Unknown	3681	585	1000	896	793	689
72	790	340 – 350	2171	900	1106	1055	1003	952
74	--	Unknown	2193	1310	1872	1732	1591	1451
77	980	960 – 980	2286	1,120	1682	1542	1401	1261
79	600	Unknown	2374	1,500	2318	2114	1909	1705
83	198	Unknown	2858	1,120	1816	1642	1468	1294
88	400	Unknown	3549	320	1000	830	660	490
90	800	Unknown	2552	1,400	1596	1547	1498	1449
91	980	960 – 980	2474	1,020	1558	1424	1289	1155
95	805	Unknown	2449	1340	1950	1798	1645	1493
96	500	Unknown	2606	1100	1676	1532	1388	1244
99	750	730 – 750	2513	1,140	1658	1529	1399	1270
101	200	Unknown	2741	1210	1735	1604	1473	1341
102	--	Unknown	2046	1,500	2551	2288	2026	1763
157	71	Unknown	3755	1,360	2468	2191	1914	1637
204	--	Unknown	3693	380	1000	845	690	535
242	155	Unknown	2933	780	1656	1437	1218	999
316	830	Unknown	2474	1,060	1524	1408	1292	1176
317	700	Unknown	2474	692	1444	1256	1068	880
322	850	Unknown	2513	1,140	1504	1413	1322	1231
324	560	Unknown	2513	740	1000	935	870	805
325	380	Unknown	2513	1,070	1687	1533	1378	1224
420	780	Unknown	2286	1,080	1560	1440	1320	1200
421	620	Unknown	2286	1,280	1761	1640	1520	1400
424	1000	Unknown	2291	1,260	1658	1559	1459	1360
467	1140	Unknown	2224	1070	1846	1652	1458	1264
568	188	Unknown	1905	860	1118	1054	989	925
841	600	170 – 580	1761	561	1000	890	781	671
845	380	100 – 360	1712	1,250	1250	1250	1250	1250

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 Representative Monitoring

As discussed in 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. 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 0.9 inches per year, as shown in Section 2.2. Currently, there are no state, federal, or local standards that regulate subsidence rates.

5.6.2 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 0.9 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 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.

5.7 Depletions of Interconnected Surface Water

The following content reflects what was included in the 2020 GSP. DWR is in the process of developing additional guidance documents to assist GSAs in addressing the interconnected surface waters sustainability indicator. At this time, those guidance documents have not been published, but the CBGSA plans to utilize those resources when they become available for future updates to the GSP and for future ISW implementation.

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.

5.7.1 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.

5.7.2 Minimum Thresholds, Measurable Objectives, and Interim Milestones

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, and the new methodology for the chronic lowering of groundwater levels ISW incorporates protections for beneficial users including GDEs, the groundwater level thresholds are used by proxy to protect the Basin from undesirable results related to depletion of interconnected surface water.

The ISW monitoring network includes 12 wells, nine of which are representative wells for which minimum thresholds and measurable objective have been defined. The MT, MO, and UR criteria (30 percent of representative wells below their MTs for two consecutive years) are the same as those calculated and provided in the groundwater level representative network for the groundwater level monitoring. MTs at the representative well locations are protective of GDE locations in the upper and lower portions of the river, with MTs less than 30 feet from the bottom of the river channel in the vicinity of four wells (89, 114, 830 and 832). Note that Well 906 is part of a new multi-completion well that was constructed in the summer of 2021 under DWR's Technical Support Services; while Well 906 is a representative well, sustainability criteria will not be developed for this well until a history of groundwater level measurements has been established. These thresholds are included in Section 5.2 but are also included in Table 5-3 below.

Table 5-3: 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)
114	Central	58	56	58	57	57	58	--	--	1,925
568	Central	47	46	47	47	46	188	--	--	1,905
2	Southeastern	52	35	48	44	39	73	--	--	3,720
89	Southeastern	62	42	57	52	47	125	--	--	3,461
830	Far-West Northwestern	63	60	62	62	61	77.2	--	--	1,571
832	Far-West Northwestern	50	35	46	43	39	131.8	--	--	1,630
833	Far-West Northwestern	48	10	30	12	-6	503.55	--	--	1,457

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.

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.

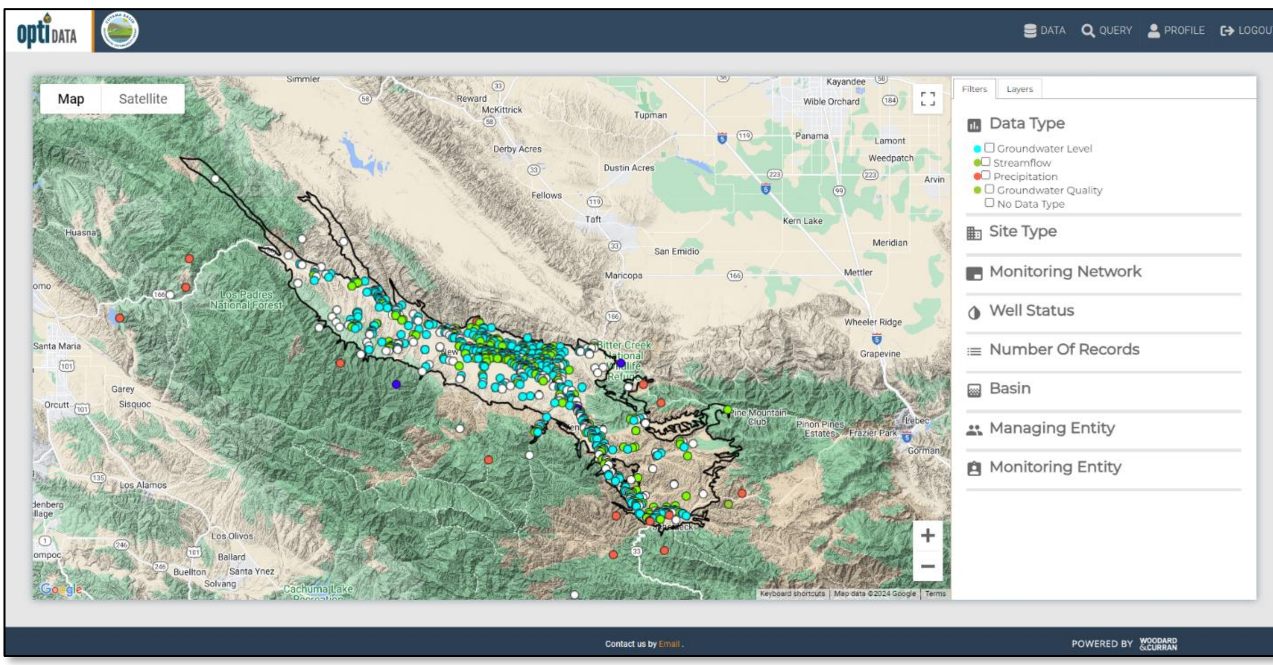

Figure 6-1: Screenshot of Opti Platform

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 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

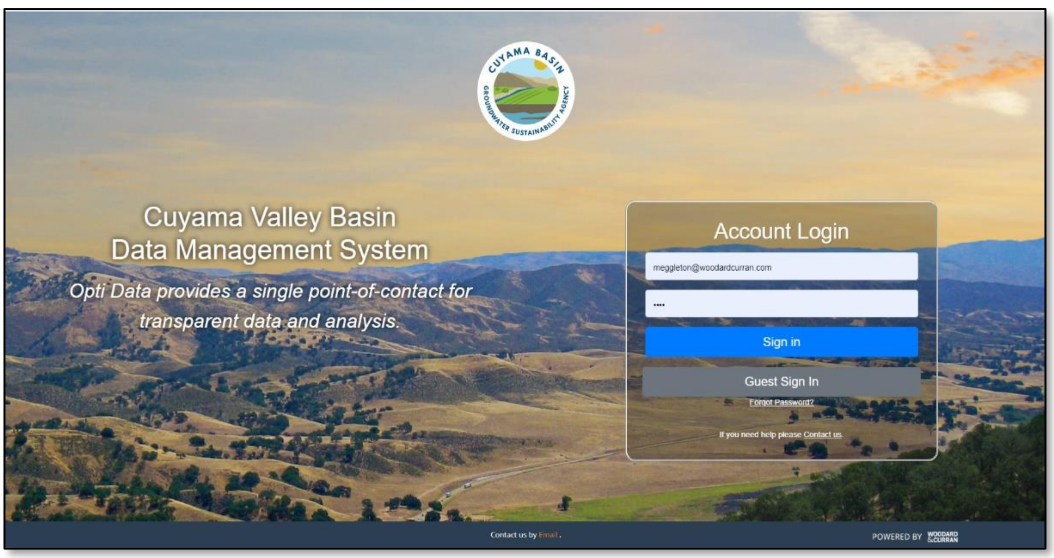

Figure 6-2: Screenshot of Opti Login Screen

Monitoring sites and their associated datasets are added to the DMS by managing entity administrators. 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.

6.2.2 Data Entry and Validation

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 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 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 USGS Code Managing Entity* Monitoring Entity* Monitoring Frequency Latitude/Longitude* Coordinates Method County Principal Aquifer County Principal Aquifer GW Basin Code GW Basin Name Well Location Description	Well Status Well Use Type Well Completion Type Reference Pint Elevation Reference Point Description Groundwater Surface Elevation Elevation Method Additional Comments	Well Completion Report Number Date Constructed Total Well Depth Total Perforation – Interval 1 Bottom Perforation – Interval 1 Casing Material Casing Diameter Date Survey 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)
MT = Minimum Thresholds
MO = Measurable Objectives
TDS = Total Dissolved Solids
* Required information

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 is a screenshot of the data entry interface.

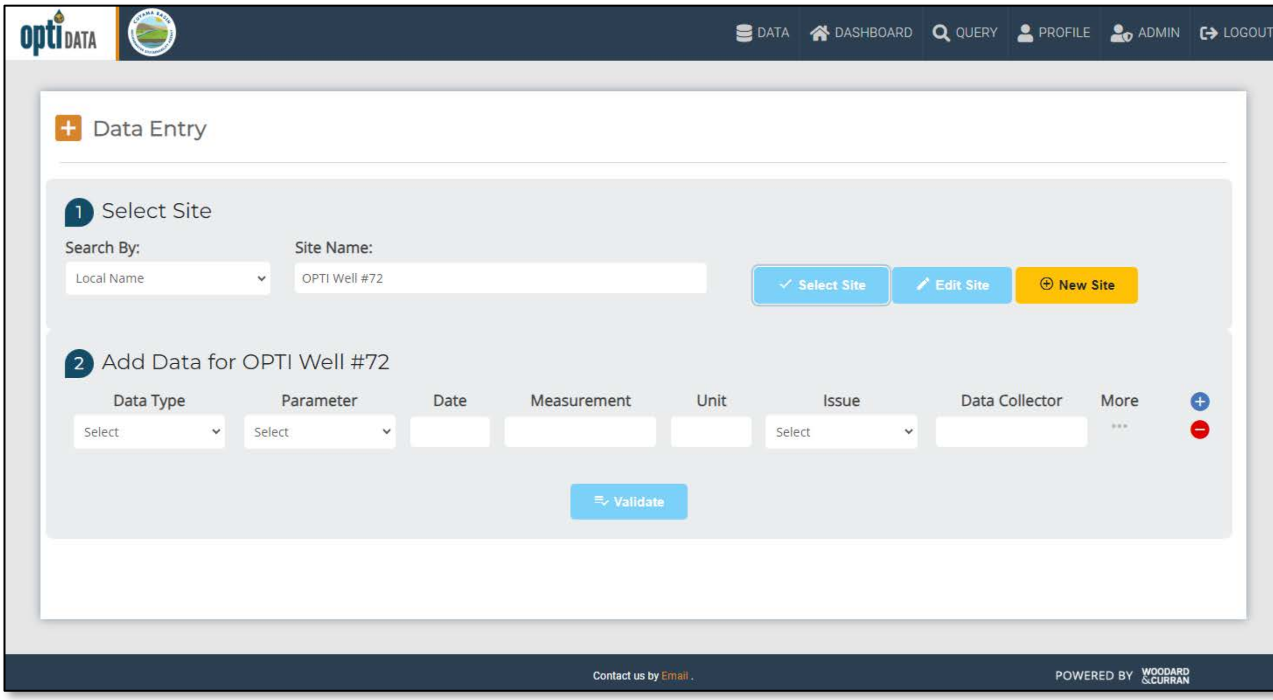

Figure 6-3: Screenshot of Data Entry Tool Interface

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 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). 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 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 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, of which 511 have historical groundwater elevation data and 376 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

Data Type	Parameter	Units	Currently Has Data in DMS
	Precipitation	inches	Yes
	Reference Evapotranspiration (ETo)	--	Yes
Precipitation	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	Date Collected	Activities Performed
US Geological Survey (USGS)	5/4/2018	Removed duplicate records Recalculated GSE based on DEM on select wells
DWR CASGEM/Water Data Library (WDL)	4/18/2018	Removed duplicate records Recalculated GSE based on DEM on select wells
San Luis Obispo County	4/2/2018	Removed duplicate records Recalculated GSE based on DEM on select wells
Santa Barbara County Water Agency	3/27/2018	Removed duplicate records Recalculated GSE based on DEM on select wells
Ventura County	3/8/2018	Removed duplicate records Recalculated GSE based on DEM on select wells
DWR Natural Resources Agency	6/14/2018	Removed duplicate records
GeoTracker	6/5/2018	Removed duplicate records
California Environmental Data Exchange Network (CEDEN)	8/29/2018	Removed duplicate records
National Water Quality Monitoring Council	6/1/2018	Removed duplicate records
UNAVCO	3/12/2018	None
Local Data	Various	Removed duplicate records Recalculated GSE based on DEM on select wells
CBGSA Monitoring Network Survey	1/29/2021	Survey wells in the GWL Representative network to get updated construction information such as ground surface elevation and reference point elevations.
Domestic Well Survey	2/23/2023	Update current records Assist in the development of an “active well” dataset
Active Well Survey	10/1/2022	Assist in the development of an “active well” dataset, including production wells
Continued CBGSA Monitoring	Ongoing	Continued monitoring

7. PROJECTS AND MANAGEMENT ACTIONS

7.1 Introduction

This chapter of the Cuyama Basin Groundwater Sustainability Agency's (CBGSA's) 2025 *Groundwater Sustainability Plan* (GSP) includes the Projects, Management Actions and Adaptive Management information that satisfies Sections 354.42 and 354.44 of the Sustainable Groundwater Management Act (SGMA) regulations.[12] These projects and their benefits will help achieve sustainable management goals in the Cuyama Groundwater Basin (Basin).

7.2 Management Areas

The CBGSA has designated two areas in the Basin as management areas: the Central Management Area and the Ventucopa Management Area, which are both defined as regions with modeled overdraft conditions greater than 2 feet per year that are projected by the Cuyama Basin Water Resources Model (CBWRM) to drop below minimum threshold levels before 2040 (see Figure 7-1). Management actions and projects within these management areas may be managed by the Cuyama Basin Water District pursuant to any agreement with the CBGSA. The two management areas are generally separated from one another by the Santa Barbara Canyon Fault. The remaining areas in the Basin are not included in a management area, and generally operate with balanced groundwater pumping and recharge, based on modeling of Basin water budgets. Future changes in management area boundaries will be considered based on updates to numerical modeling as additional information is collected.

As discussed below in Section 7.5.2, pumping allocations have been developed for the Central Management Area and farming units, but not in other portions of the Basin. However, the CBGSA will develop a management plan for the Ventucopa Management Area, which may or may not include pumping restrictions in the future. This decision will be made as more information becomes available and the basin groundwater model is updated.

7.2.1 Central Management Area

The Central Management Area is located in the middle of the CBGSA area and includes the community of Cuyama as well as the surrounding agricultural land uses that are located in areas with greater than 2 feet overdraft. The Central Management Area has been updated for the 2025 GSP by utilizing the updated 2024 CBWRM. While the Cuyama Community Service District (CCSD) service area also has modeled

[12] SGMA's requirements for GSPs can be read here: https://water.ca.gov/LegacyFiles/groundwater/sgm/pdfs/GSP_Emergency_Regulations.pdf

overdraft exceeding 2 feet, it is not included in the management area because it is a domestic user of relatively small quantity (i.e., about 150 AFY).

7.2.2 Ventucopa Management Area

The Ventucopa Management Area is located south of the Central Management Area and includes the community of Ventucopa. The 2020 GSP noted that the CBGSA intended to re-evaluate the need for pumping reductions in the Ventucopa region of the Basin after further evaluating groundwater conditions over a two-to-five-year period following submission of the GSP. At this time, the CBGSA still believes that it is premature to prescribe pumping reductions in the Ventucopa region on the basis of CBWRM model results because the development of the model in that portion of the Basin posed significant challenges:

- Limited groundwater level data was available for model calibration. Only three calibration wells were available in that area of the Basin (wells 62, 85, and 617). Since submission of the GSP, a new multi-completion monitoring well has been installed in the area, which will provide additional information for model calibration going forward.
- Characterization of streamflows and their effect on the groundwater aquifer was challenging because there were no streamflow gages on the Cuyama River with measurements taken during the calibration period and limited information was available regarding stream geometry in the region. Since submission of the GSP, a new streamflow gage has been installed on the Cuyama River upstream of the Ventucopa region.
- Groundwater pumping levels in the region were based on estimates from available land use information. However, unlike the central area of the Basin, cropping patterns in this portion of the Basin were not provided by local landowners but were instead estimated using satellite imagery. Furthermore, specific well locations were not available in this portion of the Basin. The CBGSA has addressed these shortcomings through the requirement of landowners to install meters on production wells and to report well information starting in calendar year 2022.
- The magnitude of water budget estimates in the region were relatively small as compared to the Basin as a whole, which meant that a small change in the estimate for a single water budget component could have a large effect on the estimated change in storage (and corresponding estimates of long-term groundwater elevation change). In particular, some Basin stakeholders have raised a concern that the model may be underestimating stream seepage into the aquifer in this stretch of the Cuyama River.
- Due to time and budget constraints during GSP development, model development and calibration prioritized development of an accurate representation of the central portion of the Basin's portion of the aquifer (where long-term overdraft was known to occur) with lesser emphasis on other parts of the model. The primary model calibration objective during CBWRM development of the Ventucopa region was to ensure that groundwater levels matched historical trends at the boundary of the central portion of the Basin and Ventucopa region.

In light of the uncertainties, and lack of sufficient data on the water budget components to verify the model projected water budget, the CBGSA determined that implementing a management action in the region at this stage may be premature. Instead, the CBGSA is determined to continue to compile and analyze additional data and information on groundwater levels, surface water flows, groundwater pumping, as well as information on channel geometry and subsurface conditions. This information will be used to further enhance the capabilities of the model for analysis of projected water budgets and groundwater conditions in the region, and to determine possible management actions to address any possible projected overdraft conditions. As noted above, the CBGSA plans to develop a management plan for the Ventucopa Management Area in the future, which may or may not provide for pumping restrictions.

Northwestern Region (Not a Management Area)

In the northwestern region, management actions were not included in the GSP because the available information did not indicate a projected overdraft in that region. The following information was considered during development of the 2020 GSP, and continues to be relevant for this updated 2025 GSP:

- The CBWRM model indicated a balance between groundwater inflows and outflows in the region in all of the water budget scenarios that were simulated.
- The Cleath-Harris Geologists (CHG) document Sustainability Thresholds for Northwestern Region, Cuyama Valley, dated December 7, 2018, developed under contract with the North Fork Vineyard. This document identified minimum thresholds for this area that would be protective of groundwater pumping capacity for production wells in this area. CHG proposed minimum thresholds for the region would result in a twenty percent reduction in the saturated thickness screened by the production wells, which would produce a similar reduction in transmissivity and pumping capacity of the production wells. As discussed above, the CBGSA set thresholds that are somewhat more conservative than this, representing a fifteen percent reduction in saturated thickness.

The technical analyses described in Section 5.2 regarding Potential Corrective Action 1 indicates that the potential drawdown due to the minimum thresholds set for wells 841 and 845 could have a small effect on GDEs and domestic wells in the area. However, the thresholds set in the monitoring wells located in the vicinity of these Basin resources are set at protective levels that would be indicative of any issues that may arise, allowing the CBGSA to make an appropriate adaptive management response (Section 7.6). Therefore, the available evidence indicates that management actions are not required in this region at this time.

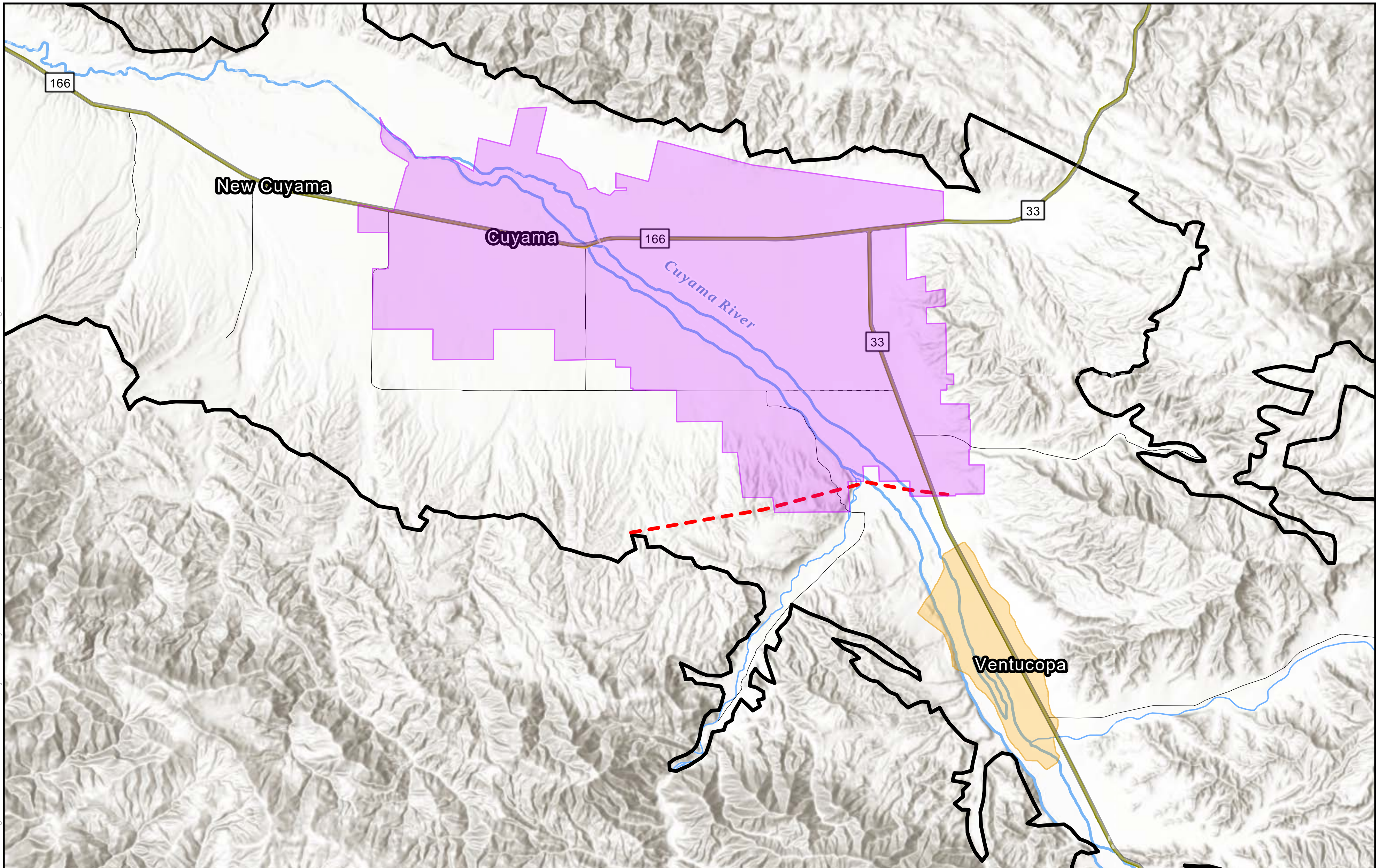

Figure 7-01: CBGSA Management Areas

Cuyama Valley Groundwater Basin

Legend

Central Management Area
Ventucopa Management Area
Highway
Local Road
Town
Creek
Cuyama River
Cuyama Basin

N

0 0.5 1 2 Miles

Map Created: January 2025

7.3 Overview of Projects and Management Actions

The CBGSA evaluated a range of potential projects and management actions to help address overdraft and move the Basin toward sustainability. Evaluation of the identified projects and management actions resulted in a set of proposed activities in the first approved GSP. These activities are shown in Table 7-1, along with their current status, potential timing, and estimated costs.

This list of activities has since been updated and expanded throughout implementation. Each annual reported included an updated version of Table 7-1, and new projects and management actions have been added. A more through description of each activity, including benefits and justification, are discussed in Sections 7.4 and 7.5.

Table 7-1: Proposed Projects, Management Actions, and Adaptive Management Strategies

Activity	Current Status	Anticipated Timing	Estimated Cost[a]
Project 1: Flood and Stormwater Capture	Water rights analysis of potential water supplies currently underway	• Feasibility study: 0 to 8 years • Design/Construction: 8 to 15 years	• Study: $1,000,000 • Flood and Stormwater Capture Project: $600-$800 per AF ($2,600,000 – 3,400,000 per year)
Project 2: Precipitation Enhancement	Feasibility Study completed in August 2024	• Refined project study: 0 to 8 years • Implementation of Precipitation Enhancement: 8 to 15 years	• Study: $200,000 • Precipitation Enhancement Project: $25 per AF ($150,000 per year)
Project 3: Water Supply Transfers/Exchanges	Not yet begun	• Feasibility study/planning: 0 to 8 years • Implementation in 8 to 15 years	• Study: $200,000 • Transfers/Exchanges: $600-$2,800 per AF (total cost TBD)
Project 4: Improve Reliability of Water Supplies for Local Communities	In progress for CCSD; not yet begun for other communities	• Feasibility studies: 0 to 5 years • Design/Construction: 5 to 7 years	• Study: $100,000 • Design/Construction: • $1,800,000
Project 5: Flow Meter Calibration Program	Not yet begun	• Implementation: 0 to 6 years	• $50,000 for program setup • $2,500 per meter per year (100 meters) = $250,000
Management Action 1: Basin-Wide Economic Analysis	Completed	December 2020	$60,000

Activity	Current Status	Anticipated Timing	Estimated Cost[a]
Management Action 2: Pumping Allocations in Central Management Area	Allocations developed and implemented for 2023 and 2024	• Allocations implemented: 2023 through 2040	• Plan: $300,000 • Implementation: $150,000 per year
Adaptive Management	Board ad-hoc committee has been formed and is considering potential actions	Only implemented if triggered; timing would vary	TBD
[a] Estimated cost based on planning documents and professional judgment AF = acre-feet			

7.3.1 Addressing Sustainability Indicators

The projects would contribute toward eliminating the projected groundwater overdraft described in the Chapter 2's Water Budget section and in maintaining groundwater levels above those identified in Chapter 5 by reducing groundwater pumping or enhancing net recharge into the groundwater aquifer. The sustainability indicators are measured directly or by proxy, with groundwater elevation used as either the direct or proxy indicator for all sustainability indicators with the exception of water quality and subsidence. Table 7-2 summarizes of how the projects and management actions in this GSP will address the applicable sustainability indicators for the Basin. Seawater intrusion is not applicable to the Basin, due to distance from the Pacific Coast.

Physical benefits of the projects and management actions in the GSP are described under each project and action in Section 7.4 and Section 7.5, below.

Table 7-2: Summary of How Projects and Management Actions Address Sustainability Indicators

Activity	Sustainability Indicator				
	Chronic Lowering of Groundwater Levels	Reduction of Groundwater Storage	Degraded Water Quality	Subsidence	Depletions of Interconnected Surface Water
Project 1: Flood and Stormwater Capture	Would increase recharge in the Basin, directly contributing to groundwater levels.	Would increase recharge in the Basin, directly contributing to groundwater storage.	Would contribute to groundwater levels through increased recharge, reducing groundwater quality degradation associated with declining groundwater levels.	Would support maintaining groundwater levels in the Basin, reducing potential for subsidence.	Increasing groundwater recharge with flood and stormwater capture would reduce the potential for groundwater levels to decline and negatively impact surface water flows.
Project 2: Precipitation Enhancement	Increases precipitation and associated groundwater recharge; reduces groundwater pumping because increased precipitation would reduce irrigation needs.	Increases volume of stored groundwater; reduces groundwater pumping	Would increase groundwater recharge, reducing groundwater quality degradation associated with declining groundwater levels.	Reduced groundwater pumping and increased groundwater recharge reduces the cause of subsidence	Would increase surface water flows in the Basin and increase groundwater recharge, which together would reduce the potential for negative surface water flow impacts associated with decreasing groundwater levels.
Project 3: Water Supply Transfers/Exports	Would allow for increased stormwater capture without interfering with downstream water rights, directly contributing to groundwater levels.	Would allow additional groundwater recharge of stormwater, directly contributing to groundwater storage.	Would allow for increased groundwater recharge, reducing groundwater quality degradation associated with lowering of groundwater levels.	Would increase potential groundwater recharge, reducing the potential for subsidence.	Would increase groundwater recharge, which would reduce the potential for negative surface water flow impacts associated with decreasing groundwater levels.
Project 4: Improve Reliability of Water Supplies for Local Communities	Would provide an alternate pumping supply for CCSD, CMWC and VWSC customers to reduce water supply reliability issues caused by historical groundwater level reductions in the Basin.	N/A	Provides for improved water quality in the potable water system, and through construction of compliant wells, reduces potential for groundwater quality impacts of improperly designed/constructed wells and failing wells within CCSD and VWSC systems.	N/A	N/A
Project 5: Flow Meter Calibration Program	Would provide irrigation pump operators more accurate flow data to reduce accidental over pumping and better comply with pumping allocations	Would reduce potential unintentional over-pumping directly contributing to groundwater storage.	Could decrease potential unintentional over-pumping and reducing groundwater extraction therefore reducing groundwater quality degradation associated with declining groundwater levels.	Could mitigate unintentional groundwater extraction, reducing the potential for subsidence.	Could decrease potential unintentional over-pumping and reducing groundwater extraction therefore reducing groundwater quality degradation associated with declining groundwater levels.
Management Action 1: Basin-Wide Economic Analysis	Would evaluate the long-term economic impacts of project implementation, which will allow the region to plan for economic changes if implementation is pursued and help avoid economically catastrophic decision-making that could result in dramatic changes to groundwater use and levels.				
Management Action 2: Pumping Allocations in Central Management Area	Would limit groundwater pumping, with allocations decreasing over time until groundwater pumping reaches sustainability	Reducing groundwater pumping will help decrease the reduction of groundwater storage associated with high levels of pumping.	Reducing groundwater pumping will help alleviate groundwater degradation associated with lowering of groundwater levels.	Reduced groundwater pumping would reduce the risk of subsidence associated with lowering of groundwater levels.	Reduced groundwater pumping would help protect groundwater levels, thereby reducing the potential for negative impacts to surface water flows associated with lowering groundwater levels.
Adaptive Management	Adaptive management actions would be triggered if groundwater levels decrease sufficiently or do not demonstrate adequate recovery as projects are implemented. Adaptive management projects that are implemented would be selected because they would help address these sustainability indicators.				

Notes:
CCSD = Cuyama Community Services District
CMWC = Cuyama Mutual Water Company
VWSC = Ventucopa Water Supply Company

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7.3.2 Overdraft Mitigation

The projects and management actions would support maintenance of groundwater levels above minimum thresholds through increased recharge or through reductions in pumping. Overdraft is caused when pumping exceeds recharge and inflows in the Basin over a long period of time. Improving the water balance in the Basin will help to mitigate overdraft.

7.3.3 Water Balance Management for Drought Preparedness

Communities in the Basin rely on groundwater to meet water needs. During drought, groundwater becomes more important due to limited precipitation. Projects that support groundwater levels through increased recharge help to protect groundwater resources for use during future drought, as well as help protect the Basin from the impacts of drought on groundwater storage. Projects that reduce pumping will help manage the Basin for drought preparedness by reducing demands on the Basin both before and during drought, supporting groundwater levels in non-drought years, and decreasing the impacts of drought on users, reducing the need to increase pumping when precipitation levels are low.

7.4 Projects

Projects included in this GSP are generally capital projects that could be implemented by the CBGSA or its member agencies on a volunteer basis that provide physical benefits to enhance supplies.

7.4.1 Flood and Stormwater Capture

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. Spreading basins are generally more affordable than injection wells because water does not need to be treated prior to recharge into the Basin. While specific recharge areas have not yet been selected, areas of high potential for recharge were identified north and east of the Cuyama River near the Ventucopa Management Area, as well as in select areas of the Central Management Area. It is likely that locating spreading facilities near the Cuyama River represents the easiest method of capturing and recharging flood and stormwaters. Agricultural lands may be used in lieu of or in addition to specialized spreading facilities, or installation of "mini dams" on the Cuyama river to slow flows and increase in-stream recharge. The likeliest of these flood and stormwater capture and recharge options to be implemented is the use of spreading basins, because it will maximize volumes of water captured and recharged into the groundwater basin. Agricultural spreading is usually achieved through intentional overirrigation; in the Basin, agricultural irrigation uses groundwater, and new facilities would still be required to implement agricultural spreading that would not negatively impact groundwater levels. Mini dams could have negative environmental impacts and would not capture as much flow as dedicated spreading basins.

This project would include development of a feasibility study to identify specific flood capture and recharge locations and to refine the potential yield and cost, as well as determine the downstream impacts of implementation and how to address those potential impacts.

Current Status

The CBGSA received SGMA implementation grant funding from DWR to help understand the feasibility of future flood and stormwater capture. Specifically, the funding was sought to perform a water rights analysis on flood and stormwater capture flows in the Basin to understand the feasibility of further developing a stormwater capture project in the Basin given water availability and existing water rights. An analysis was performed using Lake Twitchell historical operations data to identify historical periods in which there were managed releases at the lake and therefore water could be diverted upstream without impacting water storage in the lake. This analysis indicated that upstream diversions could be made in approximately 11% of all years (i.e. 7 out of 62 years from 1962-2023). The CBGSA intends to perform additional analyses following submittal of the 2025 GSP to assess the feasibility of implantation of a flood and stormwater capture project. Updates on this project will continue to be included in Annual Reports and future GSP updates.

Public Notice and Outreach

Project notice and outreach would likely be conducted during implementation of a flood and stormwater capture project. Some of this outreach would likely occur as part of the California Environmental Quality Act (CEQA) process (see below), though additional outreach may be conducted depending on public perception of the proposed project. Public notice and outreach is not anticipated during development of the feasibility study, beyond potential outreach to landowners whose property is identified as potential sites for spreading facilities.

Permitting and Regulatory Processes

Completion of a feasibility study would not require any permits or regulatory approvals beyond approval of the governing board for the agency funding the study or contracting with any potential consultant who may be retained to complete the analysis.

Implementation of a flood and stormwater capture and recharge project would require construction permits, streambed alteration agreements from the California Department of Fish and Wildlife for diversions from the Cuyama River, CEQA compliance, and potential 401 permits from U.S. Army Corps of Engineers. Additional permits may be required to complete construction and initiate operation of spreading facilities. The CBGSA would need to secure easements to or purchase the land for the spreading facilities. Additionally, the CBGSA may need to obtain surface water rights agreements from the California State Water Resources Control Board. Any water rights would need to address water rights existing downstream water rights.

Project Benefits

Implementation of flood and stormwater capture projects would provide additional infiltration into the Basin, which would increase the volume of groundwater in the Basin, reducing overdraft and increasing available supply. The 2015 *Long Term Supplemental Water Supply Alternatives Report* (Santa Barbara County Water Agency [SBCWA], 2015), completed an analysis of potential stormwater recharge options along multiple rivers in Santa Barbara County, including Cuyama River. The analysis assumed the Cuyama River would experience sufficient flows for stormwater recharge three of every 10 years, and a maximum available stormwater volume during those events as 14,700 acre-feet (AF). Capturing this volume of water would require 300 acres of land for spreading facilities, and could provide up to 4,400 acre-feet per year (AFY) of stormwater (averaged over 10 years), assuming the maximum event year supply is captured. As noted above, the analysis that was recently conducted of inflows into Lake Twitchell indicate that flows could be diverted approximately once every eleven years; therefore, the actual benefits would likely be lower. Benefits of an implemented floodwater/stormwater capture project would be measured by the volume of flow entering the spreading facility, less an assumed percentage of evaporative loss.

Actual benefits could be lower once evaporative loss is accounted for, and if the final design for spreading facilities is not sized for the maximum storm event, or if the maximum event year is not realized as frequently as anticipated. If coupled with precipitation enhancement (see Section 7.3.2), additional benefits may be realized, though some overlap in benefits may occur.

Project Implementation

The circumstance of implementation for a flood or stormwater capture project would be if the refined feasibility study recommends a project and finds it is both cost effective and would result in a meaningful volume of incremental supply.

Implementation of spreading facilities for stormwater capture would require land acquisition, construction of spreading facilities, diversion from Cuyama River, and associated pipelines and pumps. If pursued, the CBGSA anticipates implementing the project either directly or through one of its member agencies.

Supply Reliability

The success of a flood and stormwater capture project depends on the frequency of precipitation events that result in sufficient flows for capture and recharge, the recharge capacity of the spreading facilities, and the location of flows in relation to the diversion point to the spreading facilities. Rainfall is generally limited to November through March in the region, and total rainfall is low, averaging 13 inches over the last 50 years (see Water Budget section of Chapter 2). The project would allow for the limited surface water flows to be captured and used, and if implemented, a flood and stormwater capture project would improve supply reliability in the Basin by increasing groundwater recharge, allowing more water to be available to Basin users.

Legal Authority

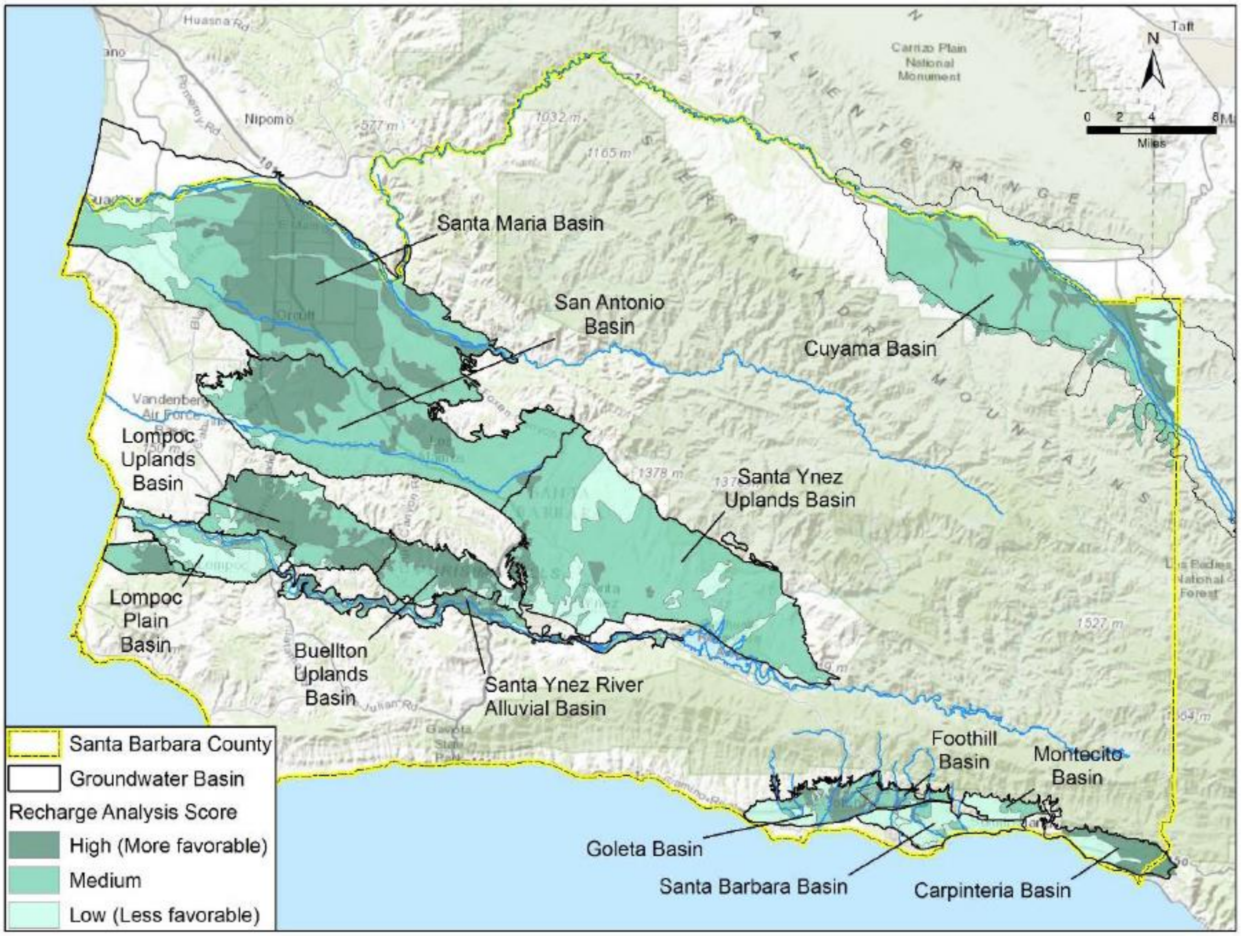
The CBGSA, through its member water supply agencies, has the legal authority to develop a flood and stormwater capture project. The CBGSA does not have the authority to increase its stormwater capture at a level that would impede downstream senior water rights holders from accessing their water rights.

Project Costs

Implementation costs would vary depending on the ultimate size and location of the spreading facilities, and any compensatory measures required for downstream users. Per acre-foot costs would also vary depending on the amount of stormwater captured and successfully recharged. The primary cost for implementation of spreading facilities is the land purchase cost. Because the project would capture flood and stormwater (as opposed to imported or purchased water), there would be no supply costs to operate the project. The 2015 report estimated flood and stormwater capture and recharge from Cuyama River using spreading basins would cost $600 to $800 per AF (SBCWA, 2015).

Technical Justification

The use of spreading facilities for groundwater recharge is common in many areas across the state where groundwater basins are used for storage. The 2015 *Long Term Supplemental Water Supply Alternatives Report* (SBCWA, 2015) provides the basis for the estimated maximum volume of water that could be recharged by a flood or stormwater capture and recharge project. The storage potential of the Basin is based on the highest historical storage less the current storage, with the difference being unused storage potential. The Cuyama Basin has a high storage potential, greater than 100,000 AF, meaning it would be able to accommodate recharge of more than 100,000 AF. The size of the spreading facilities is based on the volume of water available for capture, and the recharge factor of a proposed site. The volume of water that could be recharged is based on the volume of water that could be diverted off of the river during peak storm flow events. Recharge potential was determined by analyzing the existing groundwater depth and hydrological soil type, and infiltration rates based on relative infiltration rate for hydrologic soil groups. High recharge potential were areas with hydrologic soils in group A/B, and had infiltration rates of 0.6 feet per day. As shown in Figure 7-2, the majority of the Basin located in Santa Barbara County has medium or high potential for groundwater recharge, with the highest potential east of the Cuyama River in the Ventucopa Management Area. The 2015 report was limited to Santa Barbara County and does not cover the portions of the Basin located in Ventura, San Luis Obispo, and Kern counties.



Source: SBCWA, 2015

Figure 7-2: Groundwater Recharge Potential in Santa Barbara County

The 2015 report recommended additional studies to refine the high-level analysis in the report. Under this project, the CBGSA would develop a study to refine the areas of potential recharge, including areas of the Basin with potential to provide land for spreading facilities that were excluded from the 2015 report due to being located outside of Santa Barbara County. The feasibility study would, calculate the potential evaporative loss, evaluate alternatives to determine the preferred size and location of spreading facilities, refine costs for the alternatives, and calculate the potential supply from implementation of the preferred alternative.

Basin Uncertainty

This project would take advantage of the uncertain rainfall in the region and capture it for future use when precipitation levels are high. This would help bolster groundwater supplies and improve supply reliability in the Basin.

CEQA/NEPA Considerations

The feasibility study would not trigger CEQA or National Environmental Policy Act (NEPA) actions because it does not qualify as a project under either program. If a flood and stormwater capture project is implemented, CEQA would be required and completed prior to construction. NEPA would only be required if federal permitting, such as a 401 permit from U.S. Army Corps of Engineers, or if federal funding is pursued.

7.4.2 Precipitation Enhancement

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). Based on the findings of the *Feasibility/Design Study for a Winter Cloud Seeing Program in the Upper Cuyama River Drainage, California* (SBCWA, 2016), such a program would use both ground-based seeding and aerial seeding to improve the outcomes of the program. Ground-based seeding would be conducted using remote-controlled flare systems, set up along key mountain ridges and could be automated. Aerial seeding would use small aircraft carrying flare racks along its wings to release silver iodide into clouds while flying through and above them.

Precipitation enhancement modeling assumed cloud seeding would increase precipitation by 10 percent from November through March, the time of the year with highest potential for rainfall in the Basin, for an average annual increase in precipitation of about 16,000 AF. With this assumption regarding precipitation increase, the numerical modeling estimated that an increase of 1,500 AF of additional annual average supply within the Basin over 50 years could be achieved. The portion of the increased precipitation would potentially benefit areas downstream of the Cuyama Basin.

This project would complete a detailed study to refine the potential yield and cost of implementation in the Basin.

Current Status

The CBGSA received SGMA implementation grant funding to perform a study to help understand the benefits of a potential precipitation enhancements project and help determine if this action should be pursued and implemented in the Basin. The CBGSA contracted with the Desert Research Institute (DRI) to assess cloud seeding effects on Santa Barbra County and the Cuyama Valley. A proposal was submitted in September 2023 and work was initiated in October 2023. The final report is expected to be competed in October 2023.

Public Notice and Outreach

Completion of the study included status updates at several CBGSA board meetings. The final results of the study were presented at the January 2025 board meeting. At this time, the CBGSA has not approved the implementation of a precipitation enhancement project is pursued for implementation, but if it is pursued in the future the project would not require public notice or outreach, except for approval by a governing body for the CBGSA that would occur in a public meeting.

Permitting and Regulatory Processes

Completion of a study to refine the feasibility of a precipitation enhancement project did not require any permits or undergo a regulatory process. If a precipitation enhancement project is pursued for implementation, it is expected to be implemented under the existing SBCWA program, and would be covered under existing permits for that program.

Project Benefits

The *Feasibility/Design Study for a Winter Cloud Seeing Program in the Upper Cuyama River Drainage, California* (SBCWA, 2016) found that cloud seeding activities both in the region and in other locations around the world resulted in increased precipitation. This increase was found to be an increase in duration, rather than intensity. The existing cloud seeding program in Santa Barbara County was estimated to increase precipitation between 9 and 21 percent between December and March. The feasibility study estimated average seasonal increases of 5 to 15 percent if this program is implemented.

Based on a 10 percent increase in precipitation between November and March, modeling demonstrates an average annual benefit of 1,500 AF per year could be achieved over a 50 year period. This includes an annual average of 400 AF of deep percolation, 400 AF available in stream seepage, and 700 AF in boundary flow. There would also be an average annual increase in Cuyama River outflow of 2,700 AF. Figure 7-3 shows the potential long-term benefits of a precipitation enhancement program. Actual benefits would be measured by evaluating rainfall data after seeding compared to long-term average rainfall in non-seeded years.

The project would complete a refined feasibility study to determine the expected precipitation yield and costs of a precipitation enhancement project. Expected benefits would be refined in that study, prior to the CBGSA making a decision to implement a precipitation enhancement program.

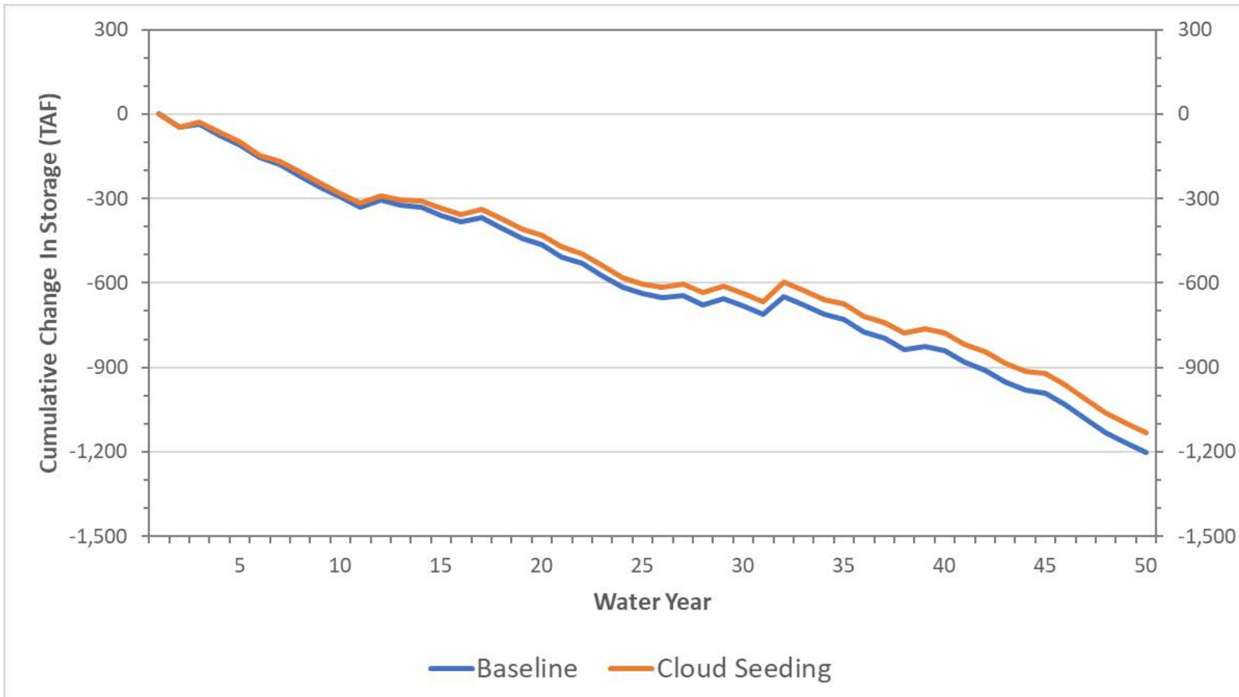


Figure 7-3: Potential Change in Groundwater Storage from Precipitation Enhancement

Project Implementation

The circumstance of implementation for a precipitation enhancement project would be if the refined project study determines it is a cost-effective measure likely to result in meaningful increases in precipitation in the Basin. The circumstance of implementation for the refined study is current conditions, where the CBGSA is ready to consider implementation of precipitation enhancement to support reduced overdraft in the Basin.

Implementation of this project would require installation of two or three additional ground-based seeding sites, referred to as an Automated High Output Ground Seeding System (AHOGS). Each AHOGS site would include:

- Two flare masts, which each hold 32 flares and includes spark arrestors to minimize fire risk
- A control box with communications system, firing sequence relays and controls, data logger, and battery
- A solar panel/charge regulation system to power the site
- Cell phone antenna

- Lightning protection

Aerial seeding would require outfitting the appropriate plane with flare racks.

Implementation of this project would likely be achieved by incorporating it into the existing precipitation enhancement activities being implemented by the SBCWA. Because implementation would be achieved through an existing program, the CBGSA does not anticipate needing to purchase and install new models or control systems beyond those necessary for the additional seeding sites and equipment.

Supply Reliability

Precipitation enhancement has been shown to provide measurable benefit to regions when implemented thoughtfully. Although the amount of precipitation increase that the project could provide is uncertain, evidence suggests potential for an average annual increase of 0.5 to 2.5 inches if this project is implemented (SBCWA, 2016), which would help to improve overall supply reliability in the Basin by increasing precipitation, reducing the need for groundwater pumping and increasing groundwater recharge. This project is not dependent on existing supplies or imported supplies for successful implementation and benefits to the Basin.

Legal Authority

The project would be implemented by the SBCWA, one of the member agencies of the CBGSA. The SBCWA already implements precipitation enhancement in the region, and has the legal authority to expand the program within its service area, which includes the Basin.

Project Costs

The 2016 *Feasibility Study* (SBCWA, 2016) recommended installing two or three AHOGS units for ground-based seeding. Each AHOGS unit would cost $30,000 to build and test, and between $4,000 and $6,000 each to install. Annual maintenance was estimated at $10,000 each. There would be minimal costs associated with initiating aerial seeding for the Basin because it would be implemented as part of the existing precipitation enhancement efforts in the region. Operational costs for aerial seeding would include flight costs ($550 per hour in 2016), and the cost of the seeding flares. Seeding flares in 2016 cost $90 apiece, and up to 50 flares used aerially and approximately 25 flares per AHOGS site in the four-month project period. Annual set-up, take-down, and reporting costs for this project are estimated at $15,000 for a combined ground-based and aerial seeding effort for the Basin, as well as personnel costs of $5,000 per month.

The 2015 *Feasibility Study* estimated that ground-based seeding would cost $45,500 to $67,500 for four months, and aerial seeding would cost $37,750 for four months, assuming that aircraft costs are funded by the existing program.

Total costs are expected to be between $20 and $30 per AF of water under this project, though exact costs would depend on the success of the program in a given year, and market conditions for project materials and aircraft time.

Technical Justification

Cloud seeding as a concept has existed for decades, and target nucleation of supercooled water droplets that exist in clouds. Supercooled water is water that has been cooled below freezing temperatures (0 degrees Celsius or 32 degrees Fahrenheit), but remains in liquid form, rather than frozen. Supercooled water above -39 degrees Celsius must encounter an impurity to freeze, referred to as freezing nuclei. In the 1940s, particles of silver iodide were discovered to be able to cause freezing of supercooled water droplets in clouds. Silver iodide is the most common freezing nuclei used for cloud seeding in which silver iodide is injected into clouds to promote precipitation. A research program in Santa Barbara County on cloud seeding was conducted in the 1960-70s in which silver iodide was released into "convective bands" as random "seeded" or "non-seeded" (no iodide) convective bands, and resulting precipitation measured by a large network of precipitation gauges. This study evaluated both ground-based seeding and seeding by aircraft. Both methods found seeding resulted in a large area of increased precipitation. Additional studies in other regions in the 1990s found that additional precipitation from cloud seeding was a result of the increased duration of the precipitation event, rather than an increase in intensity. Cloud seeding has been conducted most winters since 1981 in portions of Santa Barbara County, which have had an estimated benefit of 9 to 21 percent increase in precipitation. The 2016 *Feasibly Study* for precipitation enhancement in the Upper Cuyama River Basin estimated a potential 5 to 15 percent increase in rainfall if a seeding project was implemented (SBCWA, 2016).

Basin Uncertainty

This project would improve precipitation yields in the Basin, helping to reduce the impacts of variable precipitation and providing for increased opportunities for groundwater recharge and stormwater capture. Further, increased precipitation duration and yields would reduce demands for groundwater for irrigation, reducing the risk of crop failure associated with water supply reliability challenges.

CEQA/NEPA Considerations

If this project is implemented, it is anticipated to be incorporated into the existing cloud seeding program implemented by SBCWA. The existing seeding program achieved CEQA coverage under the Santa Barbara Mitigated Negative Declaration (MND), finalized in 2013. This project would achieve CEQA coverage either under this existing MND, or Santa Barbara Water Agency would be required to prepare an addendum to the MND to incorporate the Cuyama Basin target area for the seeding program. Unless the project pursues federal funding, NEPA is not anticipated to be required.

7.4.3 Water Supply Transfers/Exchanges

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. The study would be coordinated with the floodwater and stormwater capture in Section 7.3.1, as the feasibility of such an exchange would affect the maximum volumes of stormwater that would be captured under that project. If the feasibility study finds there is limited interest from downstream users, implementation would not be pursued.

Current Status

No progress was made toward implementation of this project since completion of the GSP in January 2020. This project will be explored if Project 1 mentioned above: flood and stormwater capture was feasible but greater volumes of water are desired.

Public Notice and Outreach

Public noticing would not be required for the feasibility study though outreach would be conducted as part of the study to determine willingness of downstream users to participate in an exchange.

Permitting and Regulatory Processes

No permits or regulatory processes would be necessary for development of the feasibility study. Agreements would need to be executed to secure additional water supply for use in a transfer/exchange, as well as to exchange water with downstream users. No other permits are anticipated to be required to implemented water transfers/exchanges.

Project Benefits

Implementation of a water transfer/exchange program would allow the CBGSA to increase stormwater capture if the Flood and Stormwater Capture project (see Section 7.3.1) is implemented because it would reduce the potential water rights conflicts that could arise from increased stormwater capture. The Basin does not have a physical connection to supplies outside the Basin and is therefore limited in the types of projects that could be implemented to increase supplies. This project would allow the CBGSA to maximize the new water supply that could be available to the Basin if flood and stormwater capture is implemented. This project would be limited to the feasibility study and would not have direct benefits. If a water transfer/exchange program is implemented as a result of the outcomes of the feasibility study, benefits would be measured by the successful execution of transfer/exchange agreements and the increased capacity of the stormwater capture and spreading facilities made possible by these agreements.

Water supply benefits would be measured by the volume of water captured above the volume that would have been allowed had the transfer/exchange agreements not been implemented.

Project Implementation

The circumstance for implementation of the feasibility study would be exploration of the feasibility of flood and stormwater capture and recharge (see Section 7.3.1). Implementation of this project would occur if downstream users expressed interest in participation in water transfers/exchanges and the feasibility study determined the potential increase in supply that transfer/exchanges would provide is cost effective for achieving supply reliability and groundwater sustainability goals.

The CBGSA would develop the feasibility study in coordination with the Flood and Stormwater Capture Project's feasibility study. Based on the outcomes of the two feasibility studies and the level of interest of downstream users, the CBGSA would determine whether implementation of a transfer/exchange project is a preferred action for the CBGSA. Implementation of the transfer/exchange program would entail coordination amongst participants: the CBGSA, agencies who own the water to be used in the transfer, and downstream users who participate in the exchange.

Supply Reliability

Transfers and exchanges would require access to a reliable water supply from outside the Basin currently owned by an agency that has sufficient water rights to be willing to sell a portion of their water to the CBGSA for this project. Because this project would be used to increase the capacity of the stormwater capture project, benefits would be experienced only following a heavy precipitation event. It is likely that in years with large precipitation events, other parts of the state will also experience wet winters, increasing available supplies from sources like the State Water project, or other surface water supplies. The feasibility study would require an evaluation of supply reliability and explore the potential mechanisms for a successful transfer/exchange program that would account for the uncertainty of precipitation events on a year-to-year basis and available supply and potential benefit to the Basin.

Legal Authority

The CBGSA, through its member water supply agencies, has the legal authority to enter into transfer and exchange agreements with other water suppliers and users. The CBGSA does not have the authority to increase its stormwater capture at a level that would impede downstream senior water rights holders from accessing their water rights, making this project a critical component of an expanded capacity stormwater project (beyond what could be achieved without this project).

Project Costs

A feasibility study would likely cost between $100,000 and $200,000 to complete, including outreach to downstream water users and potential sources of supply for the transfer/exchange program. Costs to implement a transfer and exchange program would be evaluated in the feasibility study and are estimated to range from $600 to $2,800 per AF. Costs would vary depending on the details of the transfer/exchange, source of new water, and parties involved.

Technical Justification

A transfer/exchange program would be at minimum a one-to-one exchange, meaning for each AF of water provided to downstream users through the program, the CBGSA could capture an additional AF of stormwater. The feasibility study would identify which supplies could be purchased to exchange with downstream users, based on supply availability, connectivity to downstream users, willingness of supply owners to participate, and cost. One purpose of the feasibility study would be to determine a preferred alternative for the transfer/exchange program and provide a technical justification of the preferred program. If technical justification cannot be made, the program would be considered infeasible and would not be pursued.

Basin Uncertainty

The transfer/exchange project would help address uncertainty in the basin by allowing the CBGSA to increase groundwater recharge, using years with surplus surface water flows to supplement groundwater during dry years by increasing the volume of stormwater that can be captured without interfering with downstream users' water rights.

CEQA/NEPA Considerations

Development of a feasibility study would not trigger CEQA or NEPA. Water exchanges or transfers are not anticipated to include construction of new facilities. However, since a water exchange or transfer is a discretionary action, they are likely to be considered projects under CEQA or NEPA. NEPA documentation may be required if any of the water being exchanged or transferred is federal agency (i.e. Bureau of Reclamation of Corps of Engineers).

7.4.4 Improve Reliability of Water Supplies for Local Communities

The Basin is experiencing overdraft in the central portion of the Basin and Ventucopa areas, which are the population centers of the Basin. Domestic water users in these areas are experiencing water supply reliability challenges, and in the 2012-2016 drought experienced well failures. While the following actions would not affect the water budget in the Basin, they are intended to address ongoing water supply reliability issues affecting these communities. 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. Specific information would be coordinated with the respective community water system entities and is therefore not available for this GSP.

Current Status

Since the 2020 GSP adoption, DWR's IRWM program awarded the CCSD a grant to install a new production well. Work by the CCSD to install the new well is ongoing.

CCSD Replacement Well

The CCSD Replacement Well would drill a new well in CCSD's service area to replace Well 2, which has been abandoned due to an electrical failure that damaged the well and pumping equipment and subsequent damage the well incurred when an attempt was made to remove the pump. Previously, a replacement well for Well 2 was attempted, but found to produce water that was unsuitable for potable use due to the design and construction of the well. Construction of the new well is expected to be completed soon and would include:

- Drilling, installing, and testing a new well
- Installing a well head, submersible well pump, and electrical panel
- Construction of an 8-inch pipeline to connect the new well to CCSD's system

Ventucopa Well Improvements

The Ventucopa Well Improvements would construct a new water supply pump, pipelines, and meters for the existing Ventucopa Well 2 and seek approval for the well's use for drinking water from the County of Santa Barbara's Department of Health Services (DHS). These improvements would:

- Install a pump, electrical service, and controls at Well 2
- Construct an 8-inch pipeline from Well 2 to Ventucopa's existing hydropneumatics tank
- Install meters at Well #1 and Well 2
- Install a SCADA system for Well 2
- Install piping, valves, and inline mixer to blend water from Well 1 and Well 2

Public Notice and Outreach

Public notice and outreach would not be required beyond that necessary for approval at a public Board of Directors meeting or applicable CEQA.

Permitting and Regulatory Processes

CCSD's new well construction would require acquisition of a well drilling permit and approval of well design and well completion report. It would also require well testing that demonstrates the new well is capable of producing water that is suitable for drinking water. In addition to a well drilling permit from

Santa Barbara County, CCSD's existing water system permits would need to be revised to include the new well and associated features.

Improvements to VWSC's well would require compliance with Santa Barbara County's regulations for water systems in the unincorporated county. VWSC would need to acquire the appropriate well drilling permits from the County as well as receive DHS certification of the suitability of the upgraded well for potable use before water from Well 2 can be delivered to customers.

Project Benefits

These projects would improve supply reliability for Ventucopa and CCSD residents and customers by creating system redundancies and upgrades to address challenges with meeting existing demands associated with aging and failing infrastructure. As planned, up to 460 gallons per minute could be made available to CCSD and up to 55 gallons per minute available to VWSC as a result of this project. Benefits of this project would be measured by the volume of water produced by the two improved wells and reduction in the number of days system failures threaten access to water supplies.

Project Implementation

The circumstance of implementation for this project is identified need for system improvements to meet public health and safety concerns. Both CCSD and VWSC have documented challenges with their water supply systems, including lack of redundancy, wells that do not adequately meet domestic water supply requirements, and limited capacity (CCSD, 2018; VWSC, 2007).

The two components of this project would be implemented by their respective system owners, CCSD and VWSC. CCSD is responsible for planning, design, construction, testing, and permitting of the new Well 4, while VWSC would be responsible for planning, design, construction, testing, and permitting of the Well 2 improvements.

Supply Reliability

This project would improve supply reliability to customers through system improvements designed to address known issues with accessing and conveying groundwater suitable for potable use.

Legal Authority

CCSD owns the property for the proposed well site, and has the legal authority to design and construct a new well. As the owner-operator of the CCSD system, CCSD also has the legal authority to connect the new well to its existing distribution system and deliver water from the new well to customers once all appropriate permits have been acquired.

VWSC already owns Well 2 and the other existing components of the proposed project. It has the legal authority to implement projects that serve the water supply needs of its customers, and once all appropriate permits have been acquired, is legally able to connect Well 2 to its existing system.

Project Costs

In total, these improvements are expected to cost approximately $1,175,000.

CCSD's 2018 Engineering Report for Well 4 estimated project costs of $489,800 for drilling and $485,280 for equipping, for a total cost of $975,080 (CCSD, 2018).

VWSC's 2007 *Ventucopa Water System Evaluation Report* estimated the well improvements included in this GSP would cost $191,200 (VWSC, 2007). Costs are assumed to have increased since 2007, and well improvements are currently expected to cost approximately $200,000 to implement.

Technical Justification

Both components of this project have completed initial planning efforts. Preliminary engineering and design has been completed for the CCSD Well 4 improvements, including the 2018 Engineering Report and preliminary design drawings. VWSC's well improvements were described and evaluated in the 2007 Evaluation Report. Implementation of this project would include final design for all components, as well as testing to ensure that well improvements meet the needs they are designed to address.

Basin Uncertainty

These improvements would reduce uncertainty associated with supply reliability in CCSD and VSWC's service areas.

CEQA/NEPA Considerations

Well drilling permits are a discretionary action in Santa Barbara County, which would trigger CEQA. CCSD and VSWC would need to complete the appropriate CEQA document to comply with these requirements prior to construction of this project. The project would not trigger NEPA unless federal funding or permits are required for completion of the project. The size and location of the project indicates it is unlikely to require federal permits, and NEPA is likely to only be required if federal funding is pursued.

7.4.5 Flow Meter Calibration Program

During the implementation of the 2020 GSP, the CBGSA took action to require non-de minimis groundwater users in the Basin to install water meters on all groundwater extraction wells by the end of 2021. Groundwater flow data are used in conjunction with groundwater level data in a variety of ways, including to provide water production data and information on groundwater basin conditions. This is especially important for sustainable regional management of groundwater resources.

The flow meter recalibration program would require all flow meters to be tested for accuracy once every three years. Flow meters will need to be accurate within +/- 5% of actual flows, and testing would need to be conducted by a qualified company or person approved by the GSA.

Current Status

This project has been recently conceptualized and added this GSP for the first time. Work has not commenced on this project and will only commence if the CBGSA decides to pursue it.

Public Notice and Outreach

Public notice and outreach would not be required beyond that necessary for approval at a public Board of Directors meeting or applicable CEQA.

Permitting and Regulatory Processes

No permits or regulatory processes would be necessary for development of the Flow Meter Calibration Program.

Project Benefits

This project will help ensure the accurate reporting of pumping volumes from metered pumps in the in the Basin. Accurate pumping data is used by the CBGSA to ensure compliance with pumping allocations in the Central Management Area and to help calibrate and update the model. Calibration of the flow meters that provide this data will ensure pump owners have the best available flow data and the CBGSA has accurate data for its monitoring. This will help avoid potential accidental and unknown over-pumping if a flow meter begins to underestimate flows, or potential under-pumping (and therefore reduced water volumes for beneficial uses and users) that could impact pump owners detrimentally.

Project Implementation

The circumstance of implementation for this project is an identified need for meter calibration and verification of pumping volumes by applicable groundwater producers. Implementation would require outreach to stakeholders, and a detailed program for the requirements of meter calibration. A timeline and reporting period and methodology would also need to be established to ensure all calibration information is properly collected and reviewed by the CBGSA.

Supply Reliability

This project would not change supply reliability to beneficial uses and users. It would ensure more accurate data on pumping where flow meters are installed.

Legal Authority

The CBGSA has the legal authority to place reporting requirements on groundwater extractors within the Basin.

Project Costs

In total, it is expected that this project would cost approximately $50,000 for the initial set up, and $250,000 annually. The $250,000 was calculated using conservative flow meter calibration cost estimates of $2,500 per flow meter for the 100 flow meters installed in the Basin. The initial set up cost for this program includes the development of guidance materials and requirements, a reporting system, and analysis of collected data.

Technical Justification

The flow meter calibration program would ensure that accurate data from applicable groundwater producers is provided to the CBGSA which is used for monitoring groundwater extractions and used in GSP implementation and groundwater modeling. The calibration program will ensure data is accurate and can be used by the CBGSA for implementation of the GSP.

Basin Uncertainty

The flow meter calibration program would ensure that accurate data from applicable groundwater producers is provided to the CBGSA which is used for monitoring groundwater extractions and used in GSP implementation and groundwater modeling. This will ensure data used by the CBGSA for GSP implementation leads to equitable and accurate decision making to reach sustainability.

CEQA/NEPA Considerations

Development of a flow meter calibration program would not trigger CEQA or NEPA. A calibration program is not anticipated to include construction of new facilities.

7.5 Water Management Actions

Water management actions are generally administrative locally implemented actions that the CBGSA or its member agencies could take that affect groundwater sustainability. Typically, management actions do not require outside approvals, nor do they generally involve capital projects.

7.5.1 Basin-Wide Economic Analysis

Changes to pumping in the Basin and access to water supplies may have economic consequences given that the Basin is dominated by agricultural land uses that are dependent on groundwater availability. Implementation of stormwater capture may require purchase of agricultural land for the spreading facilities, which could affect agricultural output in the region. The small population of the Basin limits the available revenue to fund projects. This Project entailed developing a study of the economic impacts of the projects and management actions included in the GSP. It included an evaluation of how implementation of the project could affect the economic health of the region and the local agricultural industry. It would also consider the projected changes to the region's land uses and population and whether implementation of these projects would support projected and planned growth. The economic analysis will be considered by the CBGSA when deciding whether to implement a proposed project and potentially when to implement the projects.

Current Status

A Basin-wide direct economic analysis of proposed GSP actions has been completed. The results of this analysis were presented to the GSP Board on December 4, 2019, and the final report was completed in December 2019. The final Basin-wide economic analysis report was provided in the 2020 Annual Report. This management action is 100% complete.

Public Notice and Outreach

This project was a study and did not require public notice or outreach. The results of the economic analysis were presented to the GSP Board on December 4, 2019.

Permitting and Regulatory Processes

No permits or regulatory approvals were required to complete the economic analysis.

Project Benefits

The economic analysis provided information to the CBGSA regarding the potential economic benefits and drawbacks to implementation of different projects under the GSP. This project did not provide direct benefits as related to water supply or groundwater sustainability, but will allow the CBGSA to move forward with implementation of projects that would continue to sustain local economies and would not inadvertently cause substantial economic harm, which could affect the ability of a proposed project to continue to provide benefits.

Project Implementation

The circumstance of implementation for this project were the consideration of the implementation of any project included in this GSP or otherwise considered by the CBGSA. The CBGSA implemented this project with the assistance of an economic consultant that completed the analysis based on data for the region and information provided by the CBGSA.

Supply Reliability

This project is a study and did not depend on any water supply for implementation or successful completion.

Legal Authority

The CBGSA is a joint-powers authority with authority to authorize an economic study for the projects in this GSP.

Project Costs

The basin-wide economic analysis had a cost of approximately $60,000.

Technical Justification

This project is a study that would use economic methods and analysis tools consistent with the standards and practices of the industry.

Basin Uncertainty

This project will help the CBGSA understand the economic uncertainty around implementation of the projects in the GSP. Improved understanding of the economic implications of a project will help the CBGSA decide which projects should move forward to support basin sustainability without unintended consequences that could increase overall uncertainty in the basin, including uncertainty regarding groundwater demands in the basin associated with the local and regional economy.

CEQA/NEPA Considerations

As a study, the basin-wide economic analysis did not trigger CEQA or NEPA.

7.5.2 Pumping Allocations in Central Management Area

As described in Section 2.3 of this GSP, the Basin is in overdraft conditions and to achieve balanced pumping and recharge groundwater users must decrease pumping by approximately 61 percent, in the absence of projects that increase recharge in the Basin or otherwise offset demands. While the projects identified in Section 7.4 would increase the water available to users in the Basin through increased recharge and precipitation, they are not expected to reduce the groundwater deficit sufficiently to achieve the Basin's sustainability goals. As such, the CBGSA has and will continue to implement pumping allocations.

Outlined here is a framework for how CBGSA has developed and implemented pumping allocations in the Central Management Area (CMA). As part of implementation of the pumping allocation program, the CBGSA allowed for operators within the CMA to create farming units, which irrigated land areas outside of the CMA that operate in common with areas inside the CMA. Consistent with the magnitude of projected overdraft estimated by the CBWRM, pumping allocations would not apply to users outside of 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 provide 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.

There are four key steps to developing pumping allocations:

1. Determine the Sustainable Yield of the Basin and the Central Management Area
2. Allocate sustainable yield of native groundwater to users based on:
    a) Historical use
    b) Land uses and irrigated areas
3. Determine how new/additional supplies would be allocated
4. Develop a timeline for reducing pumping to achieve allocations over time

Current Status

Pumping allocations in the CMA were implemented for 2023 and 2024. A notice of final allocations for these years was posted on the CBGSA website in May 2023. The CBGSA determined in its July 31st, 2024, Board Meeting to continue with allocations going forward, with an adjustment to the Central Management Area Boundary to conform with data available from the updated Cuyama Basin Water Resources Model. The CBGSA intends to use the model update in calculating allocations for the foreseeable future starting with 2025 allocations.

Sustainable Yield of the Basin Absent Projects and Water Management Actions

The sustainable yield of the Basin absent projects and water management actions is the volume of water that can be extracted from the Basin annually without affecting overall groundwater storage. and the sustainable yield of the Basin is estimated to be approximately 16,800 AFY, as described in the Water Budget section of Chapter 2. The sustainable yield of the Basin represents the volume of groundwater that can be allocated. Because pumping allocations would only be imposed on users in the Central Management Area, the CBGSA would need to determine the sustainable yield for only the Central Management Area, which would be less than the overall sustainable yield of the Basin.

Develop Allocations

The CBGSA will continue to develop allocations based on estimated historical use, existing land uses, or total irrigated acreage. For the 2023 and 2024 allocations, the CBGSA determined historical use by analyzing data about water use during the 20-year historical period from 1998 to 2017. This period aligns with the historical period of the water budget analysis described in Chapter 2. For this period, water use was estimated using data from the CBWRM model. In the future, the CBGSA intends to continue to use the same methodology; however, use of remote sensing and land use data to estimate agricultural consumption or of data provided by pumpers in the Basin may be considered in the future. CCSD's allocation is based on historical use, with an allowance for changes in population in the CCSD service area. CCSD is not required to reduce use in the future under this action. As such, once CCSD's allocation has been determined, it is removed from the total volume of groundwater available for allocation to non-CCSD users in the Central Management Area.

Determine Allocation of New or Additional Supplies

As the CBGSA implements projects in this GSP, additional groundwater supplies are expected to become available. These supplies would be used to reduce groundwater overdraft. The CBGSA anticipates that any new supplies made available through project implementation would be added to the total volume of water that would be allocated to the beneficiaries of those projects identified during project development. The mechanism for accounting for additional water made available by project implementation would be determined when the allocation method is refined.

Timeline for Implementation

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 completed the initial 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 will be reduced by 6.5 percent annually, so as to achieve sustainability in the Basin in 2038. Figure 7-4 shows the planned pumping reduction in the Basin. Individual users will be expected to reduce pumping at different rates to achieve the overall pumping reductions and meet their individual pumping allocations. The pumping allocation plan will identify how much each user or user-type would be required to reduce pumping annually to achieve the allocation and the overall Basin sustainability goals.

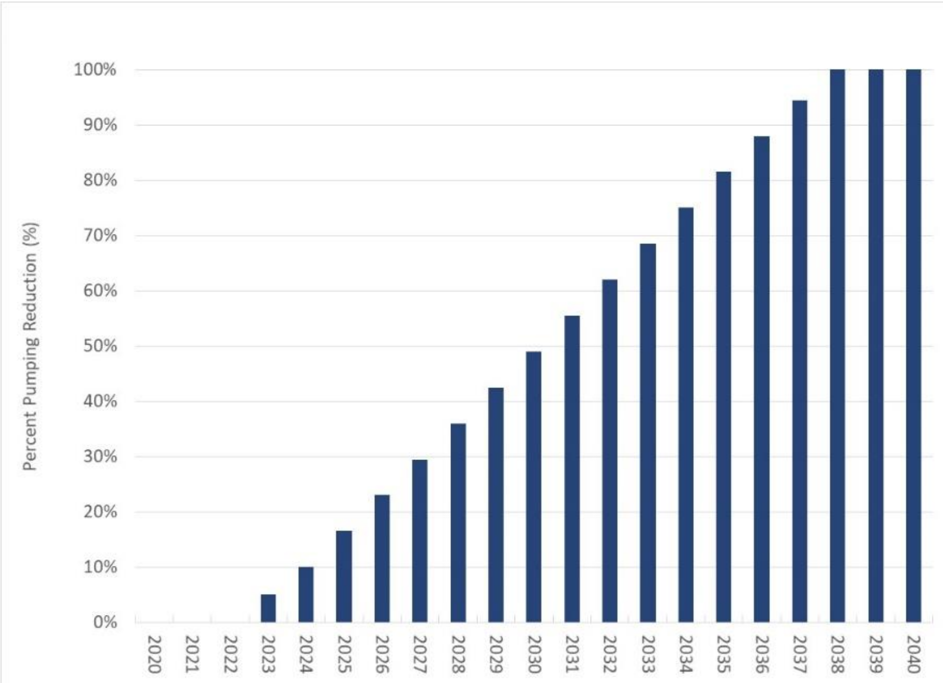


Figure 7-4: Glide Path for Central Management Area Groundwater Pumping Reductions

Public Notice and Outreach

Development of a pumping allocation plan required and will continue to require substantial public input to understand the potential impacts of pumping allocations and baseline needs that should be accounted for. The CBGSA held public workshops and meetings, updated the website, and sent out email announcements and other public notices about workshops. Updates to the pumping allocation plan will be circulated for public comment before finalized, though final approval of the plan would be made by CBGSA in partnership with its member agencies.

Permitting and Regulatory Processes

Development of a pumping allocation plan does not require any permitting but does require consideration of existing water rights and applicable permits and regulations associated with groundwater pumping in the Basin.

Management Action Benefits

A pumping allocation plan will identify how the region will achieve sustainable pumping in the Basin. Implementation and enforcement of a pumping allocation plan will directly reduce groundwater pumping.

Benefits would be measured by the change in total volume of groundwater pumped from the Basin and how many users are in compliance with their pumping allocations.

Management Action Implementation

The circumstance of implementation for developing a pumping allocation plan is identification of unsustainable groundwater pumping practices in the Basin. The CBGSA recognized recharge and pumping in the Basin is and continues to be unbalanced, and action must be taken to achieve sustainability. CBGSA developed a pumping allocation plan, in partnership with its member agencies and local groundwater users. The initial planning process was completed in 2023, with allocations implemented beginning in 2023. Successful implementation required compliance from groundwater users with the pumping allocation plan, and enforcement by the CBGSA and its member agencies. Successful roll-out of the pumping allocation plan required substantial public outreach to inform users of their annual allocation and expected annual reduction in groundwater pumping. Mechanisms for enforcement are outlined in the pumping allocation plan and are expected to be enforced by CBGSA's member agencies.

Supply Reliability

This project does not rely on supplies from outside the Basin because it is a planning effort that will result in conservation. It will support overall supply reliability by reducing overdraft in the Basin and moving the Basin towards sustainability.

Legal Authority

CBGSA has the authority to develop a pumping allocation plan and will perform implementation and enforcement of allocations through metering, water accounting, and implementing pumping fees.

Management Action Costs

Development and initiation of a pumping allocation management and tracking program is expected to cost up to $300,000 to conduct the analysis, set up the measurement and tracking system and conduct outreach. Costs to implement the plan would depend on the level of enforcement required to achieve allocation targets and the level of outreach required annually to remind users of their allocation for a given year. The pumping allocation plan would include a cost estimate for enforcement and implementation. Annual management of the program is estimated to cost about $150,000 per year.

Technical Justification

Pumping allocations will provide direct reductions of groundwater pumping. The pumping allocation plan developed allocations based on historical use data and land use data and will clearly describe the methodology and justification for the methodology used when setting pumping allocations.

Basin Uncertainty

The Basin is currently experiencing overdraft, and if current pumping practices continue conditions in the Basin are expected to worsen, increasing uncertainty regarding the availability of reliable groundwater supplies. Development and implementation of a pumping allocation plan will provide an opportunity to reduce overdraft-related uncertainty in the Basin by shifting pumping towards sustainable levels over time.

CEQA/NEPA Considerations

Development and implementation of the pumping allocation plan is not a project as defined by CEQA and NEPA and therefore did not trigger either. Reducing pumping over time is also not expected to trigger CEQA or NEPA because it does not meet the definition of a CEQA or NEPA project. As any plan is developed, CEQA and NEPA will be considered to determine if compliance is required.

7.6 Adaptive Management

Adaptive management allows the CBGSA to react to the success or lack of success of actions and projects implemented in the Basin and make management decisions to redirect efforts in the Basin to more effectively achieve sustainability goals. The GSP process under SGMA requires annual reporting and updates to the GSP at minimum every 5 years. These requirements provide opportunities for the CBGSA to evaluate progress towards meeting its sustainability goals and avoiding undesirable results.

Adaptive management triggers are thresholds that, if reached, initiate the process for considering implementation of adaptive management actions or projects. For CBGSA, the trigger for adaptive management and CBGSA’s next steps would be as follows:

- **Pumping reductions are more than 5 percent off the glide path identified in the pumping allocation plan:** CBGSA would evaluate why pumping allocations are not being met and implement additional outreach or enforcement, as appropriate.
- **If the Basin is within 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.

Adaptive management strategies may also be triggered for other reasons, such as reports by stakeholders of Basin conditions that have impacted beneficial uses or users. Stakeholders may notify the CBGSA of their concerns by (i) submitting a publicly available well reporting form (available on the CBGSA website) to the GSA, (ii) contacting the Basin manager as described in Section 1.1.1 – Contact Information, or (iii) bringing the concerns to public meetings.

If an investigation based on monitoring data and/or stakeholder reporting indicates that groundwater management in the Basin may be adversely affecting beneficial users, the CBGSA Board will determine if a response by the CBGSA is required. This will include the formation of an ad hoc committee to investigate the cause(s) of changing Basin conditions, conducting data analysis, and discussion of potential adaptive management response strategies. If appropriate, the CBGSA will implement response strategies to correct the issue; these strategies could include localized pumping management plans, installation of additional monitoring, installation of replacement wells, potential changes to sustainability criteria or pumping reduction schedule included in the GSP, or other solutions to address specific concerns and Basin conditions.

7.7 References

Cuyama Community Services District (CCSD). 2018. *Well No. 4 Drilling and Equipping Project Engineering Report*. KCWA_ID4_Well04DrillingEquippingProjEngReport_2018.pdf.

Santa Barbara County Water Agency (SBCWA). 2015. *Long Term Supplemental Water Supply Alternatives Report*. https://www.countyofsb.org/uploadedFiles/pwd/Content/Water/IRWMP/LongTermWaterSupplyReport%20FINAL%202015-12-30.pdf.

Santa Barbara County Water Agency (SBCWA). 2016. *Feasibility/Design Study for a Winter Cloud Seeding Program in the Upper Cuyama River Drainage, California.* https://www.slocounty.ca.gov/getattachment/e2ce9669-b52e-4b38-89fb-8a8a96143abd/Feasibility-Study-March-2017.aspx.

Ventucopa Water Supply Company (VWSC). 2007. *Water System Evaluation Report*. VentucopaWSC_WaterSystemEvaluationReport_2007.pdf.

8. IMPLEMENTATION PLAN

8.1 Plan Implementation

Implementation of this *Groundwater Sustainability Plan* (GSP) includes implementation of the projects and management actions included in Chapter 7, as well as the following:

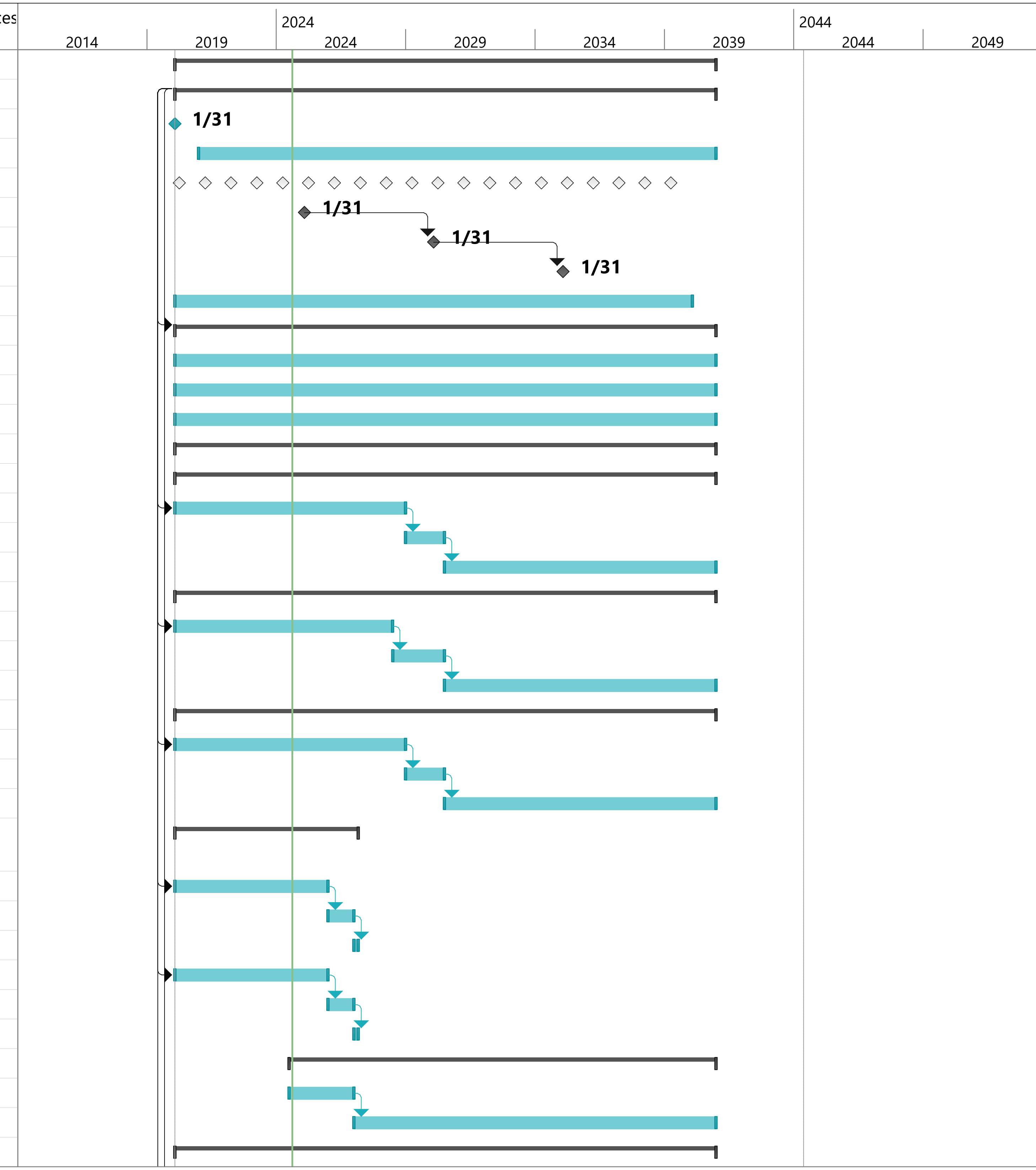
- Cuyama Basin Groundwater Sustainability Agency (CBGSA) administration and management
- Implementing the monitoring program
- Developing annual reports
- Developing required five-year periodic evaluations
- Developing GSP updates as needed

This chapter also describes the contents of both the Annual Report and five-year Periodic Evaluations that must be provided to the California Department of Water Resources (DWR) as required by Sustainable Groundwater Management Act (SGMA) regulations.

8.1.1 Implementation Schedule

Figure 8-1 illustrates the GSP's implementation schedule. Included in the chart are activities necessary for ongoing GSP monitoring and updates, as well as tentative schedules for projects and management actions. Additional details about the activities included in the schedule are provided in these activities' respective sections of this GSP. Adaptive management would only be implemented if triggering events are reached, as described in Chapter 7, and are shown as ongoing in the schedule.

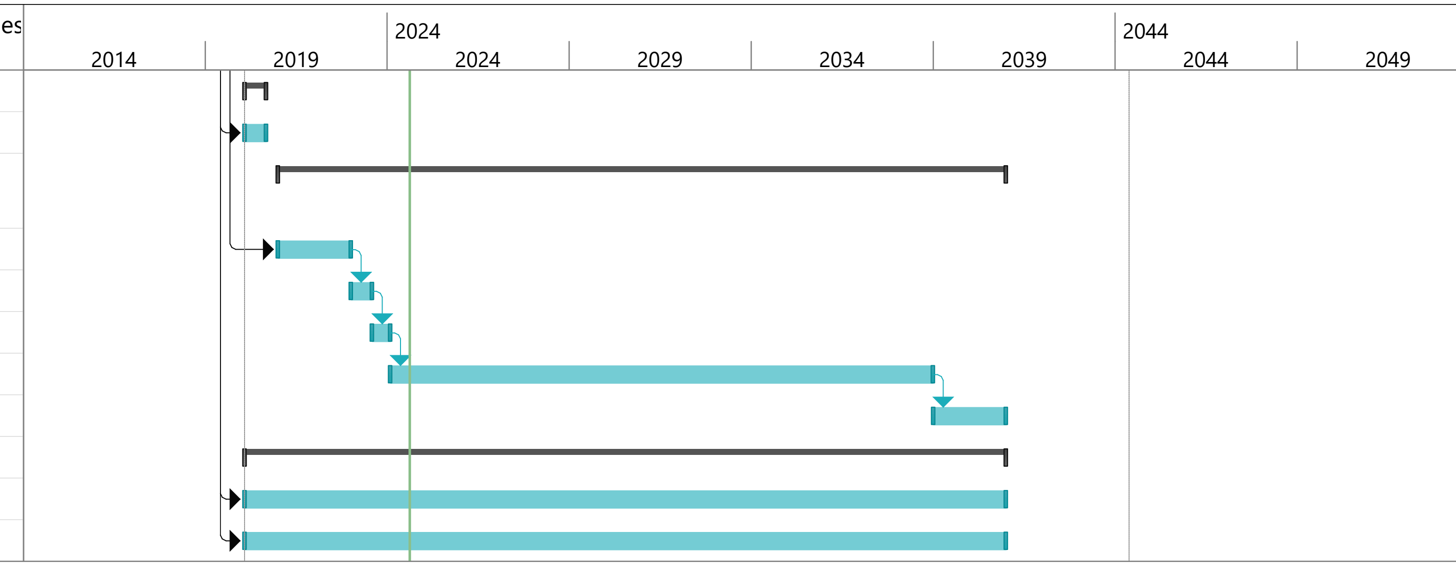
ID	Task Name	Duration	Start	Finish	Predeces
1	**Cuyama GSP Implementation**	**5458 days?**	**Fri 1/31/20**	**Mon 12/31/40**	
2	**Plan Implementation**	**5458 days?**	**Fri 1/31/20**	**Mon 12/31/40**	
3	Plan submittal to the State	0 days	Fri 1/31/20	Fri 1/31/20	
4	Monitoring	5218 days?	Fri 1/1/21	Mon 12/31/40	
5	**Annual Reports**	**4958 days**	**Wed 4/1/20**	**Fri 4/1/39**	
26	Five Year Report/Intern Target Evaluation 1	0 days	Fri 1/31/25	Fri 1/31/25	
27	Five Year Report/Intern Target Evaluation 2	0 days	Thu 1/31/30	Thu 1/31/30	26
28	Five Year Report/Intern Target Evaluation 3	0 days	Wed 1/31/35	Wed 1/31/35	27
29	Plan Updates (as needed)	5219 days	Fri 1/31/20	Tue 1/31/40	
30	**GSP Administration**	**5458 days**	**Fri 1/31/20**	**Mon 12/31/40**	**2SS**
31	CBGSA Administration	5458 days	Fri 1/31/20	Mon 12/31/40	
32	Stakeholder and Board Engagement	5458 days	Fri 1/31/20	Mon 12/31/40	
33	Outreach	5458 days	Fri 1/31/20	Mon 12/31/40	
34	**Project Implementation**	**5458 days?**	**Fri 1/31/20**	**Mon 12/31/40**	
35	**1. Flood and Stormwater Capture**	**5458 days**	**Fri 1/31/20**	**Mon 12/31/40**	
36	Planning	2328 days	Fri 1/31/20	Sun 12/31/28	2SS
37	Construction	391 days	Mon 1/1/29	Mon 7/1/30	36
38	Benefits	2740 days	Tue 7/2/30	Mon 12/31/40	37
39	**2. Precipitation Enhancement**	**5458 days**	**Fri 1/31/20**	**Mon 12/31/40**	
40	Planning	2197 days	Fri 1/31/20	Fri 6/30/28	2SS
41	Construction	522 days	Mon 7/3/28	Tue 7/2/30	40
42	Benefits	2739 days	Wed 7/3/30	Mon 12/31/40	41
43	**3. Water Supply Transfers/Exchanges**	**5458 days?**	**Fri 1/31/20**	**Mon 12/31/40**	
44	Planning	2328 days?	Fri 1/31/20	Sun 12/31/28	2SS
45	Agreement Negotiation	391 days?	Mon 1/1/29	Mon 7/1/30	44
46	Implementation of Transfers	2740 days?	Tue 7/2/30	Mon 12/31/40	45
47	**4. Improve Reliability of Water Supplies for Local Communities**	**1850 days**	**Fri 1/31/20**	**Thu 3/4/27**	
48	CCSD Replacement Well - Planning & Design	1544 days	Fri 1/31/20	Wed 12/31/25	2SS
49	CCSD Replacement Well - Construction & Permitting	261 days	Thu 1/1/26	Thu 12/31/26	48
50	CCSD Replacement Well - Testing	45 days	Fri 1/1/27	Thu 3/4/27	49
51	VWSC Well Improvements - Planning & Design	1544 days	Fri 1/31/20	Wed 12/31/25	2SS
52	VWSC Well Improvements - Construction & Permitting	261 days	Thu 1/1/26	Thu 12/31/26	51
53	VWSC Well Improvements - Testing	45 days	Fri 1/1/27	Thu 3/4/27	52
54	**5. Flow Meter Calibration Program**	**4307 days**	**Mon 7/1/24**	**Mon 12/31/40**	
55	Planning	654 days	Mon 7/1/24	Thu 12/31/26	
56	Program Implementation	3653 days	Fri 1/1/27	Mon 12/31/40	55
57	**Management Action Implementation**	**5458 days?**	**Fri 1/31/20**	**Mon 12/31/40**	



Project: Figure 8-1
Date: Fri 8/16/24

Task		Project Summary		Manual Task		Start-only		Deadline	
Split		Inactive Task		Duration-only		Finish-only		Progress	
Milestone		Inactive Milestone		Manual Summary Rollup		External Tasks		Manual Progress	
Summary		Inactive Summary		Manual Summary		External Milestone			

ID		Task Name	Duration	Start	Finish	Predeces
58		**1. Basin-Wide Economic Analysis**	**153 days**	**Fri 1/31/20**	**Tue 9/1/20**	
59		Plan Development	153 days	Fri 1/31/20	Tue 9/1/20	2SS
60		**2. Pumping Allocations in Central Management Area**	**5218 days?**	**Fri 1/1/21**	**Mon 12/31/40**	
61		Develop Allocation Method	522 days	Fri 1/1/21	Sat 12/31/22	2SS
62		Determine Allocatio nof New Water Supplies	151 days	Mon 1/2/23	Mon 7/31/23	61
63		Develop Timeline for Pumping Reduction	132 days	Tue 8/1/23	Wed 1/31/24	62
64		Implement Annual Puming Reductions	3892 days	Thu 2/1/24	Thu 12/30/38	63
65		Maintain Pumping Allocations	522 days?	Sat 1/1/39	Mon 12/31/40	64
66		**Adaptive managemetn Action Implementation**	**5458 days?**	**Fri 1/31/20**	**Mon 12/31/40**	
67		Evaluate Unimplemented Projects	5458 days?	Fri 1/31/20	Mon 12/31/40	2SS
68		Revist Projects not included in GSP	5458 days?	Fri 1/31/20	Mon 12/31/40	2SS



Project: Figure 8-1
Date: Fri 8/16/24

Task	Project Summary	Manual Task	Start-only	Deadline
Split	Inactive Task	Duration-only	Finish-only	Progress
Milestone	Inactive Milestone	Manual Summary Rollup	External Tasks	Manual Progress
Summary	Inactive Summary	Manual Summary	External Milestone	

8.2 Implementation Completed

The CBGSA adopted the Cuyama GSP in 2020 and adopted the amended GSP in 2022. Since the adoption of the first GPS, the CBGSA has successfully implemented and continues to implement many components of the plan. Since January 2020, the CBGSA has:

- Submitted the original version of the GSP and resubmitted an amended GSP in 2022 that was approved by DWR
- Submitted Annual Reports for water years 2020, 2021, 2022, and 2023
- Implemented schedule pumping allocations to move the Basin towards sustainability
- Conducted a water rights analysis of potential water supplies has been initiated to support potential flood and stormwater capture
- Performed a study of potential precipitation enhancement in the Basin
- Installed six new multi-completion wells and three shallow groundwater monitoring wells (piezometers)
- The CCSD secured grant funding for a new well
- Completed a Basin-wide Economic Analysis
- Prepared a 2025 GSP update
- Prepared the Periodic Evaluation

8.3 Implementation Budgets and Funding Sources

CBGSA operations and GSP implementation will incur costs, which will require funding by the CBGSA. The five primary activities that will incur costs are listed here. Table 8-1 summarizes these activities and estimated budgets. These estimates will be refined during GSP implementation as more information becomes available.

- Implementing the GSP
- Implementing GSP-related projects and management actions
- CBGSA operations
- Developing annual reports
- Developing five-year periodic evaluations and potential GSP updates

Table 8-1: CBGSA and GSP Implementation Budgets

Activity	Estimated Budget[a]
GSP Implementation and GSA Management	
CBGSA Administration and Legal Support	$390,000 annually
Stakeholder and Board Engagement	$140,000 annually
Outreach	$25,000 annually
GSP Implementation Program Management	$75,000 annually for fiscal years (FYs)
Monitoring Program, including Data Management	$160,000 annually. Additional costs to establish monitoring program in FY 2021 ($150,000) and FY 2021 ($50,000)
Annual Reporting	$50,000 annually
Periodic Evaluations	$40,000 every five years
Five-Year GSP Updates	$1,000,000 every five years (across two fiscal years)
Projects and Management Actions	
Project 1: Flood and Stormwater Capture	Construction: $46 million Operations and Maintenance: $500,000
Project 2: Precipitation Enhancement	$150,000 annually
Project 3: Water Supply Transfers/Exchanges	$600 to $2,800 per acre-foot (AF) (total cost to be determined)
Project 4: Improve Reliability of Water Supplies for Local Communities	$1.8 million
Project 5: Flow Meter Calibration Program	$50,000 for program setup $2,500 per meter per year (100 meters) = $250,000
Management Action 1: Basin-Wide Economic Analysis	$50,000 - $100,000 one-time (completed)
Management Action 2: Pumping Allocations in Central Management Area	Allocation development: $300,000 Implementation/maintenance: $150,000 annually
Adaptive Management	As needed
[a] Estimates are rounded and based on full implementation years (FY 2021 through FY 2040).	

8.3.1 GSP Implementation and Funding

Costs associated with GSP implementation and CBGSA operations include the following:

- **CBGSA administration and legal support:** Overall program management, coordination activities, and legal services
- **Stakeholder/Board engagement:** Bi-monthly Stakeholder Advisory Committee (SAC) meetings, bi-monthly CBGSA Board meetings, bi-monthly calls with the CBGSA Board ad-hoc committees, and semi-annual public workshops
- **Outreach:** Email communications, newsletters, and website management
- **GSP implementation program management:** Program management and oversight of project and management action implementation, including coordination among GSA Board, staff and stakeholders, coordination of GSA implementation technical activities, oversight and management of CBGSA consultants and subconsultants, budget tracking, schedule management, and quality assurance/quality control of project implementation activities
- **Monitoring:** pump flow meter monitoring and satellite imagery analysis to track water usage, conduct groundwater level and quality monitoring, and manage data

Implementation of this GSP is projected to run between $800,000 and $1.3 million per year, and projects and management actions an additional $650,000 to $3.7 million per year. Development of the 2020 GSP was funded through a Proposition 1 Sustainable Groundwater Planning Grant. This GSP Update and CBGSA operations are funded through the Sustainable Groundwater Implementation Grant and CBGSA collected fees. Although ongoing operation of CBGSA could include contributions from its member agencies, which are ultimately funded through customer fees or other public funds, additional funding would be required to implement the GSP. Of the implementation activities in the GSP, only project implementation is likely to be eligible for grant or loan funding; funding through grants or loans have varying levels of certainty. As such, the CBGSA has developed and will refine, as needed, a financing plan that includes one or more of the following financing approaches:

- **Pumping Fees**: Pumping fees would implement a charge for pumping that would be used to fund GSP implementation activities. To meet the funding needs of the GSP, fees would be lower when pumping is higher, such as current pumping levels, and higher when pumping is lower, such as when sustainable pumping levels are achieved. Although this funding approach would meet the financial needs of the GSP and CBGSA, it may discourage pumping reductions due to cost. The financing plan developed by the CBGSA would evaluate how to balance the need for funding with encouraging pumpers to commit to compliance with desired groundwater pumping reduction goals.

- **Assessments:** Assessments would charge a fee based on land areas. There are two methods for implementing an assessment based on acreage. The first option would assess a fee for all acres in the Basin outside of those in federal lands. This option would not distinguish between land use types. The second option would be to assess a fee only on irrigated acres. Similar to the pumping fee approach, assessment based on irrigated acreage could affect agricultural operations and contribute to land use conversions, which could affect the assessment amount or ability to fully fund GSP implementation.
- **Combination of fees and assessments:** This approach would combine pumping fees and assessments to moderate the effects of either approach on the economy in the Basin. This approach would likely include an assessment that would apply to all acres in the Basin, rather than just to irrigated acreage. It would be coupled with a pumping fee to account for those properties that use more water than others.

During development or refinement of a financing plan, the CBGSA would also determine whether to apply fees across the Basin as a whole or just within the management areas. The CBGSA may choose to apply an assessment across the Basin and a pumping fee within the management areas, or choose to set different levels of assessments or fees based on location within a management area or not, or they may choose another combination of the above approaches based on location. On July 10, 2019, the CBGSA Board voted to use a groundwater extraction fee to provide funding for CBGSA activities during the first year of GSP implementation and, on November 6, 2019, the Board established a groundwater extraction fee for the 2020 calendar year. The CBGSA has continued to apply groundwater extraction fees annually in the years since then. This strategy may be modified in the future by changing to land assessments, modifying fees/assessments based on location or usage, or some other methodology as deemed appropriate to the CBGSA. Prior to implementing any fee or assessment program, the CBGSA would complete a rate assessment study and other analysis consistent with the requirements of Proposition 218.

The CBGSA will pursue grants and loans to help pay for project costs to the extent possible. If grants or loans are secured for project implementation, potential pumping fees and assessments may be adjusted to align with operating costs of the CBGSA and ongoing GSP implementation activities. A potential hurdle to the utilization of state grant funding is that delays in payment by the state can cause hardships for disadvantaged communities such as the Cuyama Basin. Therefore, it would be appropriate to expedite payments associated with grant funding by DWR.

8.3.2 Projects and Management Actions

Costs for the Projects and Management Actions are described in Chapter 7 of this GSP. Financing of the projects and management actions would vary depending on the activity. Potential financing for projects and management actions are provided in Table 8-2, though other financing may be pursued as opportunities arise or as appropriate.

Table 8-2: Financing Options for Proposed Projects, Management Actions, and Adaptive Management Strategies

Project/Activity		Responsible Entity	Potential Financing Options
Project 1: Flood and Stormwater Capture	Feasibility Study	CBGSA	• CBGSA Operating Funds • CBGSA Member Agencies
	Project Implementation	CBGSA or Member Agencies	• Grants • Loans • CBGSA Operating Funds • CBGSA Member Agencies
Project 2: Precipitation Enhancement	Feasibility Study	CBGSA	• CBGSA Operating Costs • CBGSA Member Agencies
	Project Implementation	CBGSA or Member Agencies	• CBGSA Operating Costs • CBGSA Member Agencies
Project 3: Water Supply Transfers/Exchanges	Feasibility Study	CBGSA	• CBGSA Operating Costs
	Project Implementation	CBGSA	• CBGSA Operating Costs
Project 4: Improve Reliability of Water Supplies for Local Communities	CCSD Well 4	Cuyama Community Services District (CCSD)	• Grants • Loans • CCSD Operating Costs
	VWSC Well 2	Ventucopa Water Supply Company (VWSC)	• Grants • Loans • VWSC Operating Costs
Project 5: Flow Meter Calibration Program	Project implementation	CBGSA	• Grants • CBGSA Operating Costs
Management Action 1: Basin-Wide Economic Analysis	Economic Study*	CBGSA	• CBGSA Operating Costs
Management Action 2: Pumping Allocations in Central Management Area	Allocation Plan	CBGSA	• CBGSA Operating Costs
	Enforcement	CBGSA or Member Agencies	• CBGSA Operating Costs • Member Agency Operating Costs
Adaptive Management	-	CBGSA	• Grants • Loans • CBGSA Operating Costs

** Project/Management Action Completed*

8.4 Annual Reports

Annual reports must be submitted by April 1 of each year following GSP adoption per California Code of Regulations. Annual reports must include three key sections as follows

- General Information
- Basin Conditions
- Plan Implementation Progress

An outline of what information will be provided in each of these sections in the annual report is included below. Annual reporting would be completed in a manner and format consistent with Section 356.2 of the SGMA regulations. As annual reporting continues, it is possible that this outline will change to reflect Basin conditions, CBGSA priorities, and applicable requirements.

8.4.1 General Information

General information included in the executive summary highlights the key content of the annual report. As part of the executive summary, this section includes a description of the sustainability goals, provides a description of GSP projects and their progress as well as an annually-updated implementation schedule and map of the Basin. Key components as required by SGMA regulations include:

- Executive Summary
- Map of the Basin

8.4.2 Basin Conditions

Basin conditions section describes the groundwater conditions and monitoring results from the applicable water year. This section includes an evaluation of how conditions changed in the Basin since the previous water year and compare conditions to historical groundwater data. Pumping data, effects of project implementation (e.g., recharge data, conservation, if applicable), surface water flows, total water use, and groundwater storage are included. Key components as required by SGMA regulations include:

- Groundwater elevation data from the monitoring network
- Hydrographs of elevation data
- Groundwater extraction data
- Surface water supply data
- Total water use data
- Change in groundwater storage, including maps

8.4.3 Plan Implementation Progress

Progress toward successful plan implementation is included in the annual report. This section of the annual report describes the progress made toward achieving interim milestones as well as implementation of projects and management actions. Key components as required by SGMA regulations include:

- Plan implementation progress
- Sustainability progress

8.5 Five-Year Periodic Evaluation

SGMA requires GSAs to evaluate their GSPs to assess progress toward meeting approved sustainability goals at least every five years or whenever a plan is amended, which must be done through a written assessment submitted to DWR. A description of the information that will be included in the Periodic Evaluation is provided below and will be prepared in a manner consistent with Section 356.4 of the SGMA regulations. The CBGSA will submit its first Periodic Evaluation in 2025 along with this 2025 GSP.

8.5.1 Sustainability Evaluation

This section will contain a description of current groundwater conditions for each applicable sustainability indicator and will include a discussion of overall Basin sustainability. Progress toward achieving interim milestones and measurable objectives will be included, along with an evaluation of groundwater elevations (i.e., those being used as direct or proxy measures for the sustainability indicators) in relation to minimum thresholds. If any of the adaptative management triggers are found to be met during this evaluation, a plan for implementing adaptive management described in the GSP would be included.

8.5.2 Plan Implementation Progress

This section will describe an updated status of project and management action implementation, and report on whether any adaptive management action triggers had been activated since the previous periodic evaluation. An updated project implementation schedule will be included, along with any new projects that were developed to support the goals of the GSP and a description of any projects that are no longer included in the GSP. The benefits of projects that have been implemented will be included, and updates on projects and management actions that are underway at the time of the periodic evaluation will be reported.

8.5.3 Reconsideration of GSP Elements

Part of the periodic evaluation will include a reconsideration of GSP elements. As additional monitoring data are collected during GSP implementation, land uses and community characteristics change over time, and GSP projects and management actions are implemented, it may become necessary to revise the GSP. This section of the periodic evaluation will reconsider the Basin setting, management areas, undesirable results, minimum thresholds, and measurable objectives. If appropriate, the periodic evaluation will recommend revisions to the GSP. Revisions would be informed by the outcomes of the monitoring network, and changes in the Basin, including changes to groundwater uses or supplies and outcomes of project implementation.

8.5.4 Monitoring Network Description

A description of the monitoring network will be provided in the periodic evaluation. Data gaps, or areas of the Basin that are not monitored in a manner commensurate with the requirements of Sections 352.4 and 354.34(c) of the SGMA regulations will be identified. An assessment of the monitoring network's function will also be provided, along with an analysis of data collected to date. If data gaps are identified, the periodic evaluation may include information or steps for addressing these data gaps, along with an implemented schedule for addressing gaps and how the CBGSA will incorporate updated data into the GSP.

8.5.5 New Information

New information that becomes available after the last GSP adoption, GSP amendment, or periodic evaluation would be described and evaluated. If the new information would warrant a change to the GSP, this would also be included, as described in Section 8.5.3.

8.5.6 Regulations or Ordinances

The Periodic Evaluation will include a summary of the regulations or ordinances related to the GSP that have been implemented by DWR since the previous report, and address how these may require updates to the GSP.

8.5.7 Legal or Enforcement Actions

The Periodic Evaluation will include enforcement or legal actions taken by the CBGSA or its member agencies in relation to the GSP will be summarized in this section along with how such actions support sustainability in the Basin.

8.5.8 Plan Amendments

A description of amendments to the GSP will be provided in the Periodic Evaluation, including adopted amendments, recommended amendments for future updates, and amendments that are underway.

8.5.9 Coordination

The CBGSA is the only GSA in the Cuyama Basin. It is adjacent to the Carrizo Basin, the Mil Potrero Area Basin, and Lockwood Valley Basin, which are very low priority basins per the California Statewide Groundwater Elevation Monitoring (CASGEM) Program, and not yet required to comply with SGMA. Downstream from the Basin is the Santa Maria River Valley Basin, which is currently undergoing prioritization evaluation under the CASGEM Program. A GSA has formed for the Santa Maria Basin Fringe Areas, which are located downstream from Twitchell Reservoir, and could be affected by stormwater capture activities by the CBGSA. The CBGSA may need to coordinate with this GSA, and will need to coordinate with various land use agencies and other entities to implement projects. This section of the Periodic Evaluation will describe coordination activities between these entities, such as meetings, joint projects, or data collection efforts. If additional neighboring GSAs have been formed since the previous report, or changes in neighboring basins occurred, that result in a need for new or additional coordination within or outside the Basin, such coordination activities would be included as well.

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