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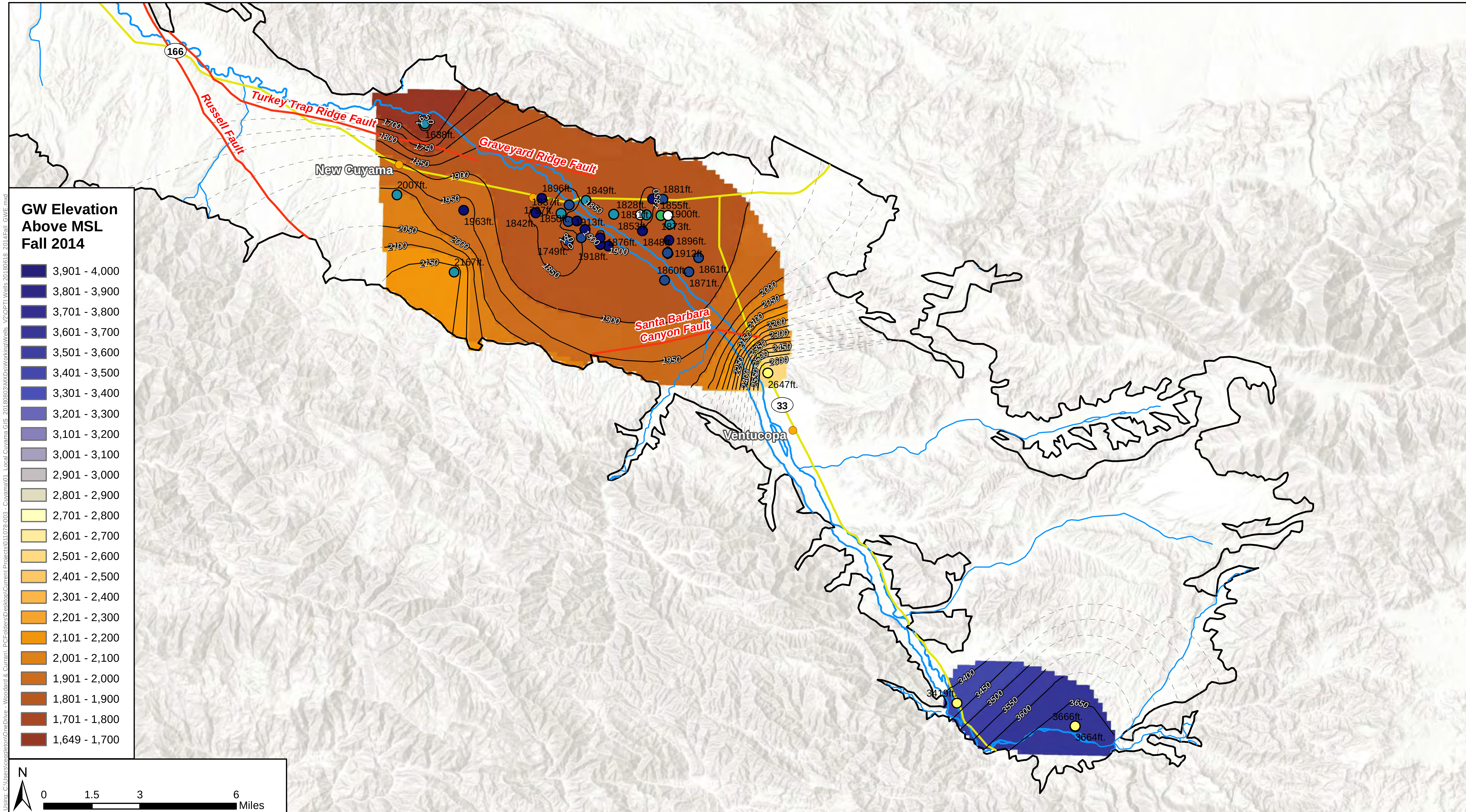

Figure 2-47: Fall 2014 Groundwater Elevation

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Cuyama Valley Groundwater Basin Groundwater Sustainability Plan

September 2019

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Legend

- Cuyama Basin
- Cuyama River
- Faults
- Groundwater Elevation Above MSL
- Inferred Groundwater Elevation Above MSL

Well Depth Below GSE

- Unknown
- 0 - 200 ft
- 200 - 400 ft
- 400 - 600 ft
- 600 - 800 ft
- 800 - 1000 ft
- 1,000 - 1,200 ft

Contours were interpolated using data measured from 9/1/2014 - 11/30/2014 due to limitated data availability.

Contours Interval: 50 ft.

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

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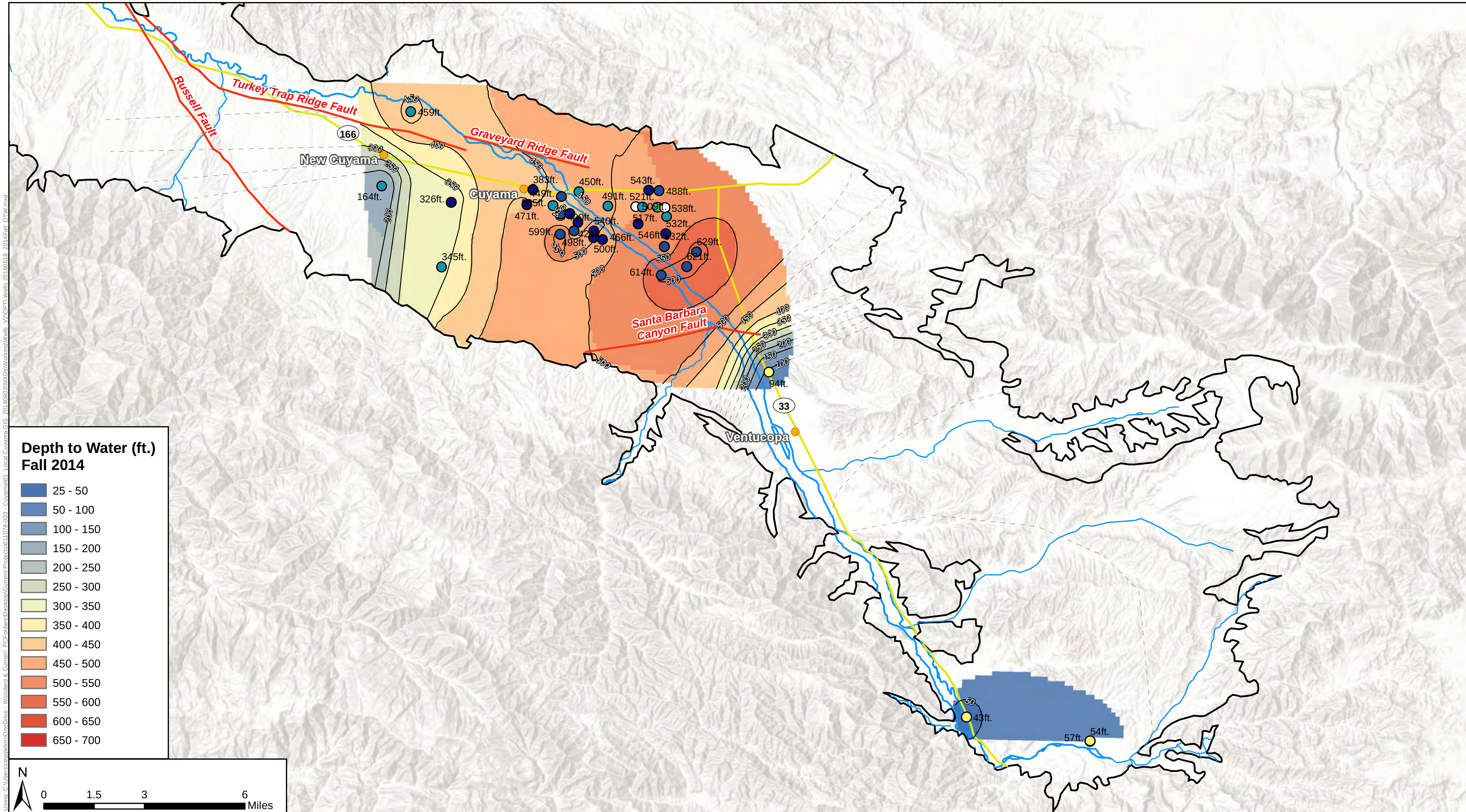

Figure 2-48: Fall 2014
Depth to Water

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Legend

- Cuyama Basin
- Cuyama River
- Faults
- Groundwater Depth-to-Water Contours below Groundsurface
- Inferred Groundwater Depth-to-Water Contours below Groundsurface

Well Depth Below GSE

- Unknown
- 0 - 200 ft
- 200 - 400 ft
- 400 - 600 ft
- 600 - 800 ft
- 800 - 1000 ft
- 1,000 - 1,200 ft

Contours were interpolated using data measured from 9/1/2014 - 11/30/2014 due to limitated data availability.

Contours Interval: 50 ft.

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2.2.4 Change in Groundwater Storage

Historical change in Basin groundwater storage has shown a consistent decline. Figure 2-49 shows change in storage by year, water year type,[8] and cumulative water volume for the last 20 years. Change in storage was calculated using the Cuyama Basin Water Resources Model (CBWRM). Average annual use over the 20-year period was -23,076 AF. The color of bar for each year of change in storage correlates a water year type defined by Basin precipitation. Change in storage is negative in 18 of the 20 years, and was negative during two of three wet years, as designated by the water year type.

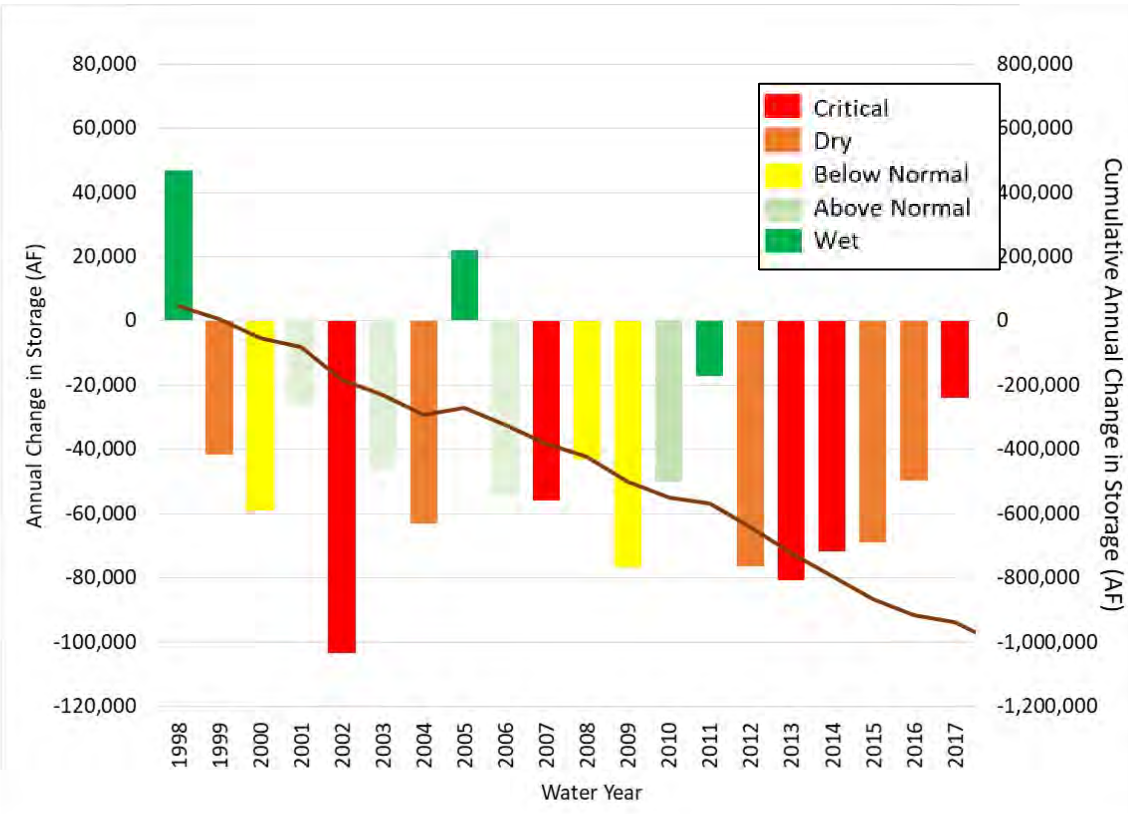

Figure 2-49: Cuyama Groundwater Storage by Year, Water Year Type, and Cumulative Water Volume

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

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

2.2.5 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.

2.2.6 Land Subsidence

In 2015, USGS measured land subsidence as part of its technical analysis of the Cuyama Valley. USGS used two CGPS sites and five reference point InSAR sites, shown in Figure 2-50 (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 global positioning system monitoring stations in the area in and around the Basin. Figure 2-43 shows the monitoring stations and their measurements since 1999. Three stations (P521, OZST, and BCWR) are located just outside the Basin. The three stations' measurements show ground surface level as either staying constant or slightly increasing. The increase is potentially due to tectonic activity in the region. Two stations (VCST and CUHS) are located within the Basin. Station VCST is located near Ventucopa and indicates that subsidence is not occurring in that area. Station CUHS indicates that 300 millimeters (approximately 12 inches) of subsidence have occurred in the vicinity of New Cuyama over the 19 years that were monitored. 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.

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

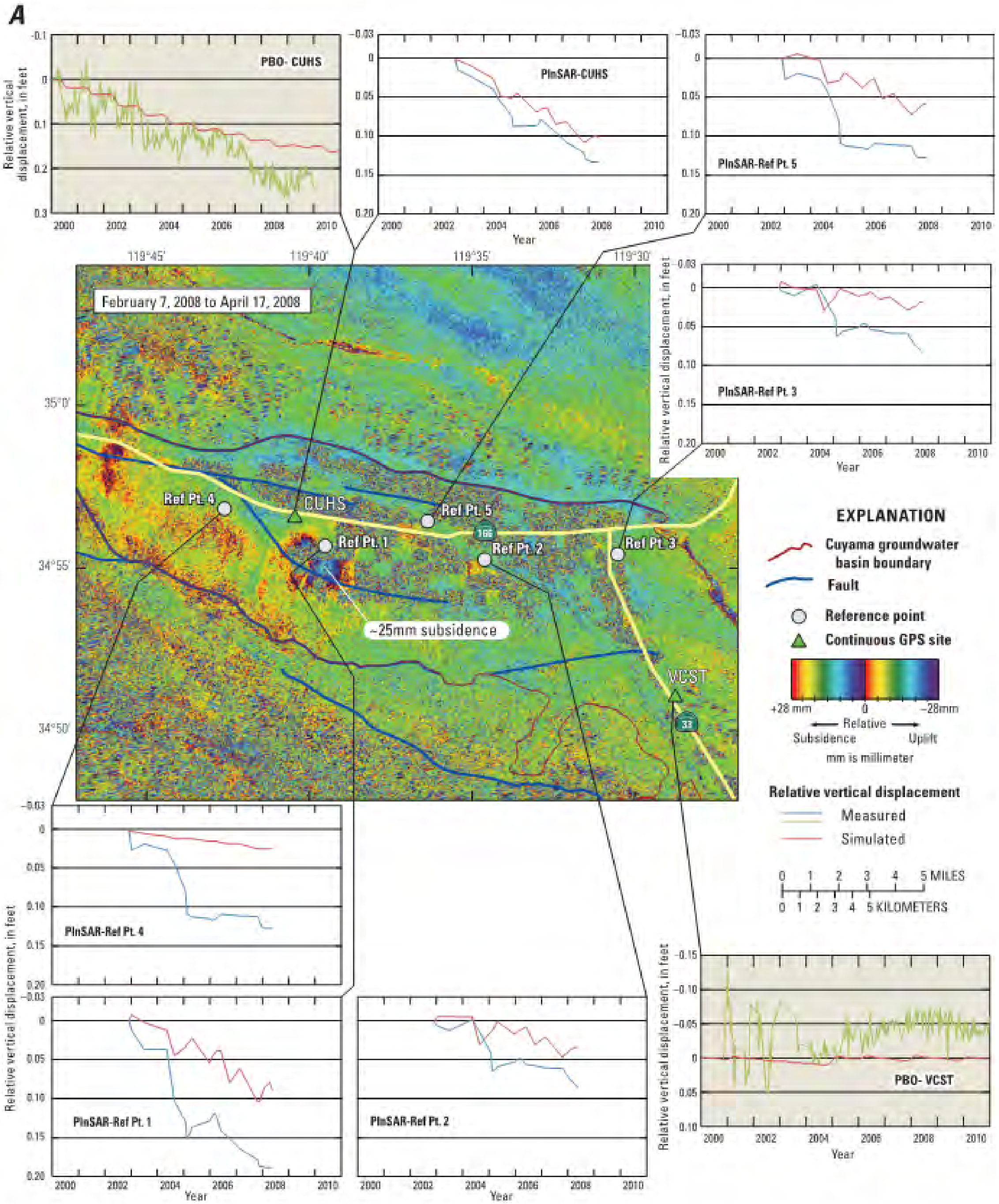

Figure 29. Historical subsidence as *A*, map of seasonal InSAR with graphs of simulated and measured time series for selected locations of relative land-surface deformation from Plate-Boundary Observation (PBO) sites and Point InSAR targets, and *B*, simulated total subsidence 1950–2010 for the calibrated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

Source: USGS, 2015

Figure 2-50: Locations of CGPS and Reference InSAR Sites in the Cuyama Valley

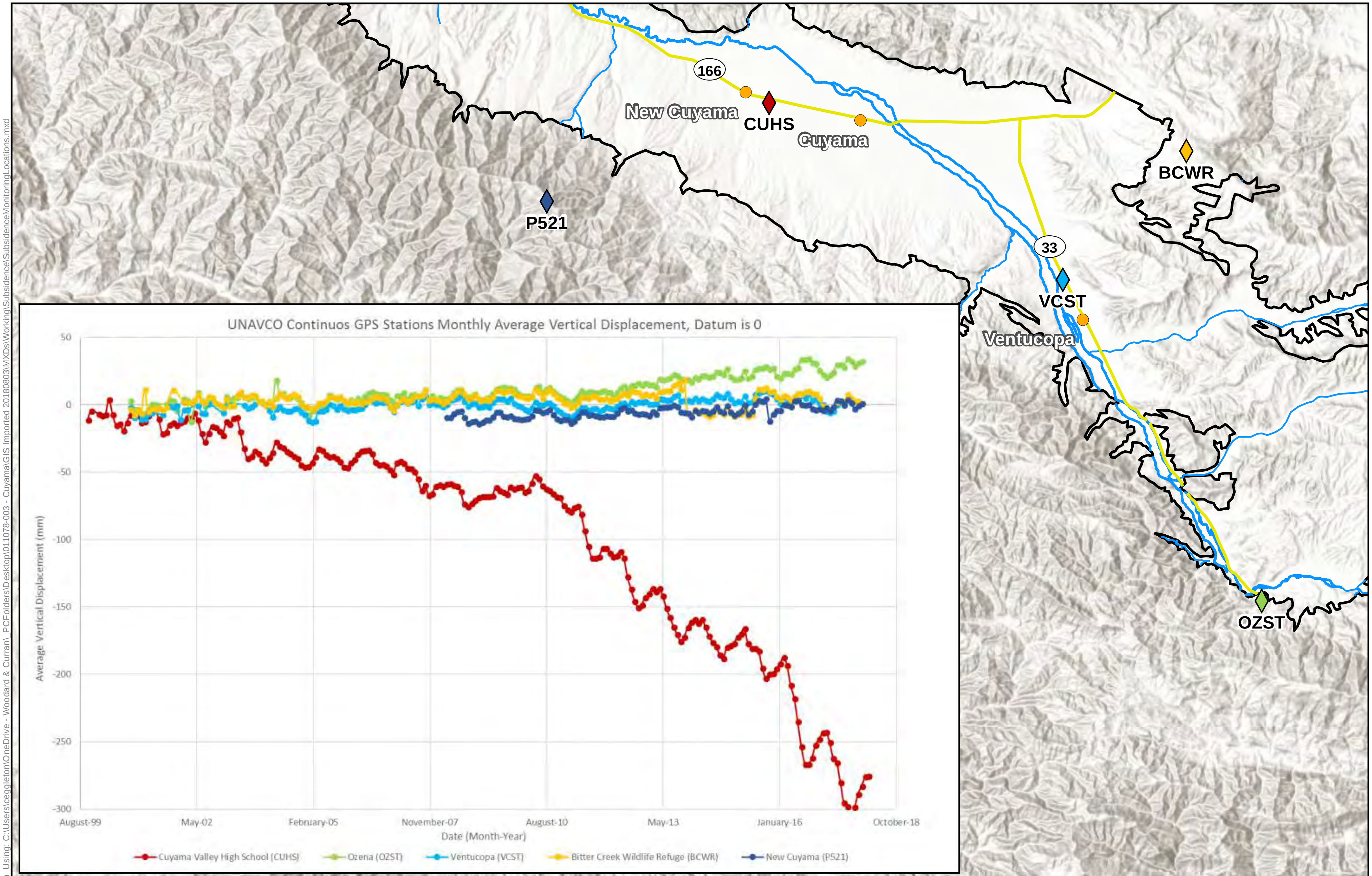

Figure 2-51: Subsidence Monitoring Locations

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Legend

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

0 2.5 5 10 Miles

N

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2.2.7 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

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 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

Data were then compiled into a database for analysis.

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

- Singer and Swarzensky. 1970. *Pumpage and Ground-Water Storage Depletion in Cuyama Valley, 1947-1966.* This report focuses on groundwater depletion, but also includes information about groundwater quality.
- USGS. 2008 *Groundwater-Quality Data in the South Coast Interior Basins Study Unit, 2008: Results from the California Groundwater Ambient Monitoring and Assessment (GAMA) Program*. This study summarizes water quality testing on 12 wells in the Cuyama Valley; wells were tested for a variety of constituents.
- SBCWA. 2011. *Santa Barbara County 2011 Groundwater Report.* This report provides groundwater conditions from throughout the county, and provides water quality information for the Cuyama Valley.
- USGS. 2013c. *Geology, Water-Quality, Hydrology, and Geomechanics of the Cuyama Valley Groundwater Basin, California, 2008-12*. This report investigates a wide variety of groundwater components in the Cuyama Valley, including water quality.

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.

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

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

Figure 2-54 shows measurements of TDS for selected monitoring points over time. Monitoring points were selected by the number of measurements, with higher counts of measurements selected to be plotted. The charts indicate that TDS in the vicinity of New Cuyama has been over 800 mg/L TDS throughout the period of record, and that TDS has either slightly increased or stayed stable over the period of record. The chart for Well 85 at the intersection of Quatal Canyon and the Cuyama River is generally below 800 mg/L TDS with rapid spikes of TDS increases above that level. The timing of rapid increases in measured TDS correspond with Cuyama River flow events, indicating a connection between rainfall and stream flow and an increase in TDS. This is the only location where this trend was detected.

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

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

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

Figure 2-57 also shows that arsenic measurements were below the MCL of 10 µg/L in the majority of the Basin where data was available. However, high arsenic values exceeding 20 µg/L were recorded at three well locations in the area south of New Cuyama; all of these high concentration samples were taken at depths of 700 feet or greater, and readings in the same area taken at shallower depths were below the MCL.

Figure 2-58 shows the results of a query using the 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.

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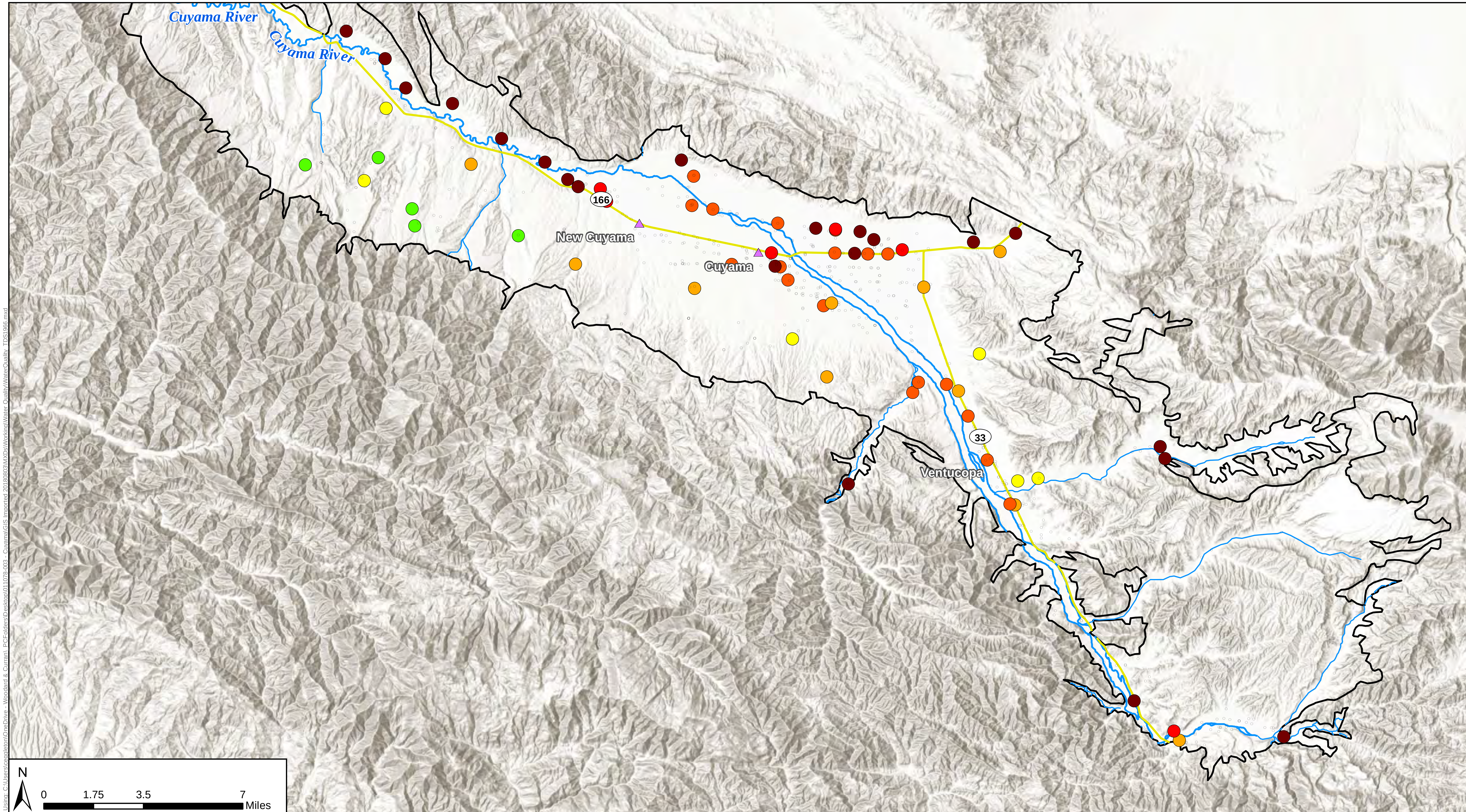

Figure 2-52: 1966 Average Well Measurements of Total Dissolved Solids, mg/L

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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

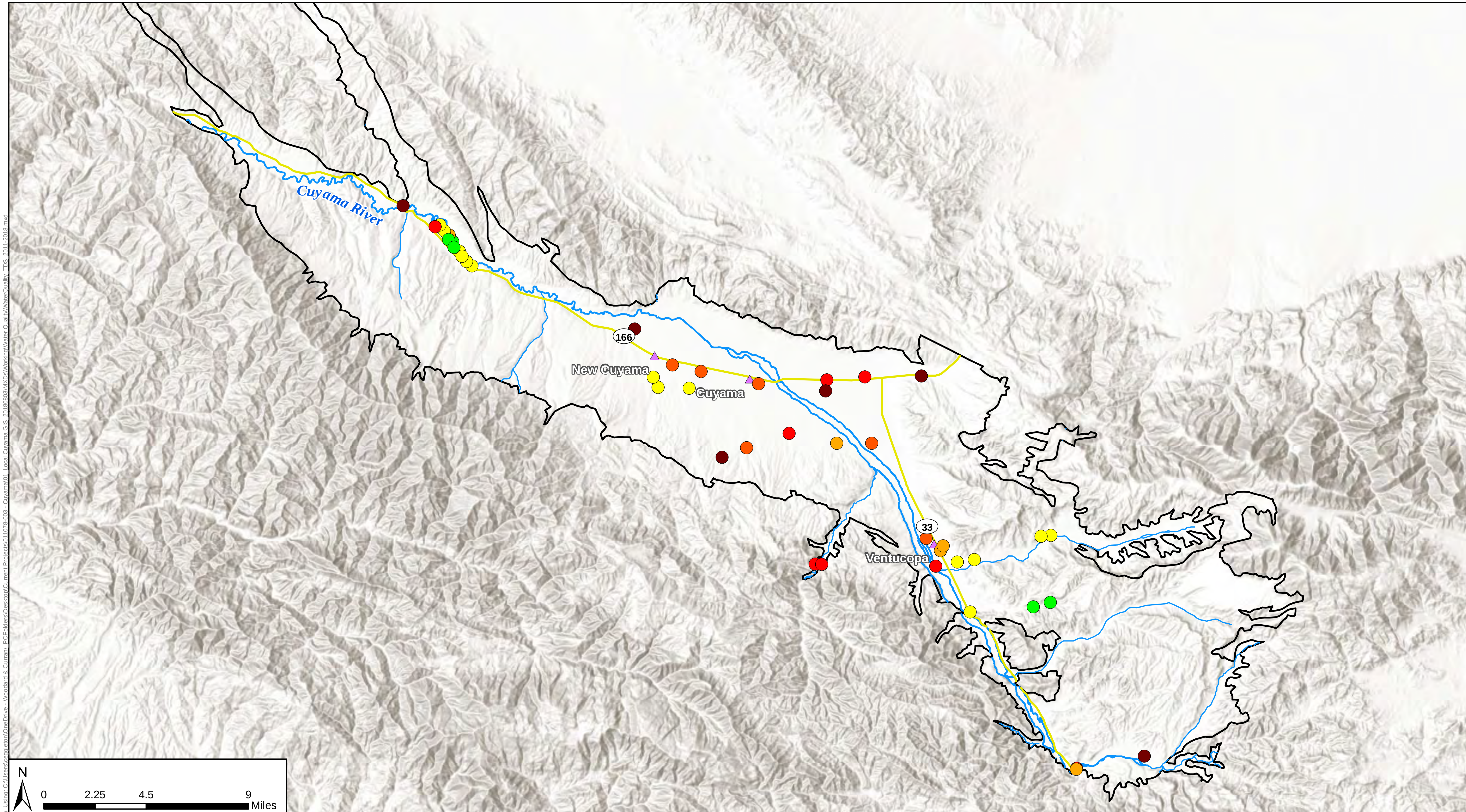

Figure 2-53: 2011-2018 Average Well Measurements of Total Dissolved Solids, mg/L

Cuyama Basin Groundwater Sustainability Agency

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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

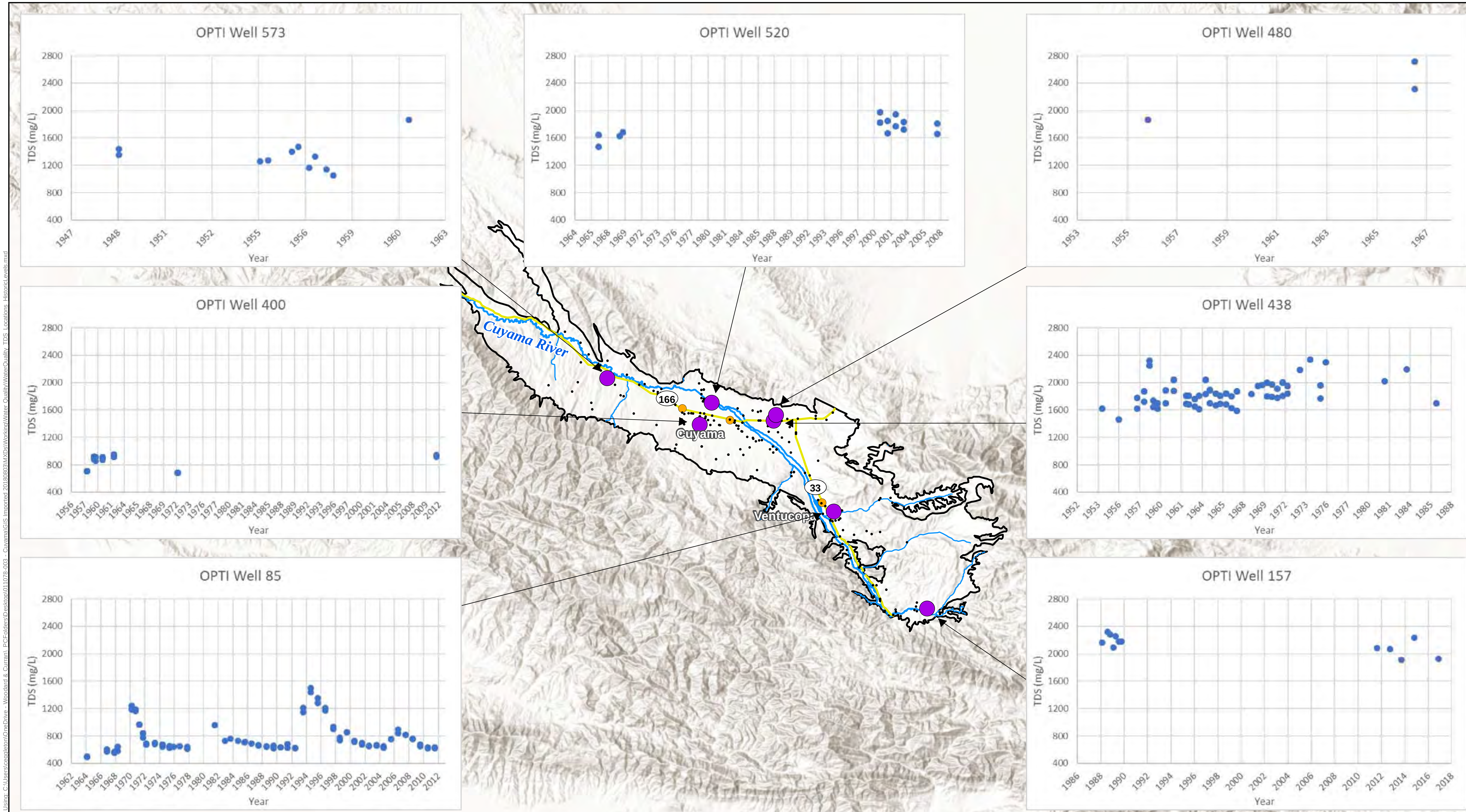

Figure 2-54: Cuyama Groundwater Basin Historic TDS Levels in Selected Wells

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Legend

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

N

0 4.5 9 18 Miles

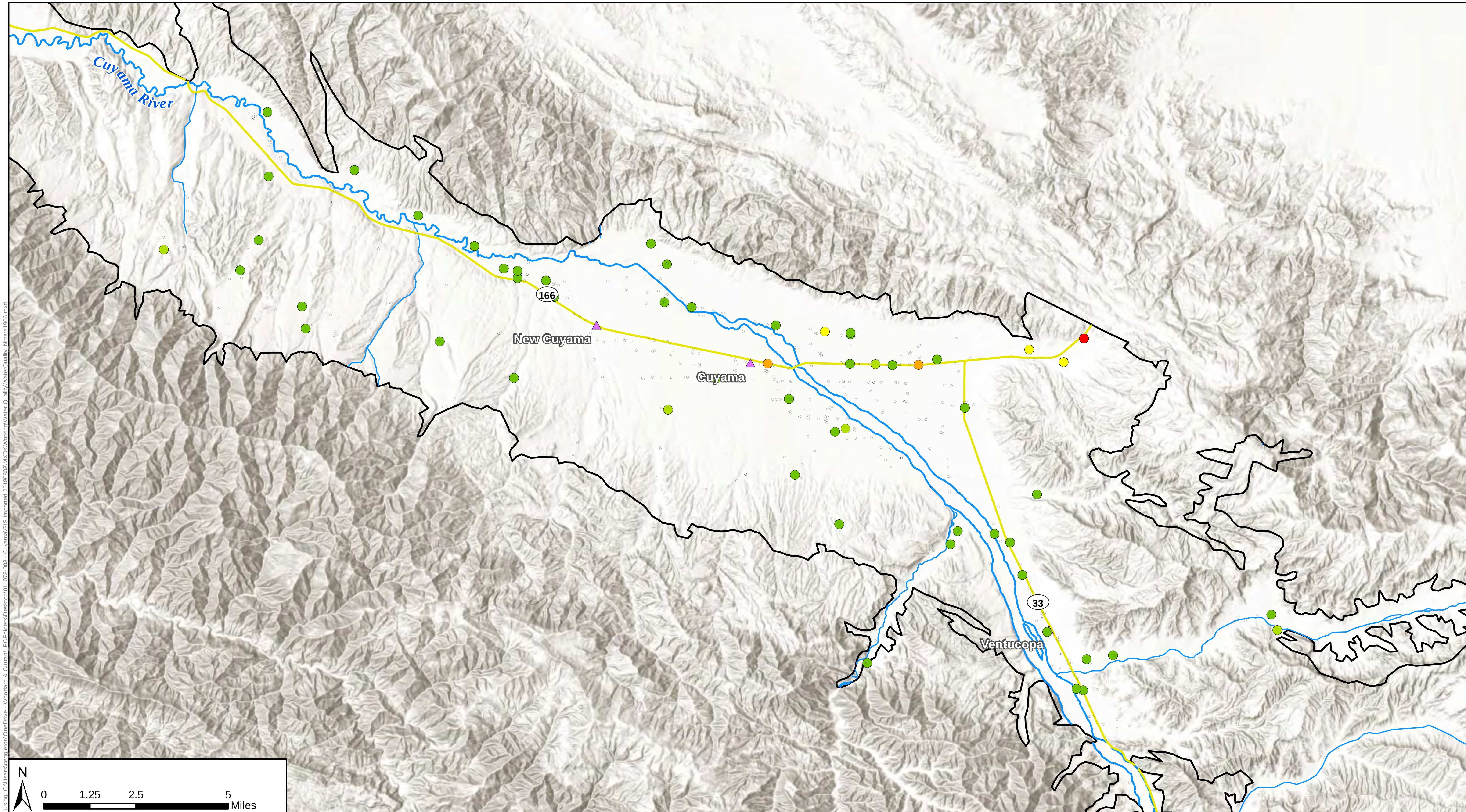

Figure 2-55: 1966 Average Well Measurements of Nitrate (NO3) as Nitrogen

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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

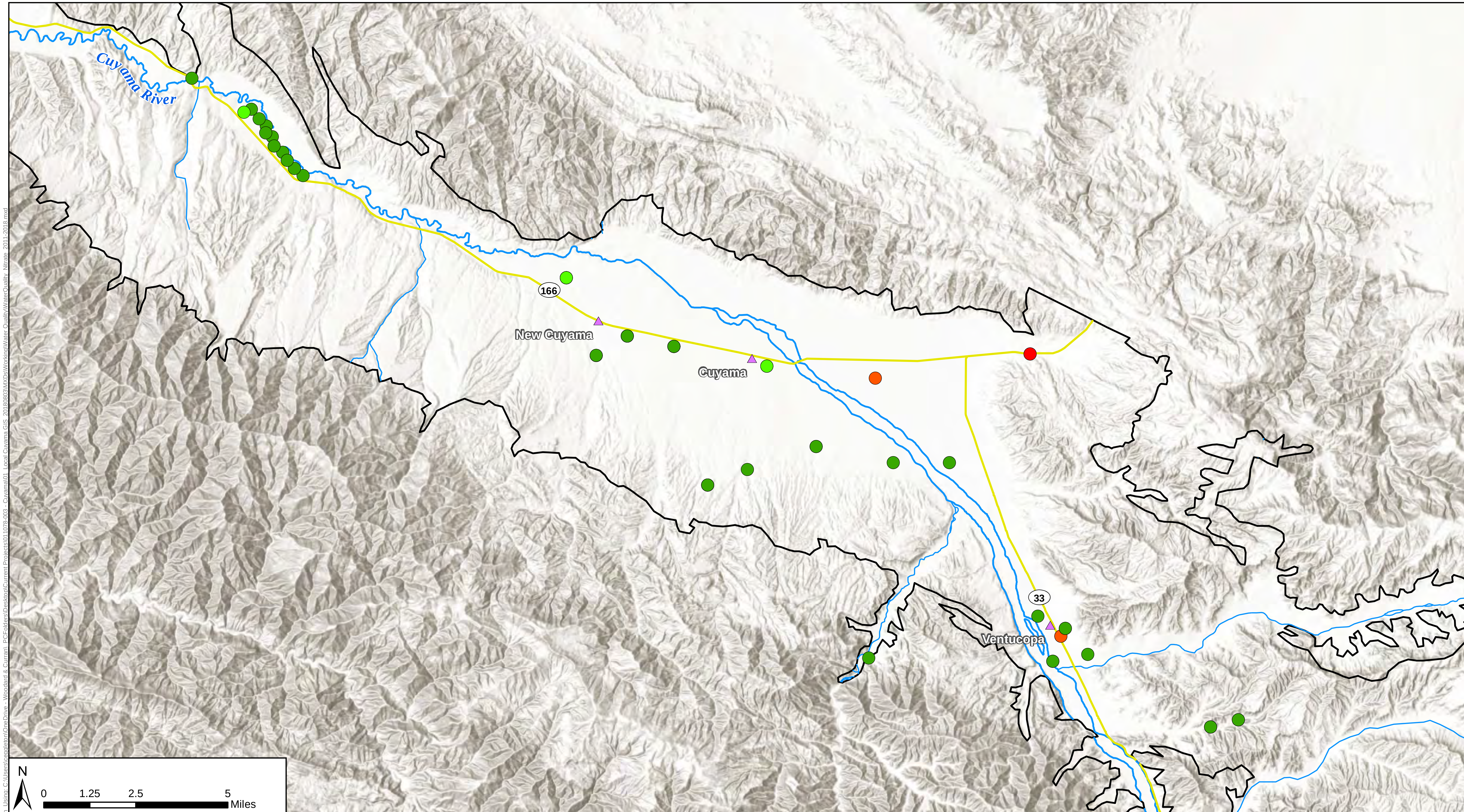

Figure 2-56: 2011-2018 Average Well Measurements of Nitrate (NO3) as Nitrogen

Cuyama Basin Groundwater Sustainability Agency

Cuyama Valley Groundwater Basin Groundwater Sustainability Plan

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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

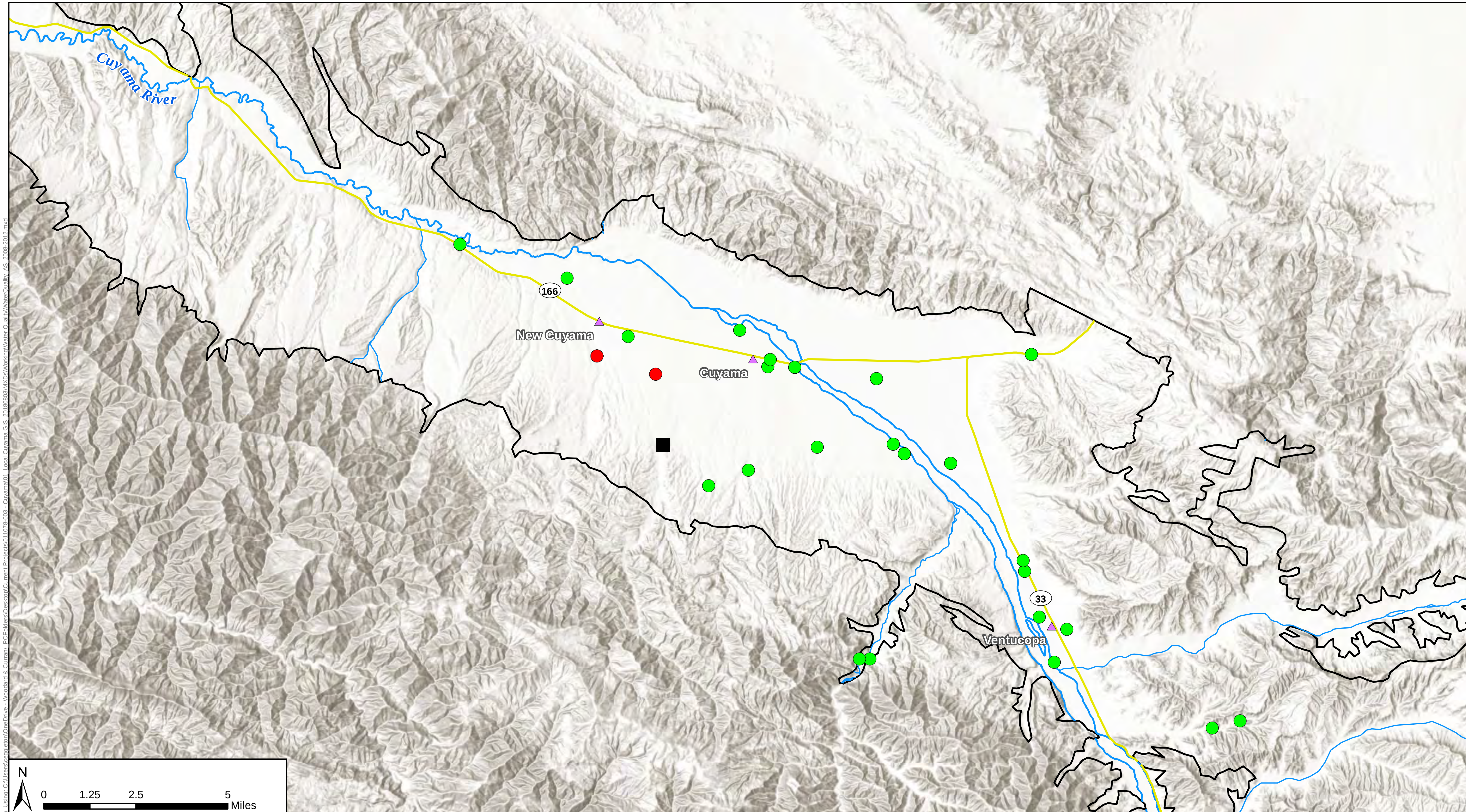

Figure 2-57: 2008-2018 Average Well Measurements of Arsenic, ug/L

Cuyama Basin Groundwater Sustainability Agency

Cuyama Valley Groundwater Basin Groundwater Sustainability Plan

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Legend

Aresenic (As), ug/L

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

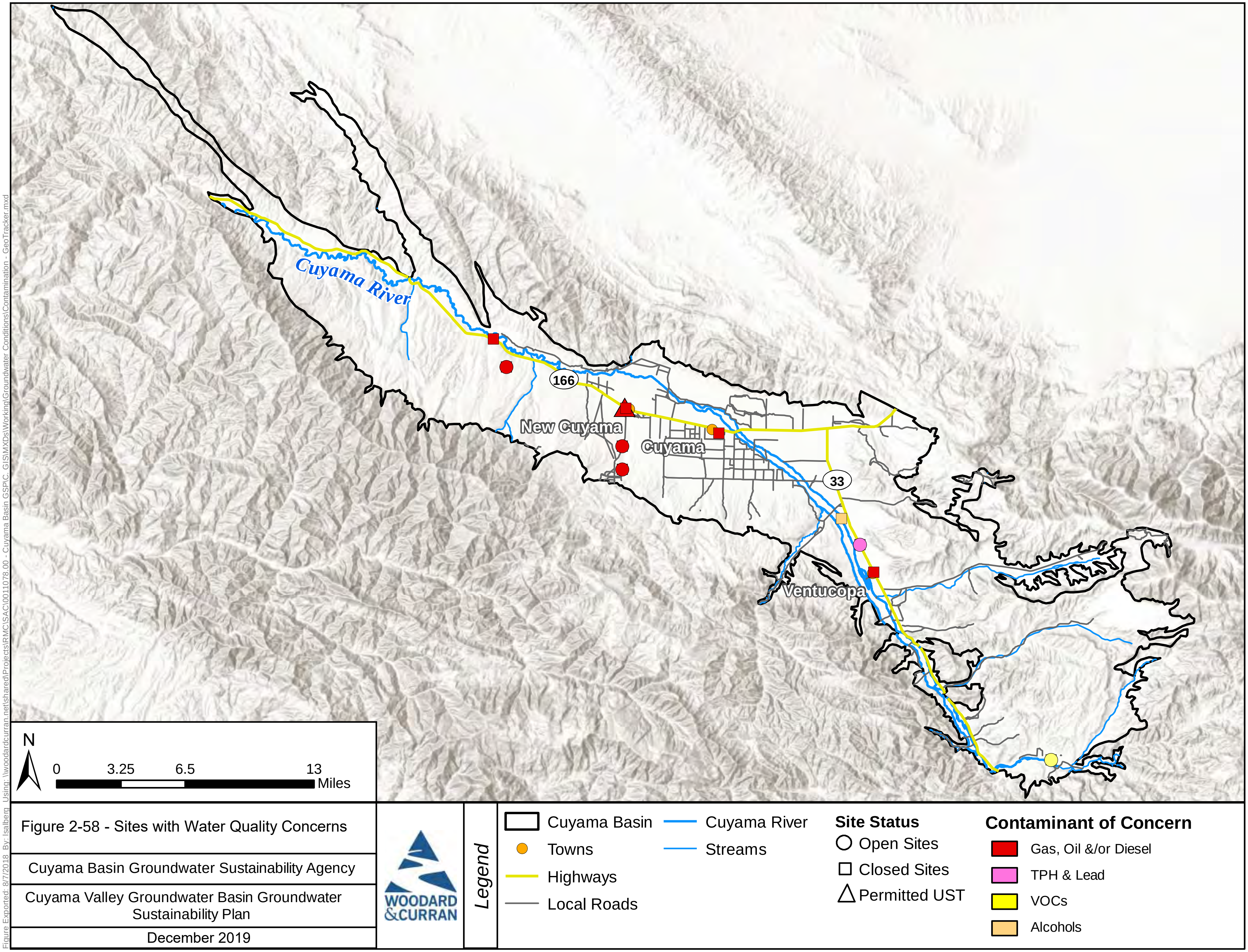


Figure 2-58 - Sites with Water Quality Concerns

Cuyama Basin Groundwater Sustainability Agency

Cuyama Valley Groundwater Basin Groundwater Sustainability Plan

December 2019

Figure Exported: 8/7/2018 By: Isalberg Using: \\woodardcurran.net\shared\Projects\RMC\SAC\0011078.00 - Cuyama Basin GSP\C. GIS\MXDs\Working\Groundwater Conditions\Contamination - GeoTracker.mxd

Literature Review

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

In 2008, USGS reported GAMA Program results. The GAMA Program sampled 12 Basin wells for a wide variety of constituents. Figure 2-59 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 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

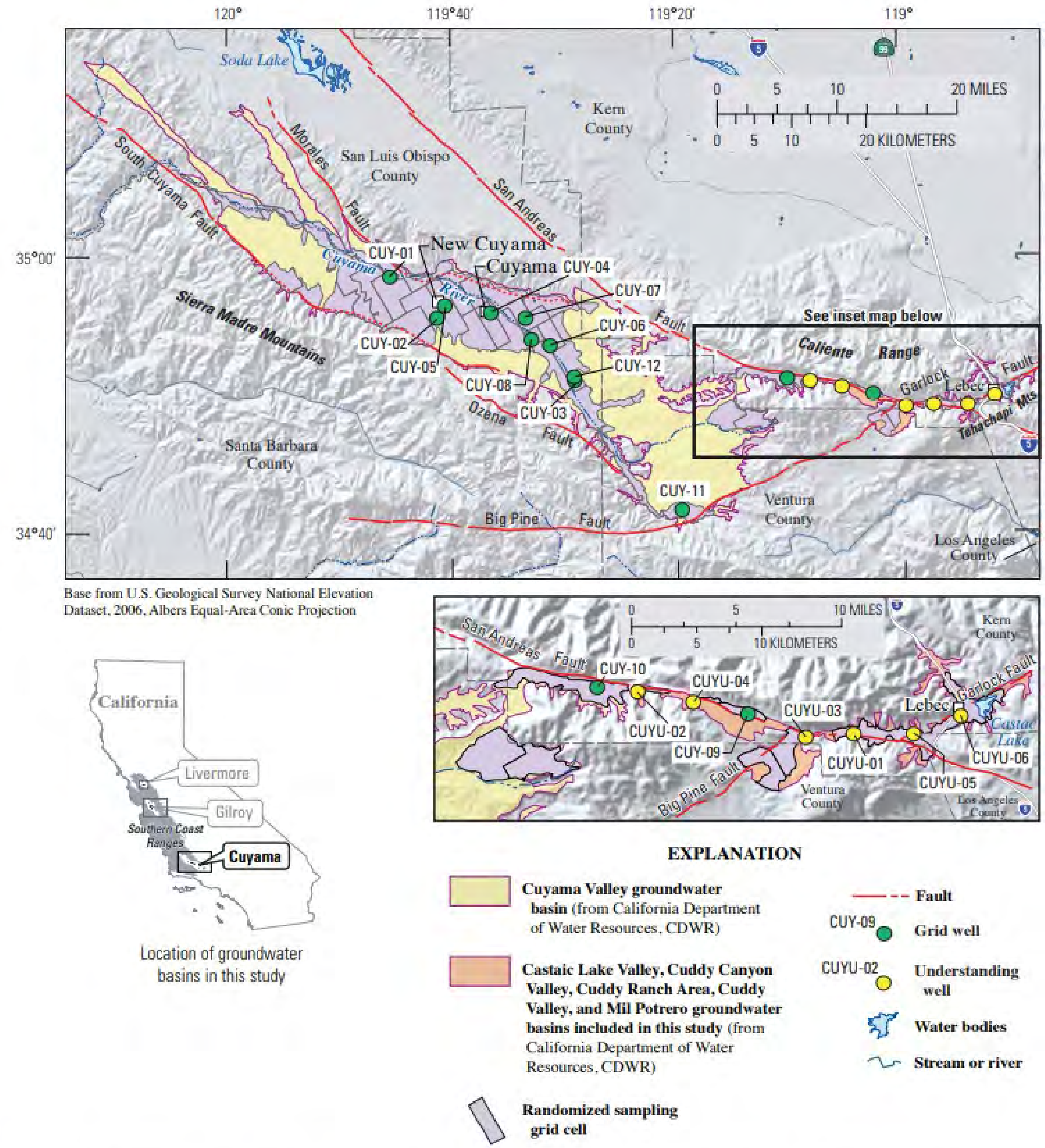


Figure 5. The South Coast Interior Basins Groundwater Ambient Monitoring and Assessment (GAMA) study unit showing the distribution of the Cuyama study-area grid cells, the location of sampled grid wells and understanding wells, the Cuyama Valley, Castaic Lake Valley, Cuddy Canyon Valley, Cuddy Ranch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

Source: USGS, 2008

Figure 2-59: Locations of GAMA Program Sample Locations

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

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

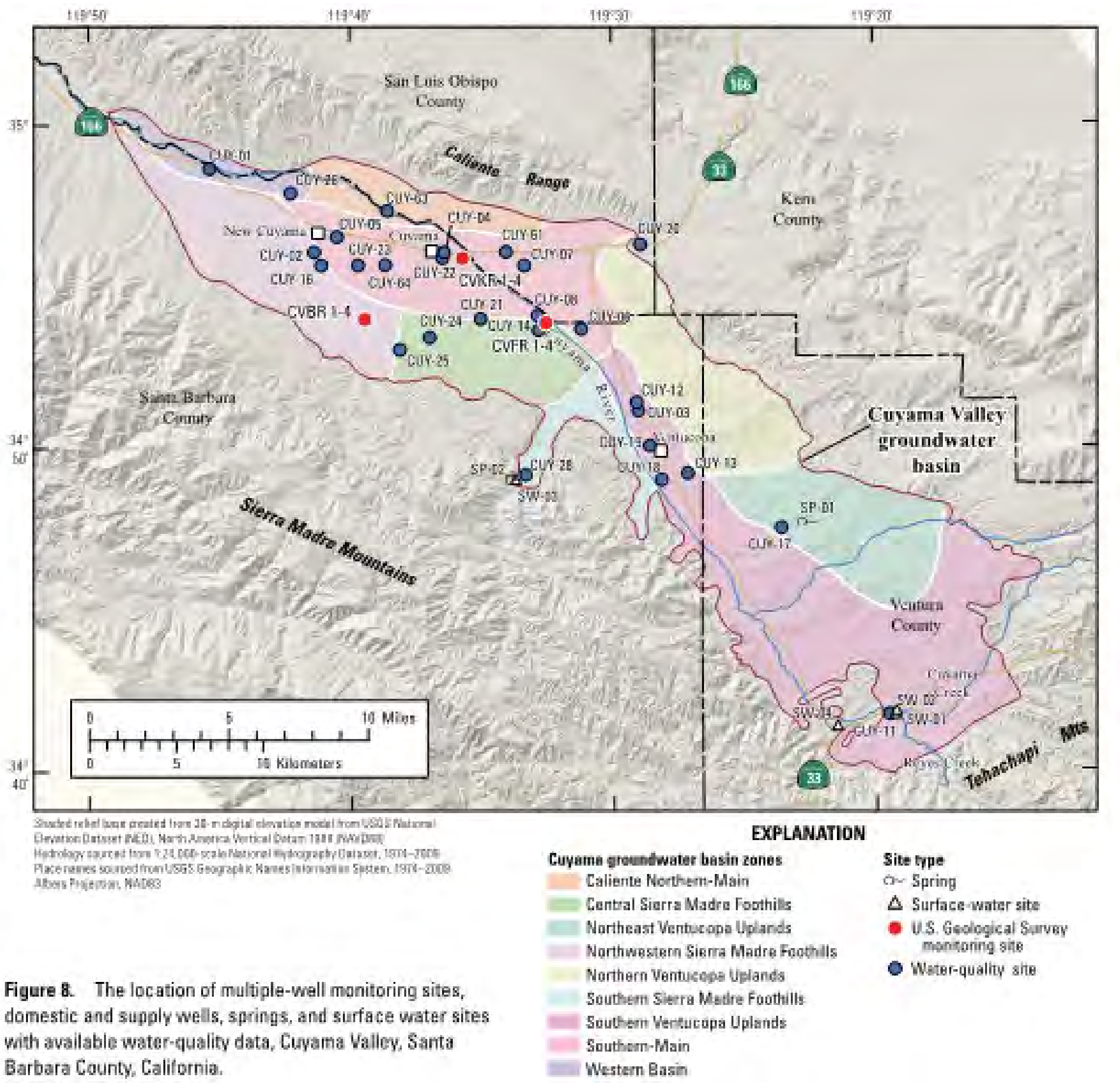
SBCWA also reported: "There was little change in TDS, calcium, magnesium, nitrates and sulfates during the 2009- 2011 period. In some cases, concentrations of these nutrients actually fell during the period, most likely due to a lack of rainfall, recharge and flushing of the watershed. As the Cuyama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

In 2013, USGS reported that they collected groundwater quality samples at 12 monitoring wells, 27 domestic wells, and 2 springs for 53 constituents including: field parameters (water temperature, specific conductance, pH, DO, alkalinity), major and minor ions, nitrate, trace elements, stable isotopes of hydrogen and oxygen, tritium and carbon-14 activities, arsenic, iron, and chromium. Figure 2-60 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 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.



USGS 2013c

Figure 2-60: USGS 2013c Water Quality Monitoring Sites

2.2.8 Interconnected Surface Water Systems

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

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

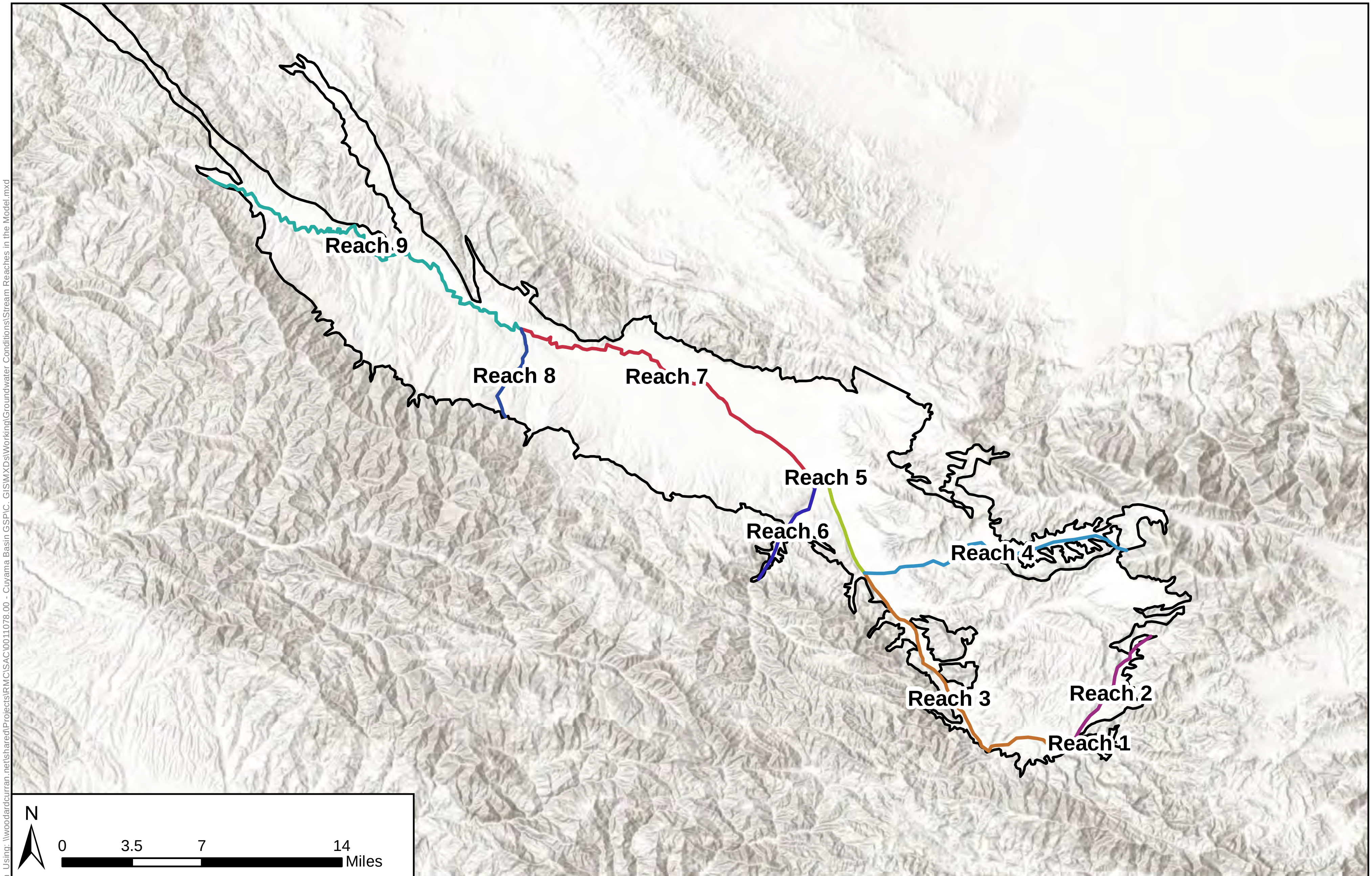


Figure 2-61: Stream Reaches Used in Cuyama Groundwater Model

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Legend

Cuyama Basin

Stream Reach

1
2
3
4
5
6
7
8
9

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Table 2-2: Stream Depletion by Reach

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

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2.2.9 Groundwater Dependent Ecosystems

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

DWR provided the NCCAG dataset through the SGMA data portal at https://gis.water.ca.gov/app/NCDatasetViewer/ . The NCCAG dataset was compiled using a set of six pre-existing dataset sources, and is explained in detail at: https://gis.water.ca.gov/app/NCDatasetViewer/sitedocs/# . Figure 2-62 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 2-63. Analysis concluded that there were 123 probable GDEs and 275 probable non-GDEs in the Basin, as shown in Figure 2-64.

The installation of piezometers to measure groundwater depths near GDE locations would be beneficial to help monitor the health of GDEs, especially in the western portion of the Basin. During GSP implementation, the CBGSA will solicit the assistance of private landowners in the western portion of the Basin to help support installation of piezometers.

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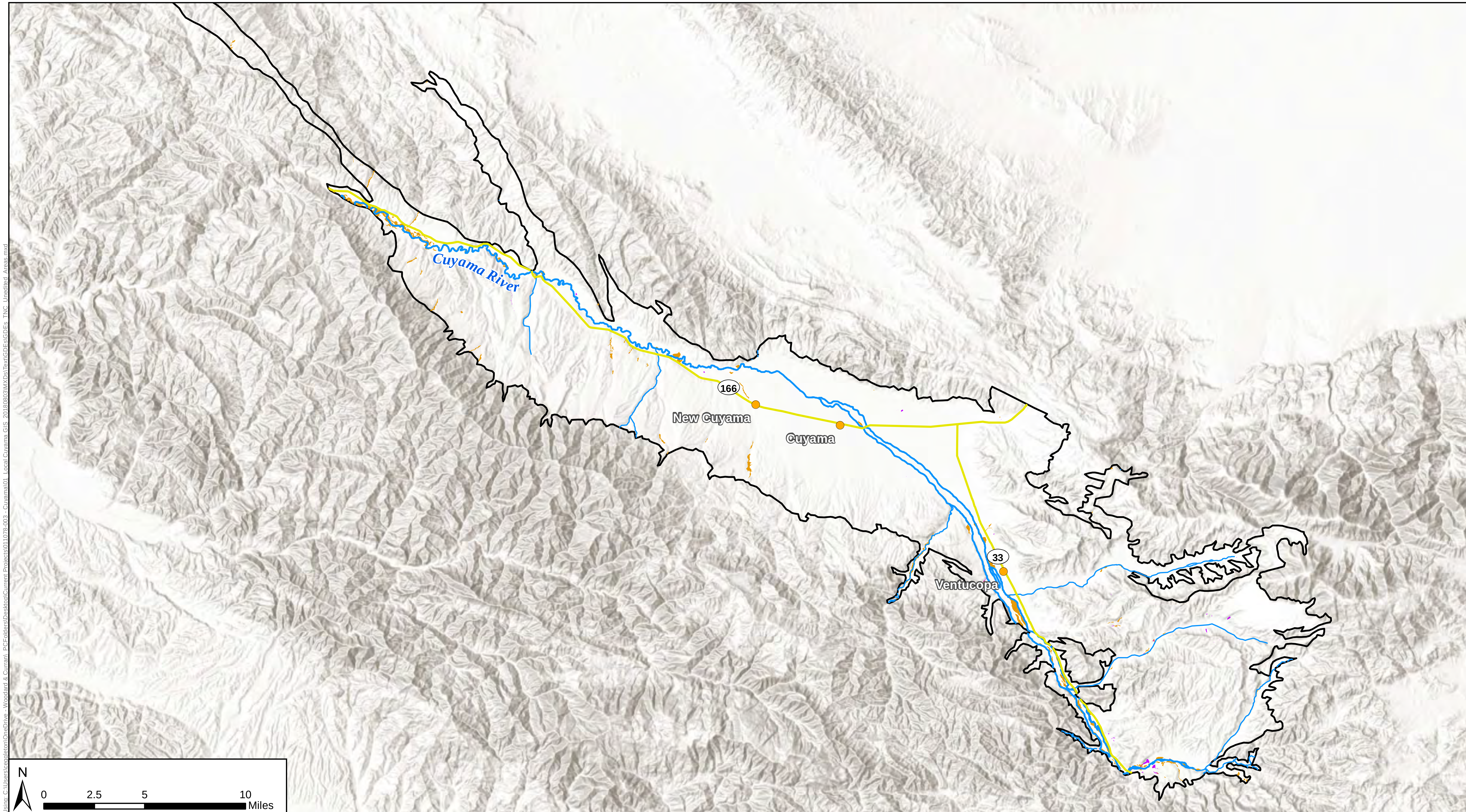

Figure 2-62 - Cuyama Basin TNC Identified NCCAG Dataset

Cuyama Basin Groundwater Sustainability Agency

Cuyama Valley Groundwater Basin Groundwater Sustainability Plan

December 2019

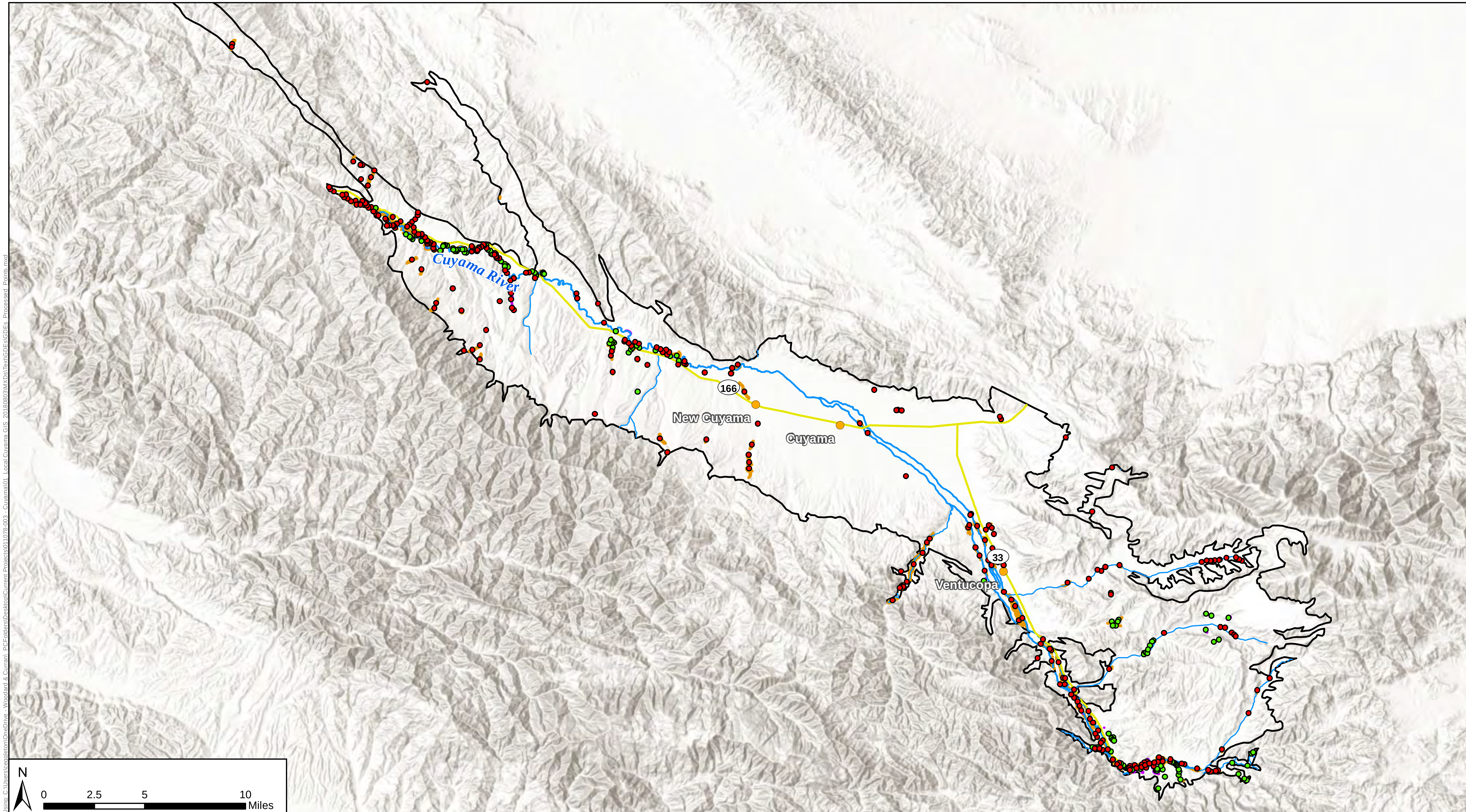

Figure 2-63 - Cuyama Basin NCAG GDE Point Analysis

Cuyama Basin Groundwater Sustainability Agency

Cuyama Valley Groundwater Basin Groundwater Sustainability Plan

December 2019

WOODARD & CURRAN

Legend

- Cuyama Basin
- TNC Identified Potential GDE Wetland
- TNC Identified Potential GDE Vegetation
- Cuyama NCAG Probable Non-GDEs
- Cuyama NCAG Probable GDEs
- Towns
- Cuyama River
- Streams
- Highways

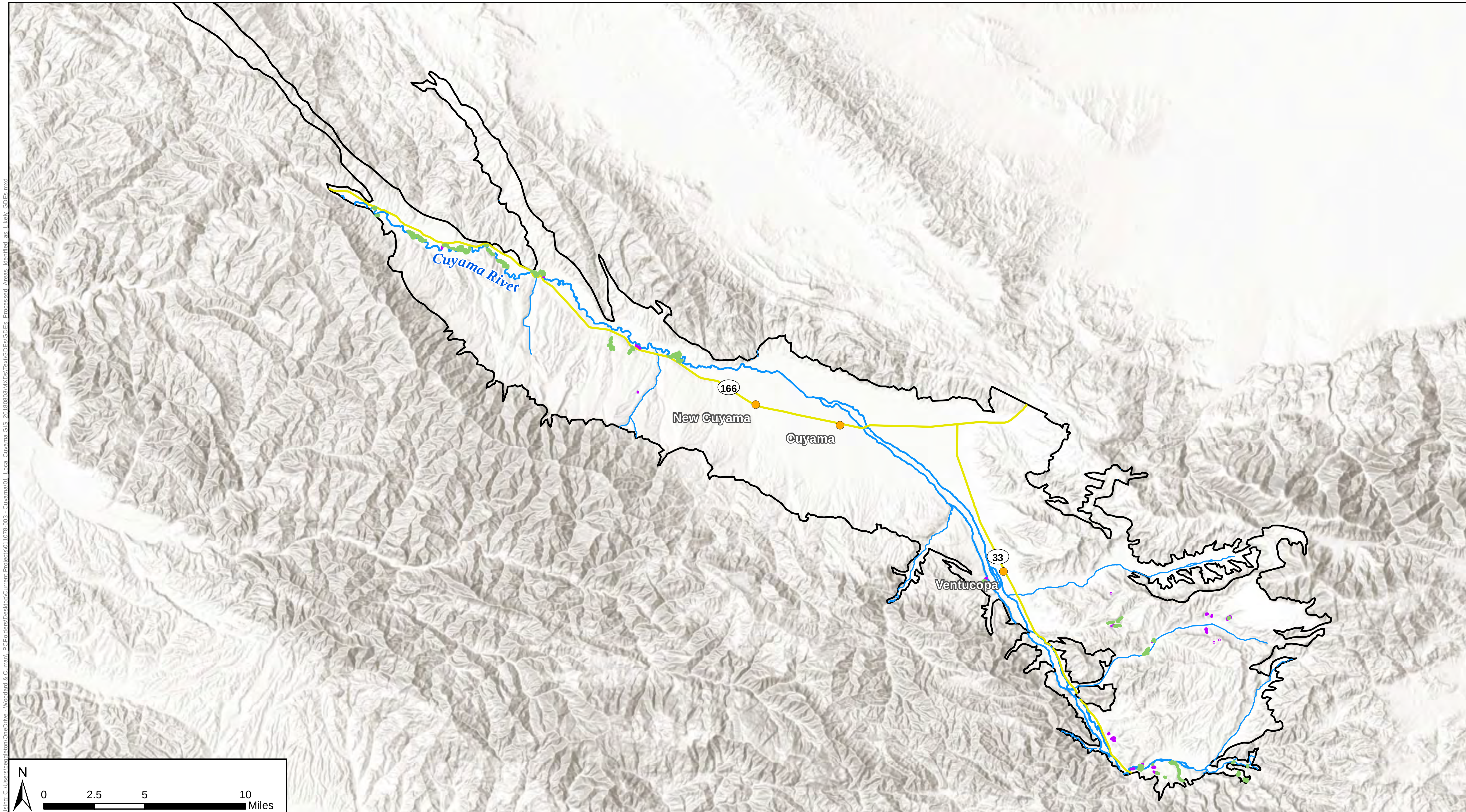

Figure 2-64 - Cuyama Basin Probable GDEs Based on Analysis

Cuyama Basin Groundwater Sustainability Agency

Cuyama Valley Groundwater Basin Groundwater Sustainability Plan

December 2019

WOODARD & CURRAN

Legend

- Cuyama Basin
- Towns
- Cuyama River
- Streams
- Highways
- Likely GDE Vegetation
- Liley GDE Weltlands

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2.2.10 Data Gaps

Groundwater conditions data gaps were identified during the development of this GSP, and when additional questions were asked by stakeholders during GSP development. Data gaps are summarized below.

- 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 depths where arsenic occurs are not known, making setting sustainability thresholds for arsenic not feasible
- 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
- Subsidence in the central portion of the Basin where groundwater levels are lowest is not monitored nor understood
- Vertical gradients in the majority of the Basin are not understood due to the lack of wells with completions of different depths near located near each other
- Salinity in groundwater in the Basin has a number of natural sources, but are not discretely identified
- GDEs could be evaluated in greater detail
- Faults are not well understood with regard to the degree they represent a barrier to flow and at what depth below the surface.
- The size of the Basin regarding groundwater in storage is not well understood.
- Information about many of the wells in the Basin is incomplete, and additional information is needed regarding well depths, perforation intervals and current status

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

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

Useful Terms

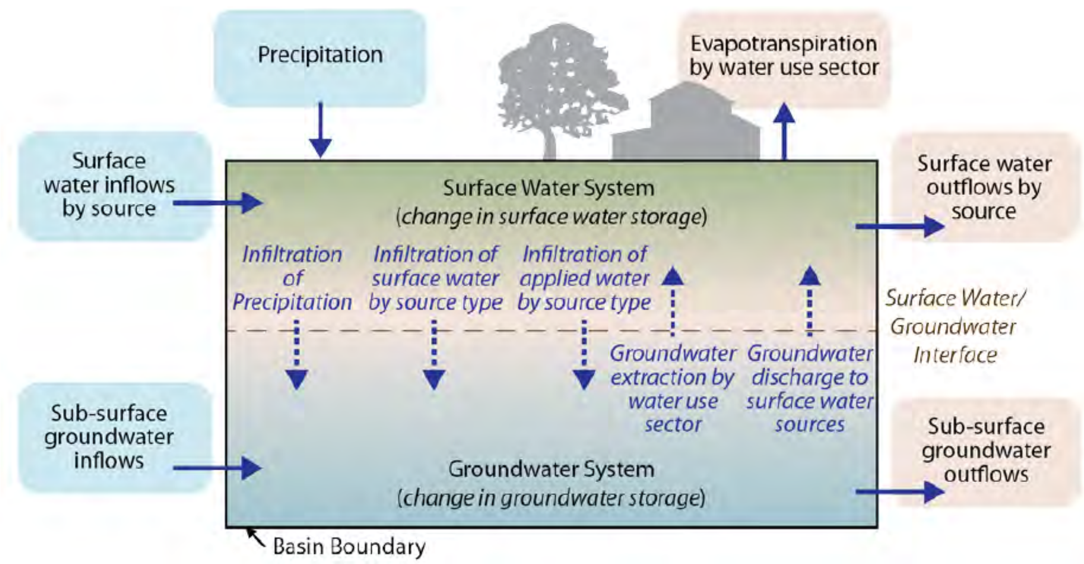
This section of Chapter 2 describes components of water budgets in the Basin. The terms listed here are intended as a guide for readers, and are not a definitive definition of any term.

- **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.

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 2-65 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 2-65: 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.

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 2-66 shows annual precipitation in the Basin for water years 1968 to 2017. The chart includes bars displaying annual precipitation for each water year and a horizontal line representing the mean precipitation of 13.1 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 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 2-66. The cumulative departure from mean precipitation is based on these data sets, and is displayed as a line that starts at zero and highlights wet periods with upward slopes and dry periods with downward slopes. More severe events are shown by steeper slopes and greater changes. The period from 2013 to 2014 illustrates a short period with dramatically dry conditions (i.e., a 16-inch decline in cumulative departure over two years).

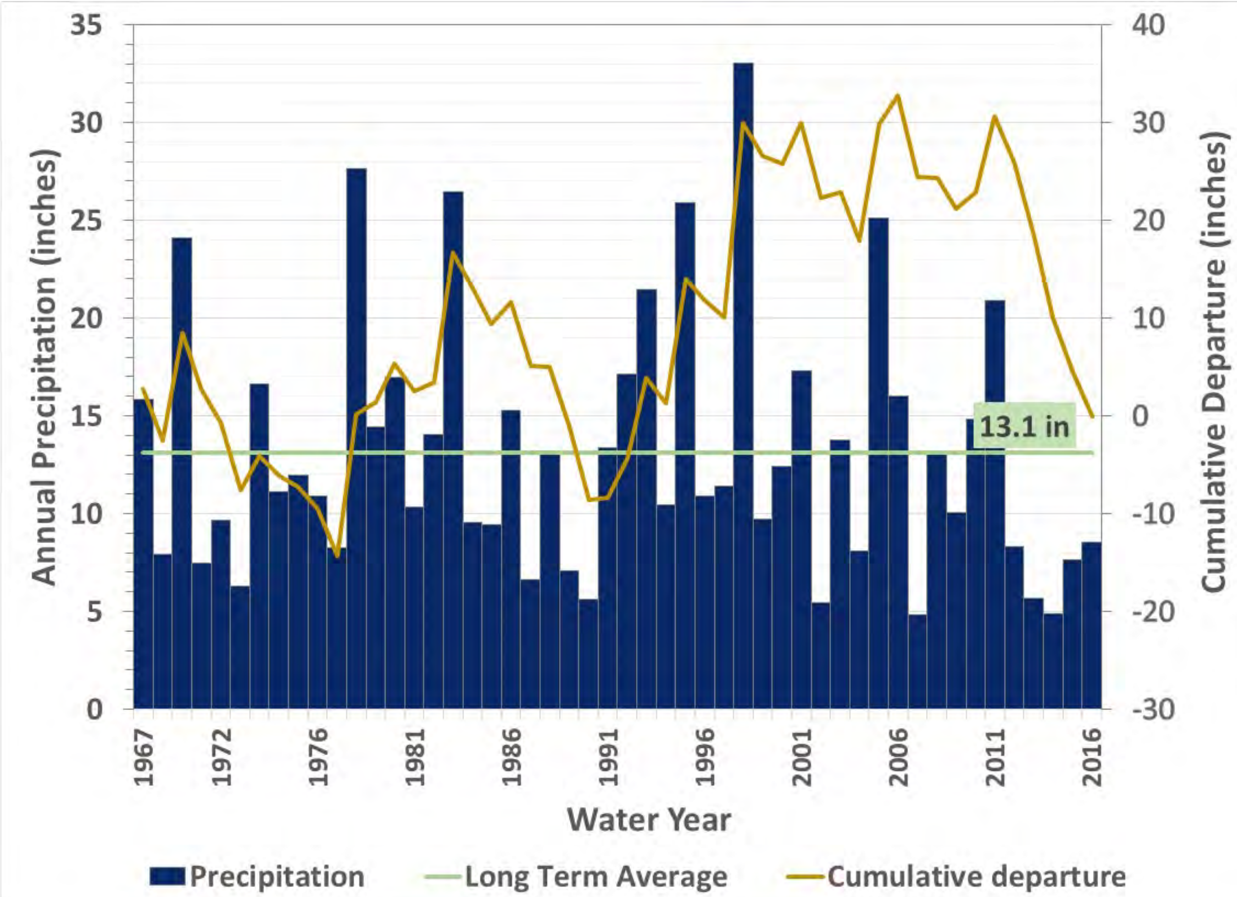


Figure 2-66: 50-Year Historical Precipitation and Cumulative Departure from Mean Precipitation

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. These calls provided opportunities for Technical Forum members to review and comment on all major aspects of model development.

The CBWRM integrates the groundwater aquifer with the surface hydrologic system and land surface processes and operations. The CBWRM was calibrated for the hydrologic period of October 1995 to September 2015 by comparing simulated evapotranspiration, groundwater levels, and streamflow records with historical observed records. Development of the model involved study and analysis of hydrogeologic conditions, agricultural and urban water demands, agricultural and urban water supplies, and an evaluation of regional water quality conditions. The model was developed based on the best available data and information as of June 2018. It is expected that the model will be refined in the future as improved and updated monitoring information becomes available for the Basin. These refinements may result in changes in the estimated water budgets described in this section.

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

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

- The **historical water budget** was based on a simulation of historical conditions in the Basin.
- The **current water budget** was based on a simulation of current (2017) land and water use over historical hydrologic conditions, assuming no other changes in population, water demands, land use, or other conditions.
- The **projected water budget** was based on a simulation of future land and water use over the historical hydrologic conditions. Since future land and water use in the Cuyama Basin is assumed to be the same as current conditions, the projected water budget is the same as the current water budget.

Water Budget Definitions and Assumptions

Definitions and assumptions for the historical, current, and projected water budgets are provided below. Table 2-2 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 2017 was selected for the historical water budget to provide a period of representative hydrology while capturing recent Basin operations. The period 1998 through 2017 has an average annual precipitation of 12.2 inches, nearly the same as the long-term average of 13.1 inches and includes the recent 2012 to 2017 drought, the wet years of 1998 and 2005, 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 2017 conditions with a historical precipitation sequence and a year-to-year variance in cropping patterns that matches the historical variability. Because there is no basis to assume any changes in Basin population or land use in the future as compared to current conditions (in the absence of projects or actions), a single baseline has been developed that reflects both current and projected conditions.

The current and projected conditions baseline includes the following conditions:

- Hydrologic period:
  - Water years 1968 to 2017 (i.e., a 50-year hydrology)
- Precipitation is based on:
  - PRISM dataset for the period from 1968 to 2017
- Land use is based on:
  - Land use estimates developed by DWR and the CBGSA using remote sensing data
  - Land use information for historical years provided by private landowners
- 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

Table 2-3: Summary of Groundwater Budget Assumptions

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

Projected Water Budget with Climate Change

A second projected level water budget has been developed that incorporates the projected effects of climate change. The projected conditions with climate change baseline are the same as the current and projected conditions baseline, except that adjustments have been made to estimated precipitation and agricultural and native vegetation evapotranspiration during the 50-year hydrologic period. The estimated precipitation and evapotranspiration from 1968 to 2017 were adjusted using perturbation factors developed from the Central Tendency climate scenario data provided by DWR. On average, the perturbation factors for this scenario result in an increase in precipitation of about 1.4 percent and in an increase in crop evapotranspiration of about 5.4 percent. Additional information about how precipitation and evapotranspiration were adjusted for climate change can be found in the 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 Tables 2-4 and 2-5 for the historical period and for current and projected conditions. The following sections provide additional information regarding each water budget.

Table 2-4: Average Annual Land Surface Water Budget

Component	Historical Water Volume[a] (AFY)	Current and Projected Water Volume[b] (AFY)	Projected Water Volume With Climate Change[b] (AFY)
Inflows			
Precipitation	226,000	230,000	233,000
Applied water	58,000	59,000	63,000
Total Inflow	**285,000**	**289,000**	**296,000**
Outflows			
Evapotranspiration			
Agriculture	58,000	63,000	66,000
Native vegetation	167,000	174,000	174,000
Domestic water use	300	400	400
Deep Percolation			
Precipitation	18,000	15,000	15,000
Applied water	10,000	11,000	11,000
Runoff	32,000	26,000	29,000
Total Outflow	**285,000**	**289,000**	**296,000**

Notes:
AFY = acre-feet per year
[a]From water years 1998 to 2017
[b]Based on 50-year hydrology

Table 2-5: Average Annual Groundwater Budget			
Component	**Historical Water Volume[a] (AFY)**	**Current and Projected Water Volume[b] (AFY)**	**Projected Water Volume with Climate Change[b] (AFY)**
Inflows			
Deep percolation	28,000	25,000	26,000
Stream seepage	3,000	5,000	6,000
Subsurface inflow	5,000	5,000	5,000
Total Inflow	**36,000**	**35,000**	**37,000**
Outflows			
Groundwater pumping	59,000	60,000	64,000
Total Outflow	**59,000**	**60,000**	**64,000**
Change in Storage	**(23,000)**	**(25,000)**	**(27,000)**

Notes:
AFY = acre-feet per year
[a]From water years 1998 to 2017
[b]Based on 50-year hydrology

Historical Water Budget

The historical water budget is a quantitative evaluation of the historical surface and groundwater supply covering the 20-year period from 1998 to 2017. This period was selected as the representative hydrologic period to calibrate and reduce the uncertainty of the IWFM. Proper analysis and calibration of water budgets within IWFM ensures the hydrologic characteristics of the groundwater basin are accurately represented. The goal of the water budget analysis is to characterize the supply and demand, while summarizing the hydrologic flow within the Basin, including the movement of all primary sources of water such as rainfall, irrigation, streamflow, and subsurface flows.

Figure 2-67 summarizes the average annual historical land surface inflows and outflows in the Basin. Figure 2-68 shows the annual time series of historical land surface inflows and outflows.

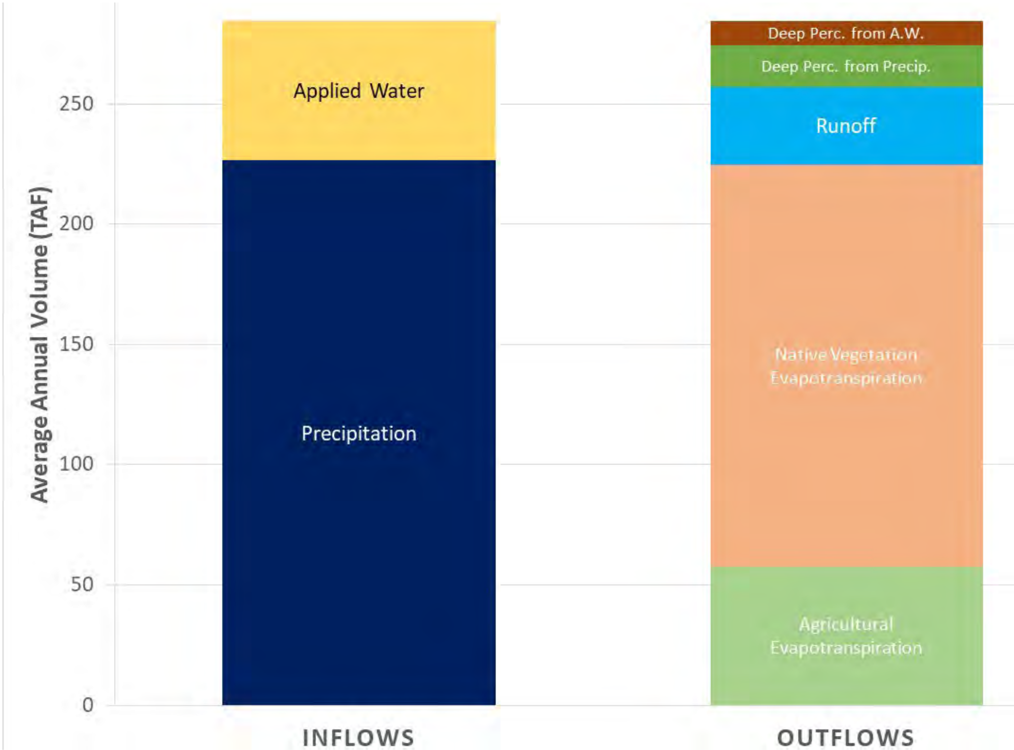


Figure 2-67: Historical Average Annual Land Surface Water Budget

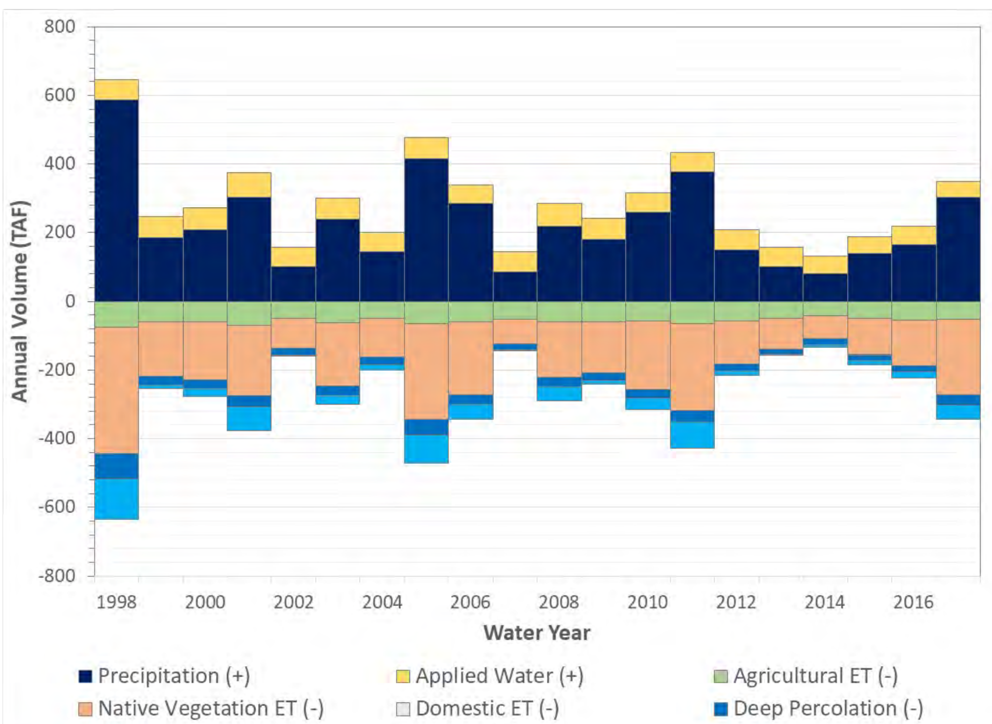


Figure 2-68: Historical Land Surface Water Budget Annual Time Series

The Basin experiences about 285,000 AF of land surface inflows each year, of which 226,000 AF is from precipitation and the remainder is from applied water. About 225,000 AF 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 132,000 AF to a high of 645,000 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 444,000 AF.

Figure 2-69 summarizes the average annual historical groundwater inflows and outflows in the Basin. Figure 2-70 shows the annual time series of historical groundwater inflows and outflows. The Basin average annual historical groundwater budget has greater outflows than inflows, leading to a projected average annual decrease in groundwater storage (i.e., overdraft) of 23,000 AF. Accounting for potential uncertainties in numerical model parameters (as described in Appendix C), the projected average annual overdraft could range from 21,000 to 26,000 AF. The groundwater storage decreases consistently over time, despite year-to-year variability in groundwater inflows.

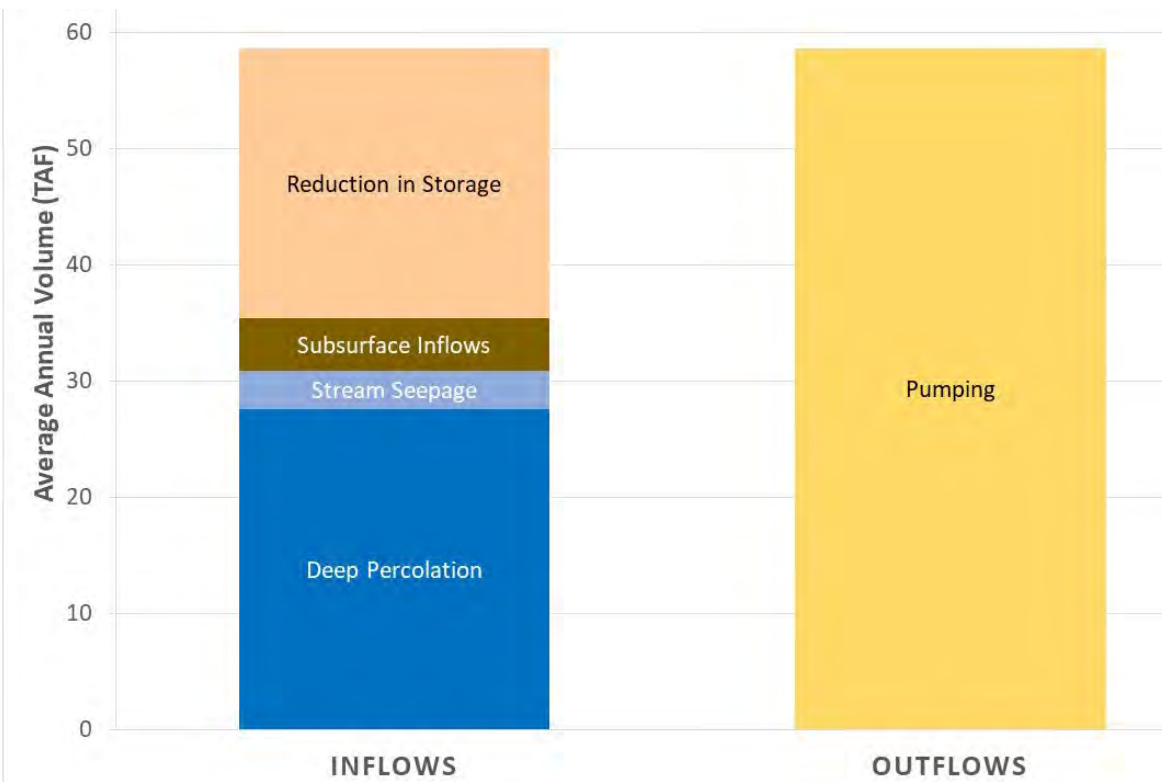


Figure 2-69: Historical Average Annual Groundwater Budget

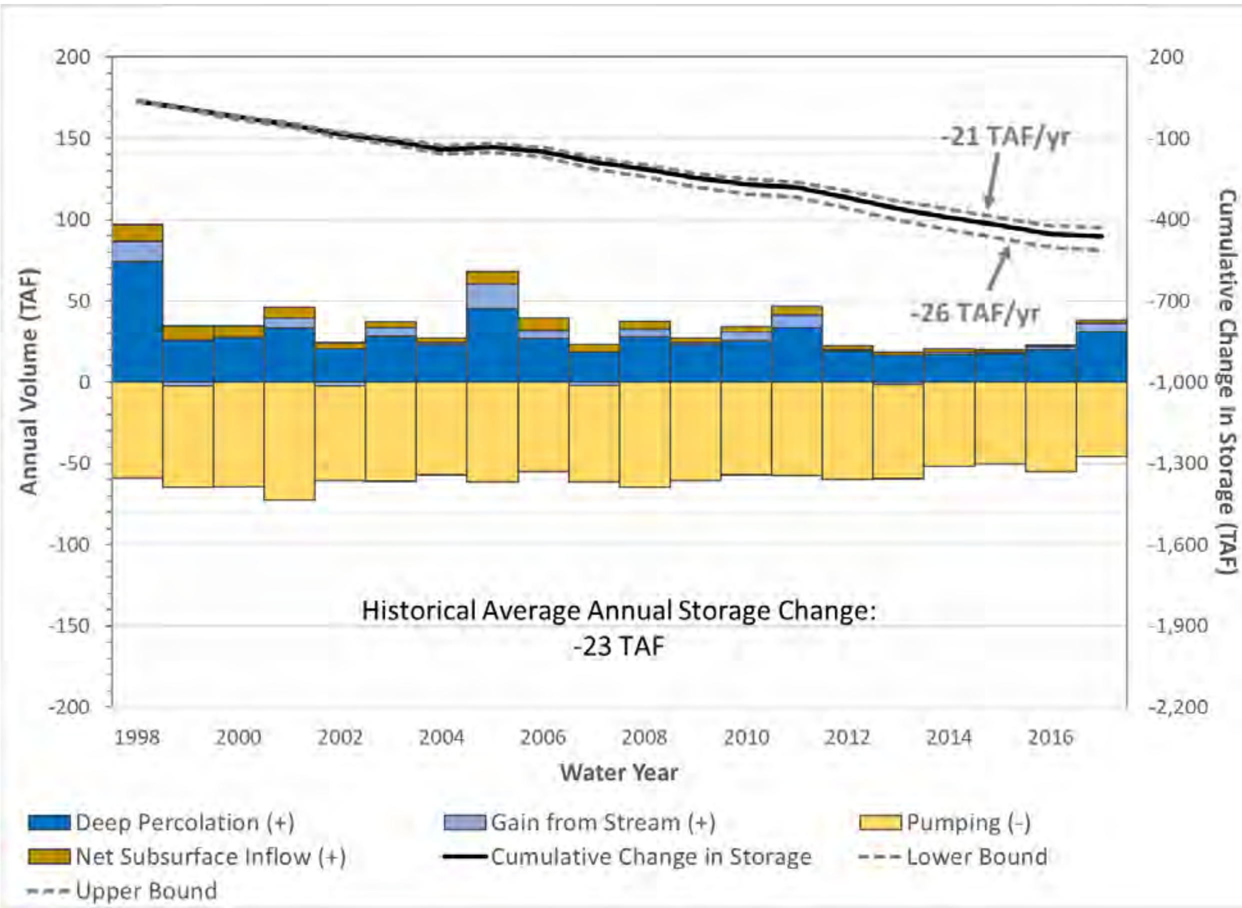


Figure 2-70: Historical Groundwater Budget Annual Time Series

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 2017 population, water use, and land use information.

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

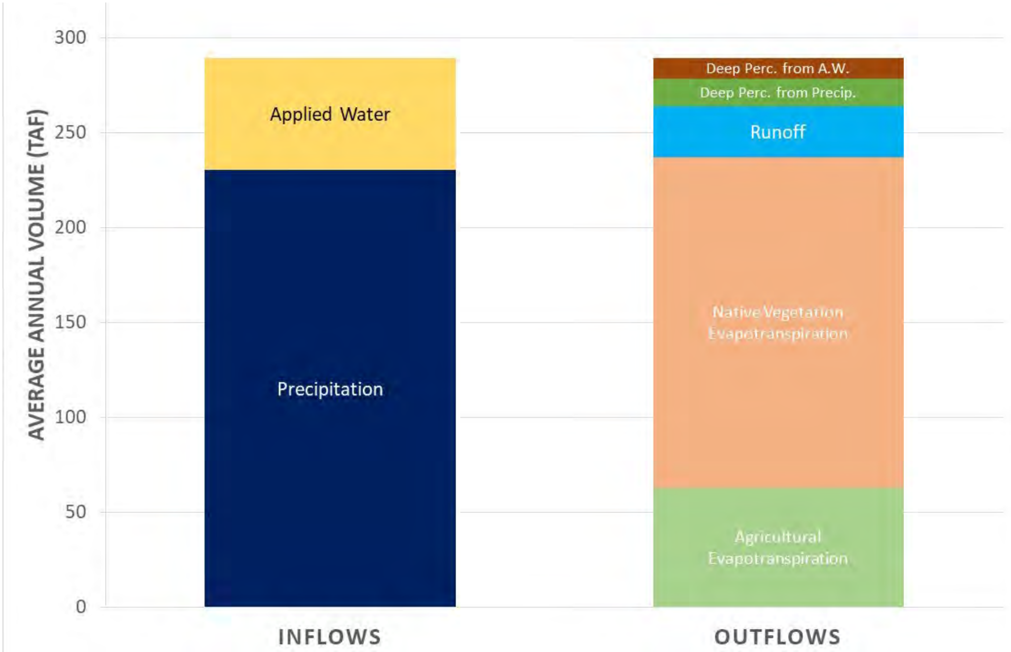


Figure 2-71: Current and Projected Average Annual Land Surface Water Budget

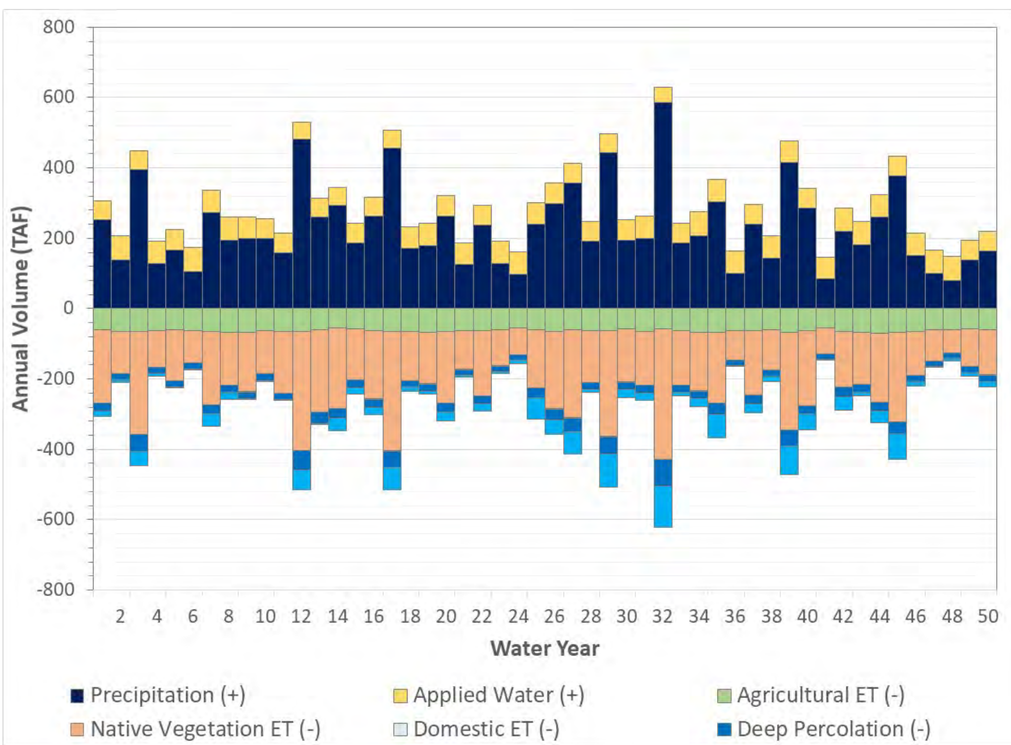


Figure 2-72: Current and Projected Land Surface Water Budget Annual Time Series

Under current and projected conditions, the Basin experiences about 290,000 AF of land surface inflows each year, of which 230,000 AF is from precipitation and the remainder is from applied water. About 238,000 AFY is consumed as evapotranspiration or domestic use, with the remainder either recharging the groundwater aquifer as deep percolation or stream seepage or leaving the Basin as river flow.

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

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

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

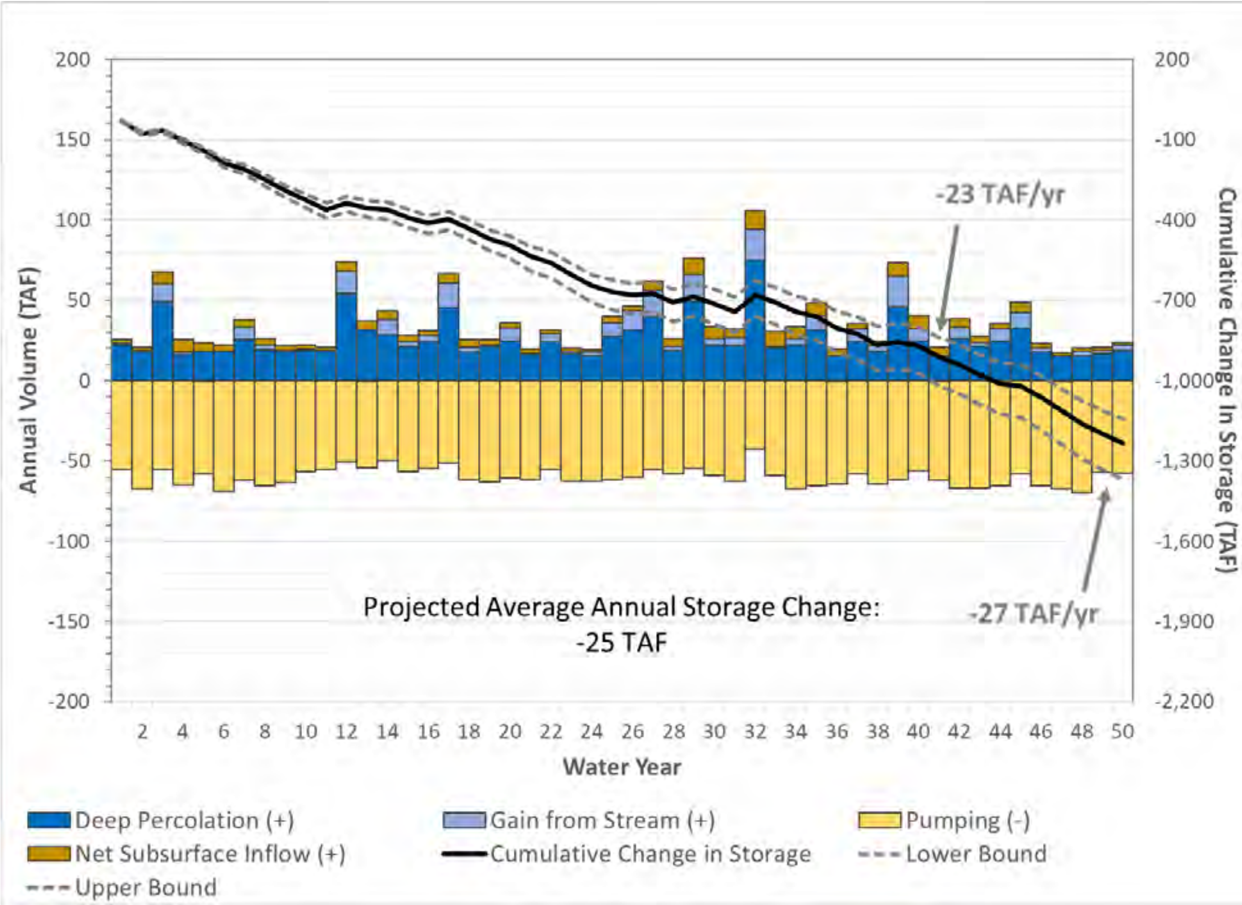


Figure 2-74: Current and Projected Groundwater Budget Annual Time Series

The current and projected water demand, water supply, and change in groundwater storage vary by water year type[9], as shown in Table 2-6. In wet years, precipitation meets a relative high proportion of the water demand, which reduces the need for groundwater. By contrast, in drier years more groundwater pumping is required to meet the agricultural demand not met by precipitation. This leads to an increase in groundwater storage in wet years and a decrease in the other year types.

[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

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

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

Projected Water Budget with Climate Change

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

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

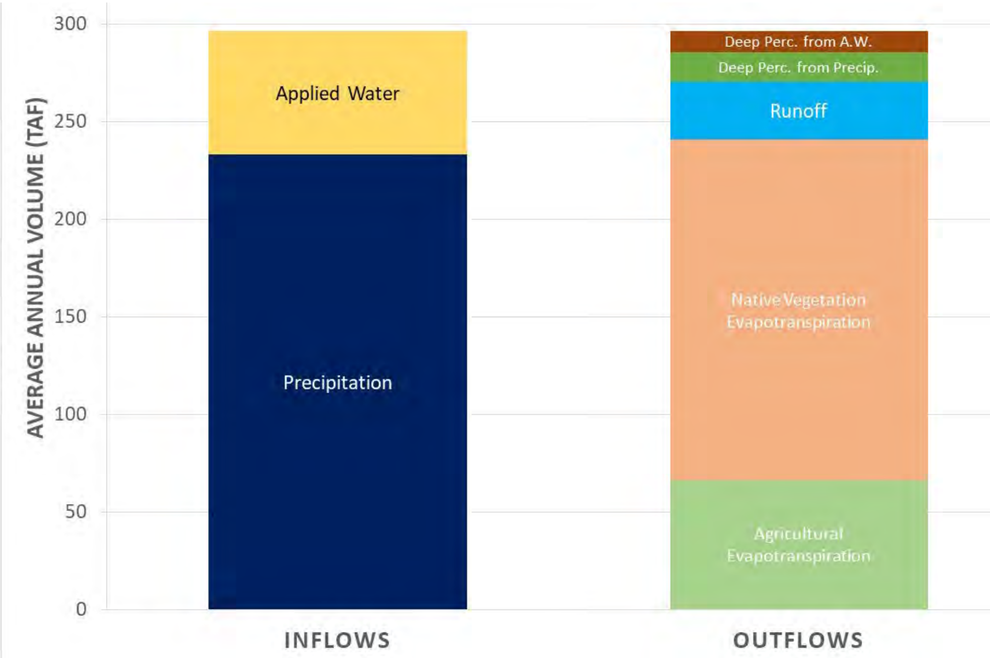


Figure 2-75: Projected Average Annual Land Surface Water Budget with Climate Change

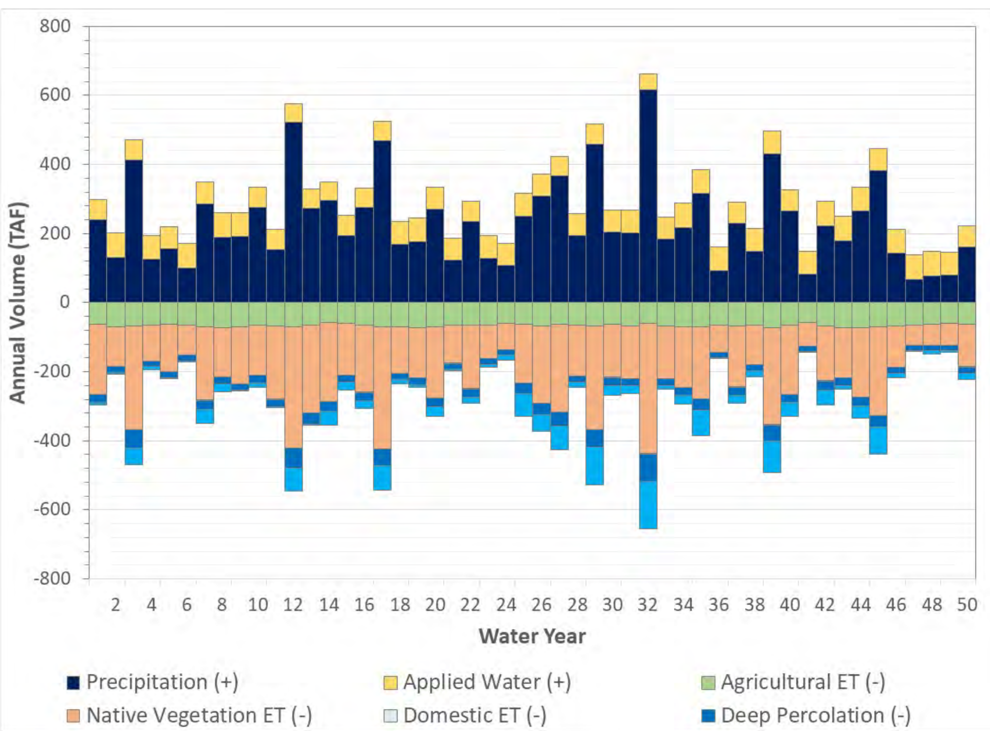


Figure 2-76: Projected Land Surface Water Budget with Climate Change Annual Time Series

Under projected conditions with climate change, the Basin experiences about 296,000 AF of land surface inflows each year, of which 233,000 AF is from precipitation and the remainder is from applied water. About 241,000 AFY is consumed as evapotranspiration or domestic use, with the remainder either recharging the groundwater aquifer as deep percolation or stream seepage or leaving the Basin as river flow.

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

Figure 2-77 summarizes the average annual projected groundwater inflows and outflows with climate change in the Basin. Figure 2-78 shows the annual time series of projected groundwater inflows and outflows with climate change. The Basin average annual current and projected groundwater budget has greater outflows than inflows, leading to an average annual decrease in groundwater storage (i.e., overdraft) of 27,000 AF. As with the historical conditions, the groundwater storage decreases consistently over time, despite year-to-year variability in groundwater inflows.

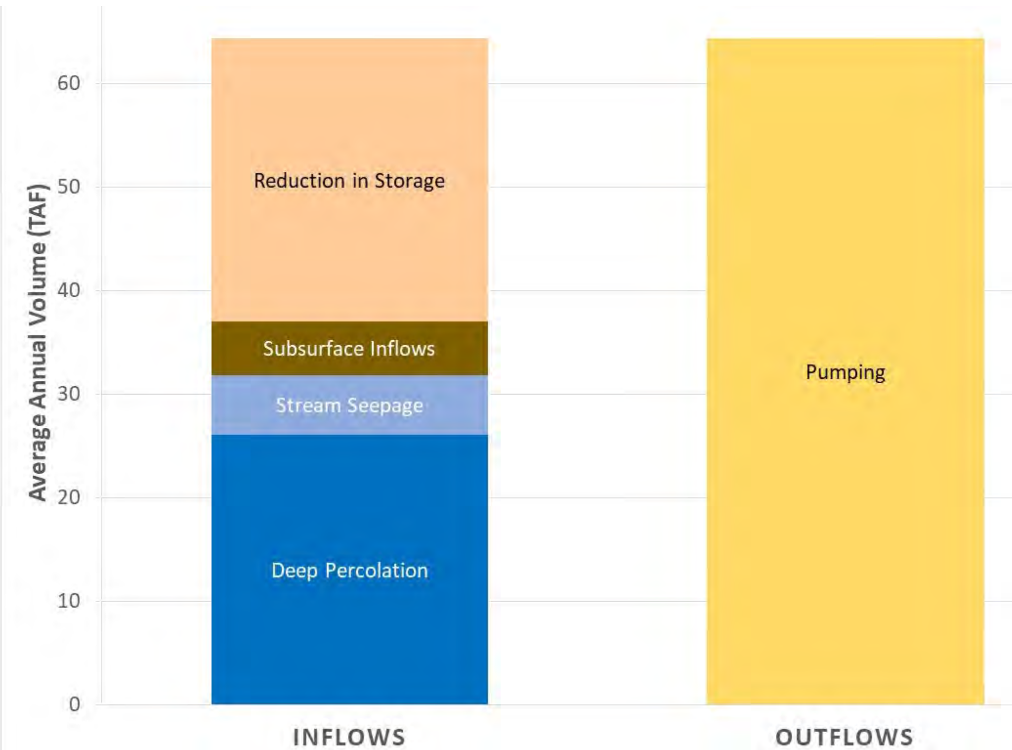


Figure 2-77: Current and Projected Average Annual Groundwater Budget

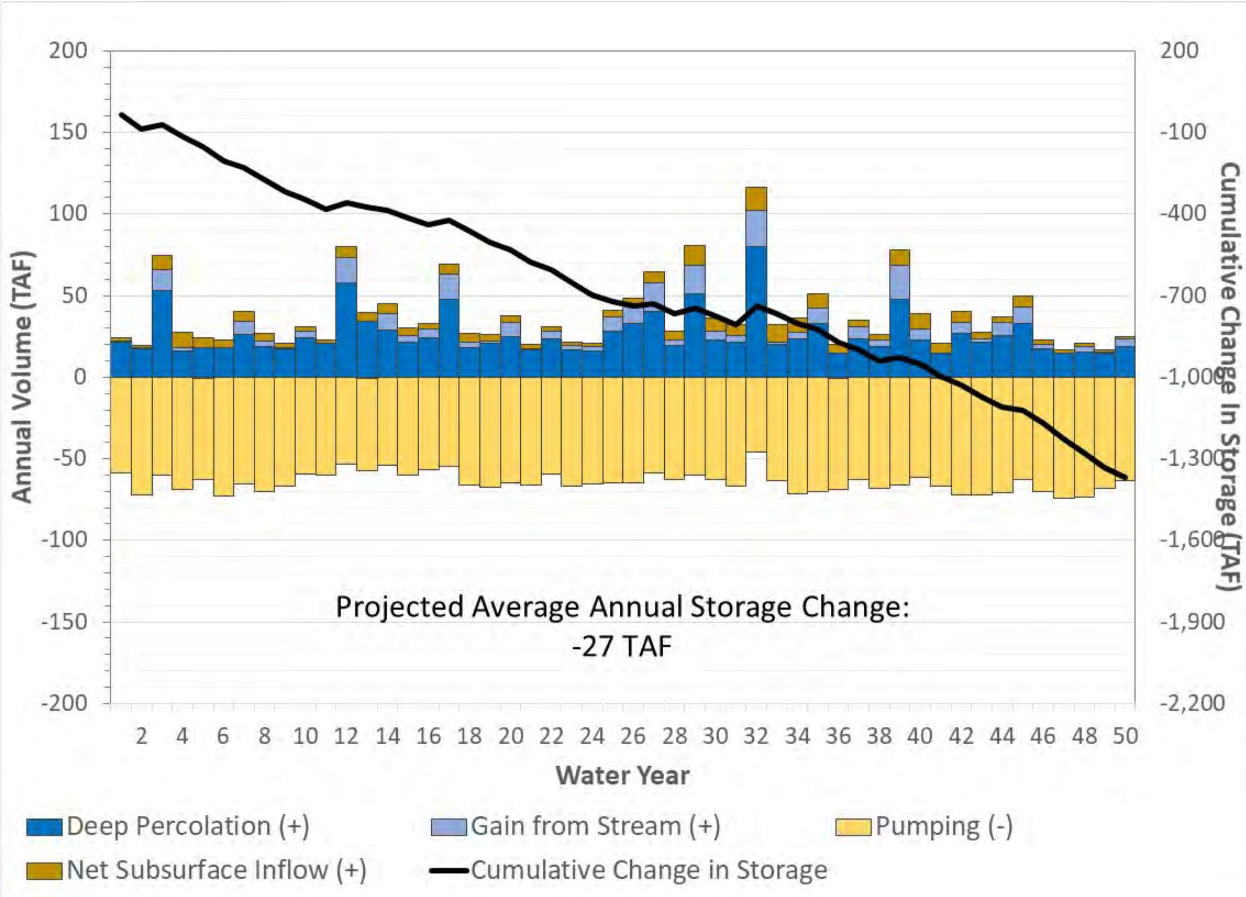


Figure 2-78: Current and Projected Groundwater Budget Annual Time Series

Sustainable Yield Estimates

Four simulations were performed 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 simulations were performed using the current and projected conditions and projected conditions with climate change baselines described above, with projects and pumping reductions implemented so as to achieve an exact balance between supplies and demands in the Basin-wide groundwater budget on average over the 50-year simulation period.

Each simulation incorporating water supply projects was performed using example projects intended to estimate the potential water supply benefits from those projects. It is anticipated that these projects will be further evaluated and refined in the future prior to potential implementation. The analyses included the following water supply projects:

- **Flood and stormwater capture –** it was assumed that facilities would be developed to capture stormwater flows and recharge them into the groundwater aquifer in the central basin area. It was assumed that approximately 2,500 AF per year could be captured and recharged.
- **Precipitation enhancement –** it was assumed that cloud seeding would be performed to increase precipitation in the upper watershed areas. Based on previous studies of potential cloud seeding programs, it was assumed that precipitation would increase by 10% on average.

Chapter 7 of this GSP describes these potential water supply projects in greater detail. Chapter 7 also describes potential mechanisms to reduce groundwater pumping.

As noted above, these simulations were performed using the best available data and information as of June 2018. It is expected that the model will be refined in the future as improved and updated monitoring information becomes available in the Basin. These refinements will result in changes in the sustainable yield estimates described in this section.

Table 2-7 shows the groundwater budget for each sustainability scenario. Because there is no long-term average change in groundwater storage in these scenarios, the groundwater pumping represents the overall estimated sustainable yield in each scenario. The Basin sustainable yield is estimated to be about 20,000 to 21,000 AFY without water supply projects (i.e., a 67 percent reduction in groundwater pumping compared to baseline) and about 27,000 AFY with water supply projects (i.e., a 55 to 63 percent reduction in groundwater pumping compared to baseline).

Table 2-7: Average Annual Groundwater Budget for Sustainability Scenarios				
Component	**Current and Projected Conditions with Pumping Reductions Only (AFY)**	**Projected Conditions with Climate Change with Pumping Reductions Only (AFY)**	**Current and Projected Conditions with Pumping Reductions and Water Supply Projects (AFY)**	**Projected Conditions with Climate Change with Pumping Reductions and Water Supply Projects (AFY)**
Inflows				
Deep percolation	12,000	11,000	18,000	18,000
Stream seepage	4,000	5,000	4,000	4,000
Subsurface inflow	4,000	5,000	5,000	5,000
Total Inflow	**20,000**	**21,000**	**27,000**	**27,000**
Outflows				
Groundwater pumping	20,000	21,000	27,000	27,000
Total Outflow	20,000	21,000	27,000	27,000
Change in Storage	**(0)**	**(0)**	**(0)**	**(0)**
Reduction in groundwater pumping relative to Baseline	**(40,000)**	**(43,000)**	**(33,000)**	**(37,000)**
Percent reduction	**-67%**	**-67%**	**-55%**	**-63%**
Notes: All sustainability scenarios are simulated using the 1968 to 2017 hydrologic period.				

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2.4.1 HCM References

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2.2.7 Supplemental Section 2.2.7: Basin Settings, Groundwater Conditions, Groundwater Quality

Additional data collection efforts were performed for nitrate and arsenic measurements, including collecting updated data from publicly available data portals such as GAMA, CEDEN, GeoTracker, and the National Water Quality Monitoring Council that were previously accessed during GSP development. In addition to accessing the public portals for each program, 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 were 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.

Summary statistics for nitrate (as N) and arsenic measurements taken from 2010-2020 are shown in Table 2-8. For nitrates, 41 of the 102 wells with measurements during this period recorded a measurement exceeding the MCL of 10 mg/L. For arsenic, five of the 23 wells with measurement recorded a measurement exceeding the MCL of 10 µg/L. Figures 2-79 and 2-80 show the locations of wells with monitoring measurements for nitrates and arsenic during the 2010-2020 period and the average concentrations measured in each well. In each case, the wells with average values exceeding the MCLs correspond with the wells tabulated in Table 2-8. 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 through increases in nitrate or arsenic sufficient to change from below the MCL before 2015 to above the MCL in 2020.

Table 2-8: Summary Statistics for Nitrate (as N) and Arsenic

	Nitrate (as N)	Arsenic
Number of monitoring wells	102	23
Number of wells with recorded MCL exceedances from 2010-2020	41	5

As shown in Figures 2-79 and 2-80, most wells with nitrate and arsenic concentrations exceeding MCLs are located in the central threshold region. The locations in the Basin of high arsenic concentrations are focused to the south of the town of New Cuyama near the existing Cuyama Community Services District (CCSD) well. This is a known issue for the CCSD that will be mitigated by the construction of a replacement well for the district, which was included as a project in the GSP (see Section 7.4.4).

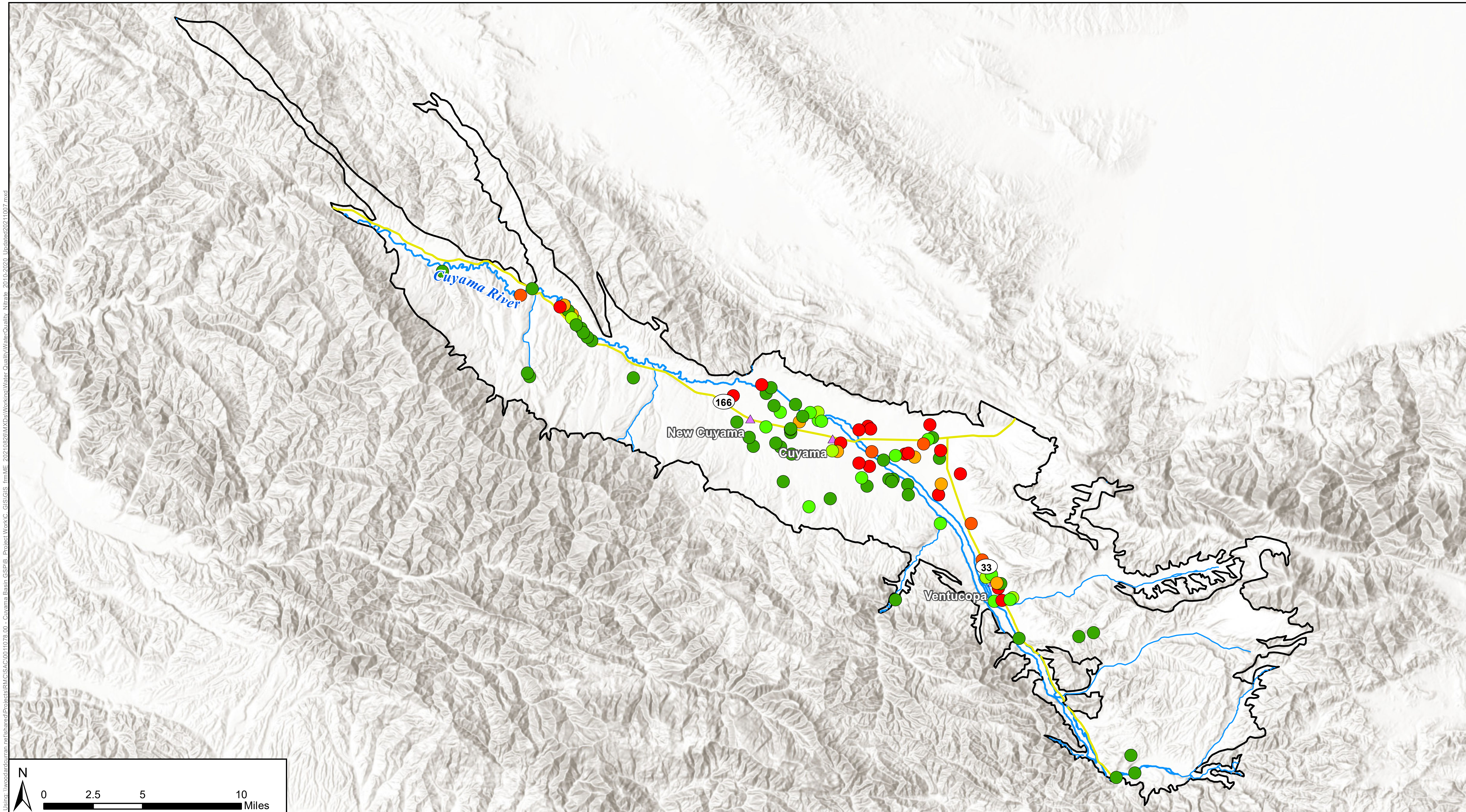

Figure 2-79: 2010-2020 Average Well Measurements of Nitrate (NO3) as Nitrogen

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

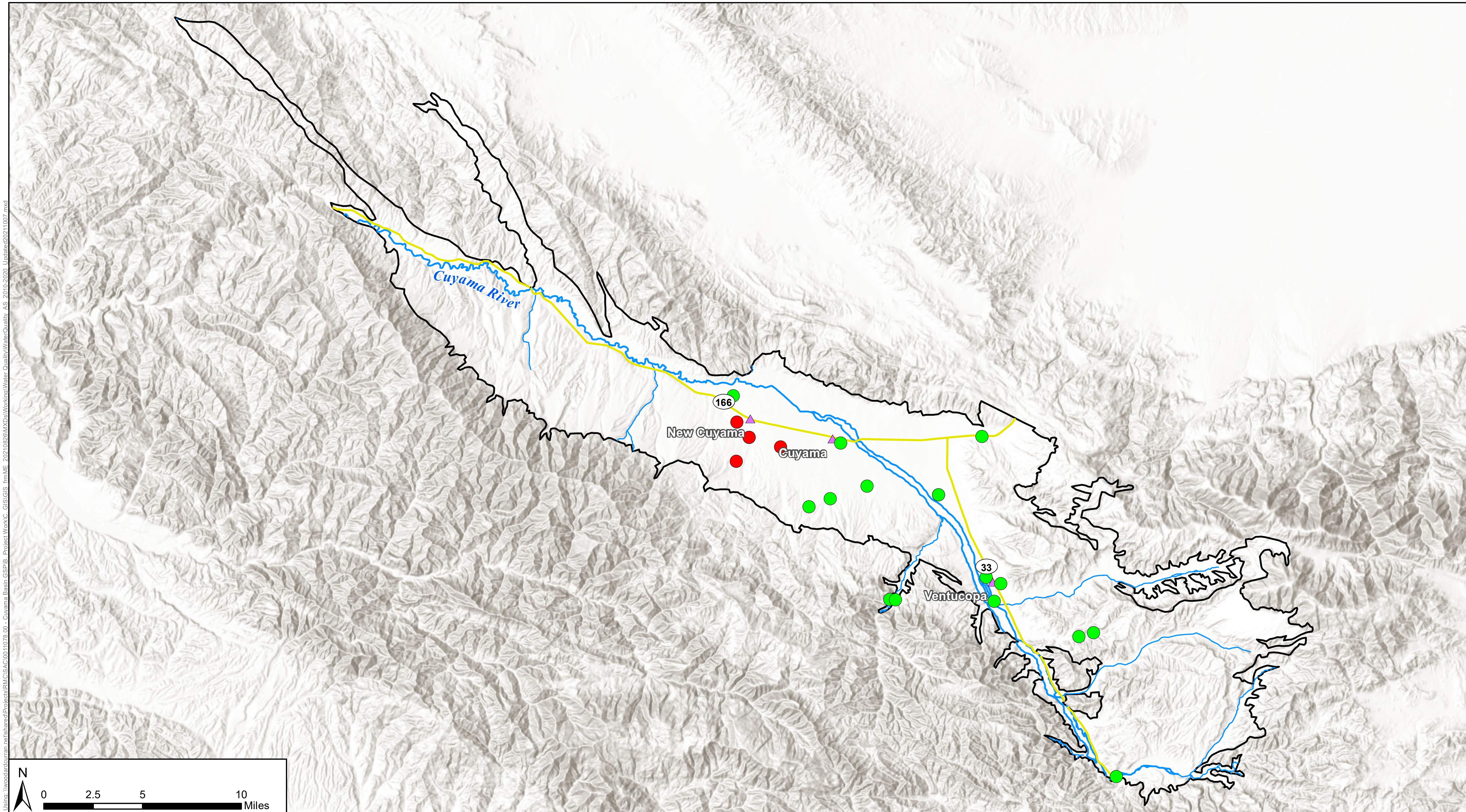

Figure 2-80: 2010-2020 Average Well Measurements of Arsenic, µg/L

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

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3. UNDESIRABLE RESULTS

This chapter presents the Undesirable Results statements for the Basin. These statements are based on quantitative thresholds on monitoring points described in Chapter 5, which are used here to indicate where Undesirable Results might occur in the monitoring network.

The first section of this chapter is the draft Undesirable Results section. The second section contains guidance from relevant portions of the 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.

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.

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., 18 of 60 wells) fall below their minimum groundwater elevation thresholds for two consecutive years.

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., 18 of 60 wells) fall below their minimum groundwater elevation thresholds for two consecutive years.

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., 20 of 64 sites) exceed the minimum threshold for a constituent for two consecutive years.

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.

Potential Causes of Undesirable Results

Potential causes of future Undesirable Results for land subsidence are likely tied to groundwater pumping resulting in dewatering of compressible clays in the subsurface.

Potential Effects of Undesirable Results

If land subsidence conditions were to reach Undesirable Results, the Undesirable Results could potentially cause damage to infrastructure, including water conveyance facilities and flood control facilities roads, utilities, buildings, and pipelines.

3.2.6 Depletions of Interconnected Surface Water

Description of Undesirable Results

The Undesirable Result for depletions of interconnected surface water is a result that causes significant and unreasonable reductions in the viability of agriculture or riparian habitat within the Basin over the planning and implementation horizon of this GSP.

Identification of Undesirable Results

This result is considered to occur during GSP implementation when 30 percent of representative monitoring wells (i.e., 18 of 60 wells) fall below their minimum groundwater elevation thresholds for two consecutive years.

Justification of Groundwater Elevations as a Proxy

Use of groundwater elevation as a proxy metric for Undesirable Results is necessary given the difficulty and cost of direct monitoring of depletions of interconnected surface water. The depletion of interconnected surface water is driven by a gradient between water surface elevation in the surface water body and groundwater elevations in the connected, shallow groundwater system. By setting minimum thresholds on shallow groundwater wells near surface water, the CBGSA can to monitor and manage this gradient, and in turn, manage potential changes in depletions of interconnected surface.

Potential Causes of Undesirable Results

Potential causes of future Undesirable Results for depletions of interconnected surface water are likely tied to groundwater production, which could result in lowering of groundwater elevations in shallow aquifers near surface water courses. This could change the hydraulic gradient between the water surface elevation in the surface water course and the groundwater elevation, resulting in an increase in depletion of surface water to groundwater.

Potential Effects of Undesirable Results

If depletions of interconnected surface water were to reach Undesirable Results, groundwater dependent ecosystems could be affected.

3.3 Evaluation of the Presence of Undesirable Results

DWR developed the *Sustainable Management Criteria* BMP (DWR, 2017) to help GSAs develop their sustainability criteria, and to identify the presence of Undesirable Results. The *Sustainable Management Criteria* BMP states: "Undesirable results will be defined by minimum threshold exceedances." The *Sustainable Management Criteria* BMP helps GSAs identify the presence of an Undesirable Result by identifying a quantitative number and location of monitoring points that may be below the minimum threshold prior to a GSA identifying conditions as an Undesirable Result.

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., 18 of 60 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 2018 and the established depth of the minimum threshold for each monitoring site. Of the 60 monitoring sites, nine were below the minimum threshold in the latest measurement in 2018, which is 15 percent of representative monitoring wells (i.e., 9 of 60), 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., 20 of 64 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 64 monitoring sites, none were worse than the minimum threshold in the latest measurement in 2018, which is 0 percent of representative monitoring wells (i.e., 0 of 64), 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. Highs during the period of rebound occur between January 1 and March 10 each year. Measurements taken from January 1, 2017 to March 10, 2017 were compared with measurements from January 1, 2018 to March 10, 2018. Each daily measurement was compared and the difference between each day was averaged. The average decline from a day in 2017 during that period and the same day in 2018 during that period was 33 millimeters (1.3 inches).

The rate of subsidence on the Ventucopa station was 0 inches over the same period. Because neither station showed a rate of subsidence over 2 inches per year, the Basin does not currently meet the requirements for an undesirable condition for land subsidence.

3.3.6 Depletions of Interconnected Surface Water

The Undesirable Result for the depletion of interconnected surface water is monitored by proxy using groundwater levels and groundwater level minimum thresholds (Section 3.2.6). Because measurements show that levels do not currently meet the requirements for an undesirable condition, depletion of interconnected surface water is not identified to be in an undesirable condition.

3.4 References

California Department of Water Resources (DWR). 2018. *Sustainable Management Criteria Best Management Practice.* Sustainable Groundwater Management Program. November. https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Sustainable-Groundwater-Management/Best-Management-Practices-and-Guidance-Documents/Files/BMP-6-Sustainable-Management-Criteria-DRAFT.pdf. Accessed March 30, 2018.

3.3 Supplemental Section 3.3: Undesirable Results, Evaluation of the Presence of Undesirable Results

SGMA requires the description of URs to include the following information:

1. The cause of the UR.
2. A quantifiable criterion used to describe when a UR occurs.
3. Potential effects on beneficial uses and users, on land uses and property interests, and other potential effects that may occur from URs.

   (Cal. Code Regs., tit. 23, § 354.26, subd. (b)(1) – (3).)

The information currently provided in the Section 3 satisfies this regulation by providing the text, explanations, and quantitative descriptions and justifications for URs. Each of these three descriptive characteristics are labeled in the excerpt from Section 3 (provided in Subsection 2.1.2 of 2022 Update Appendix A) using the left-hand bubble callout labels. Furthermore, the GSP provides a quantifiable criterion (ratio of wells) to describe the conditions it would expect to see the potential effects as described.

To address the concerns raised in the Letter, the following additional information is provided regarding the rationale for the criteria used in the GSP (i.e., "30% of exceedances over 24 consecutive months") to define the point at which Basin conditions cause significant and unreasonable effects to occur.

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 will be a likely component of future GSP updates. These future revisions will utilize the detailed and reliable data collected by the GSA during the first five years of GSP implementation.

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.

With respect to the Depletions of Interconnected Surface Water (ISW) – in conjunction with a representative monitoring network specific to ISW - the UR for ISW has been modified to be considered to occur during GSP implementation when at least 30 percent of representative ISW monitoring wells (i.e., 3 of 9) fall below their minimum groundwater elevation thresholds for two consecutive years.

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 SGMA regulations. This chapter also discusses the following:

- Monitoring network objectives
- Existing monitoring programs used as part of each network
- 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:

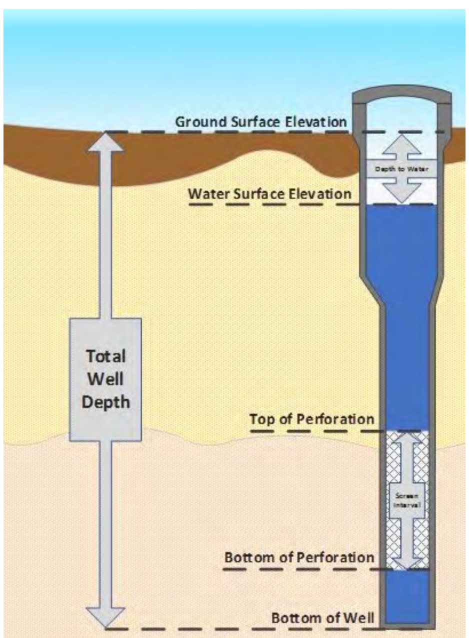

Figure 4-1: Well Completion Diagram

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 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 designed by evaluating data provided by DWR, the USGS, participating counties, and private landowners. The monitoring network consists of wells that are already being used for monitoring in the Basin. Decisions to include wells in the monitoring network were based on the criteria described 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 the 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 2016, 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.

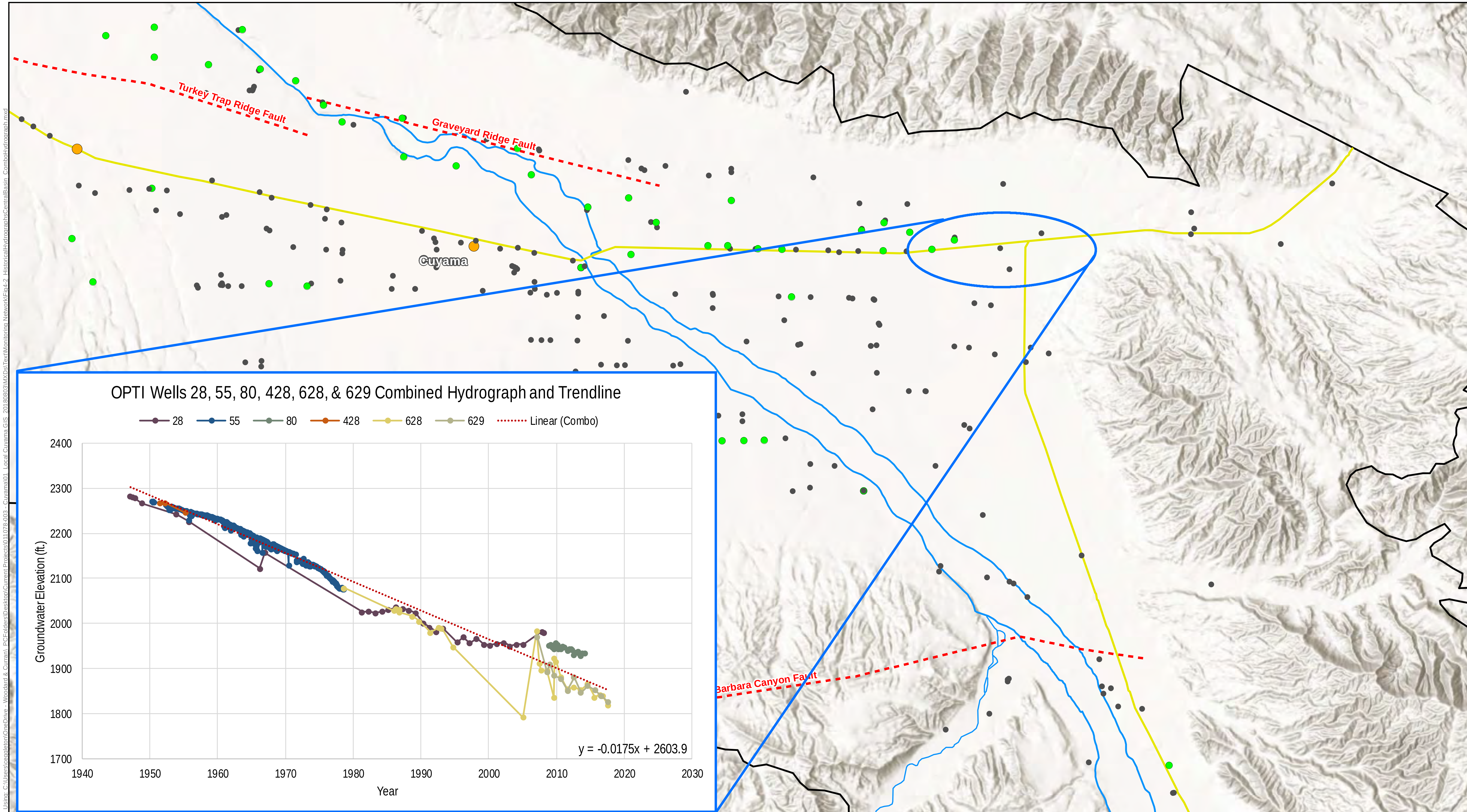

Figure 4-2: Cuyama GW Basin Central Basin with Combined Hydrograph

Cuyama Basin Groundwater Sustainability Agency

Cuyama Valley Groundwater Basin Groundwater Sustainability Plan

April 2019

WOODARD & CURRAN

Legend

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

N

0 0.5 1 2 Miles

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4.3 Existing Monitoring Used

4.3.1 Groundwater Level Monitoring

This section describes groundwater level monitoring conducted by agencies and private land owners in the Basin.

DWR, Statewide Dataset/CASGEM Program

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 Program 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 Senate Bill x7-6 establish 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 Program monitoring entities for groundwater basins throughout the State (CASGEM Brochure, 2018). CASGEM Program 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 Program monitoring entities in the Cuyama Basin as follows:

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

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

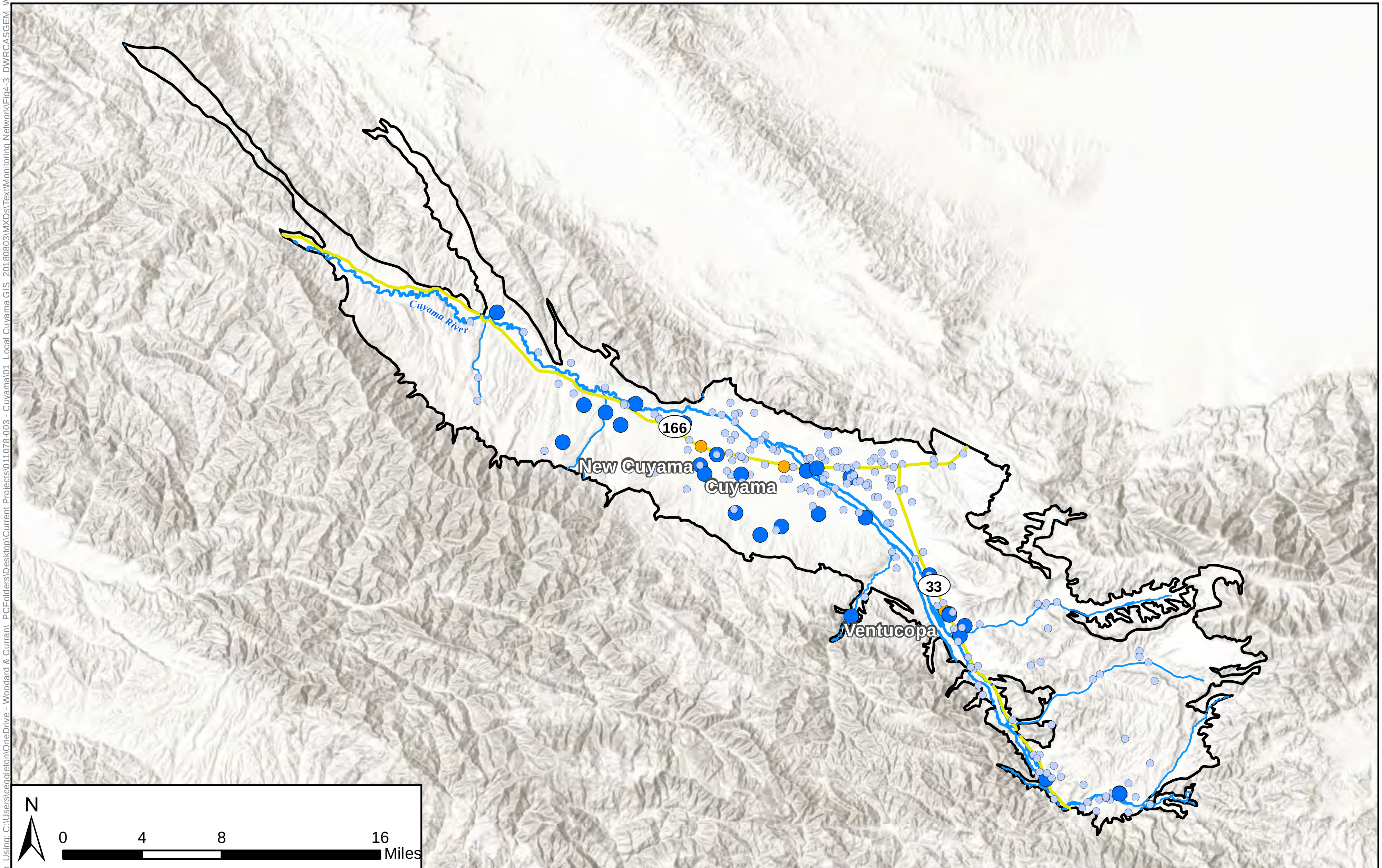

Figure 4-3: Cuyama GW Basin Wells with Monitoring Data Provided by DWR

Cuyama Basin Groundwater Sustainability Agency

Cuyama Valley Groundwater Basin Groundwater Sustainability Plan

December 2019

WOODARD & CURRAN

Legend

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

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

- Number of CASGEM Program wells: 6
- Number of voluntary wells: 107
- Total number of DWR and CASGEM Program 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 south eastern portion of the Basin upstream of Ventucopa. CASGEM Program 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.

USGS

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 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.

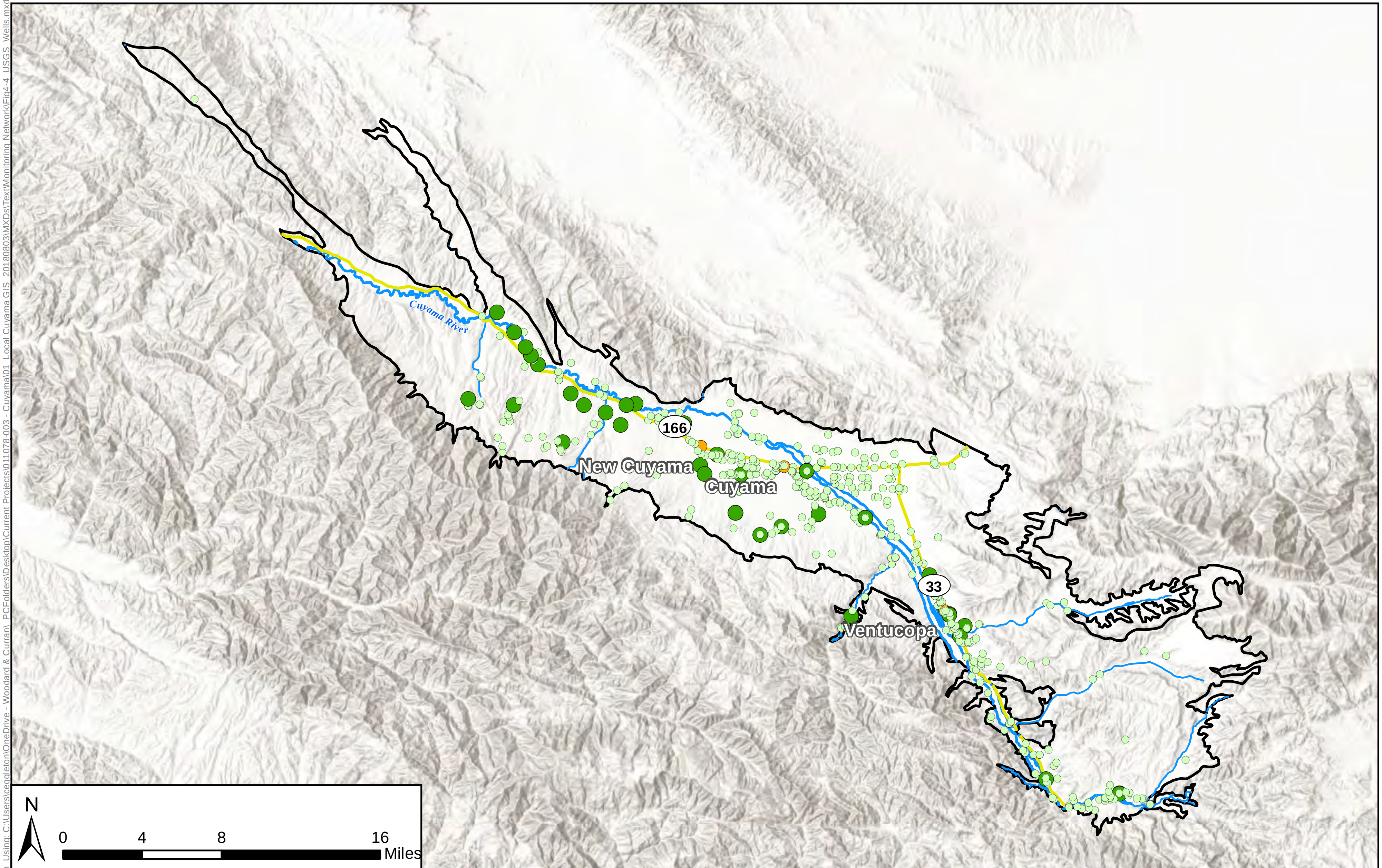

Figure 4-4: Cuyama GW Basin Wells with Monitoring Data Provided by USGS

Cuyama Basin Groundwater Sustainability Agency

Cuyama Valley Groundwater Basin Groundwater Sustainability Plan

December 2019

Legend

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

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.

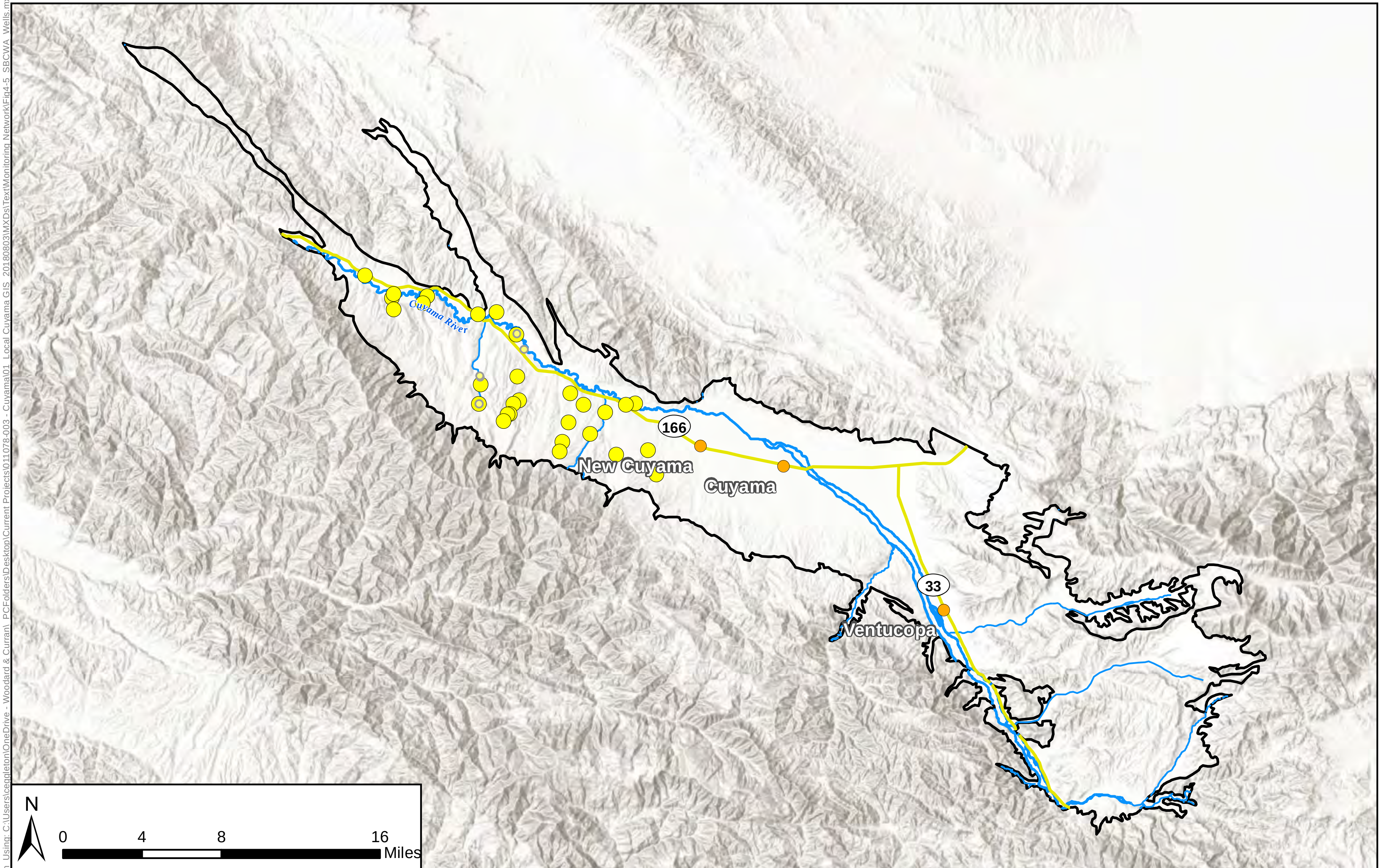

Figure 4-5: Cuyama GW Basin Wells with Monitoring Data Provided by SBCWA

Cuyama Basin Groundwater Sustainability Agency

Cuyama Valley Groundwater Basin Groundwater Sustainability Plan

December 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 theses 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 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.

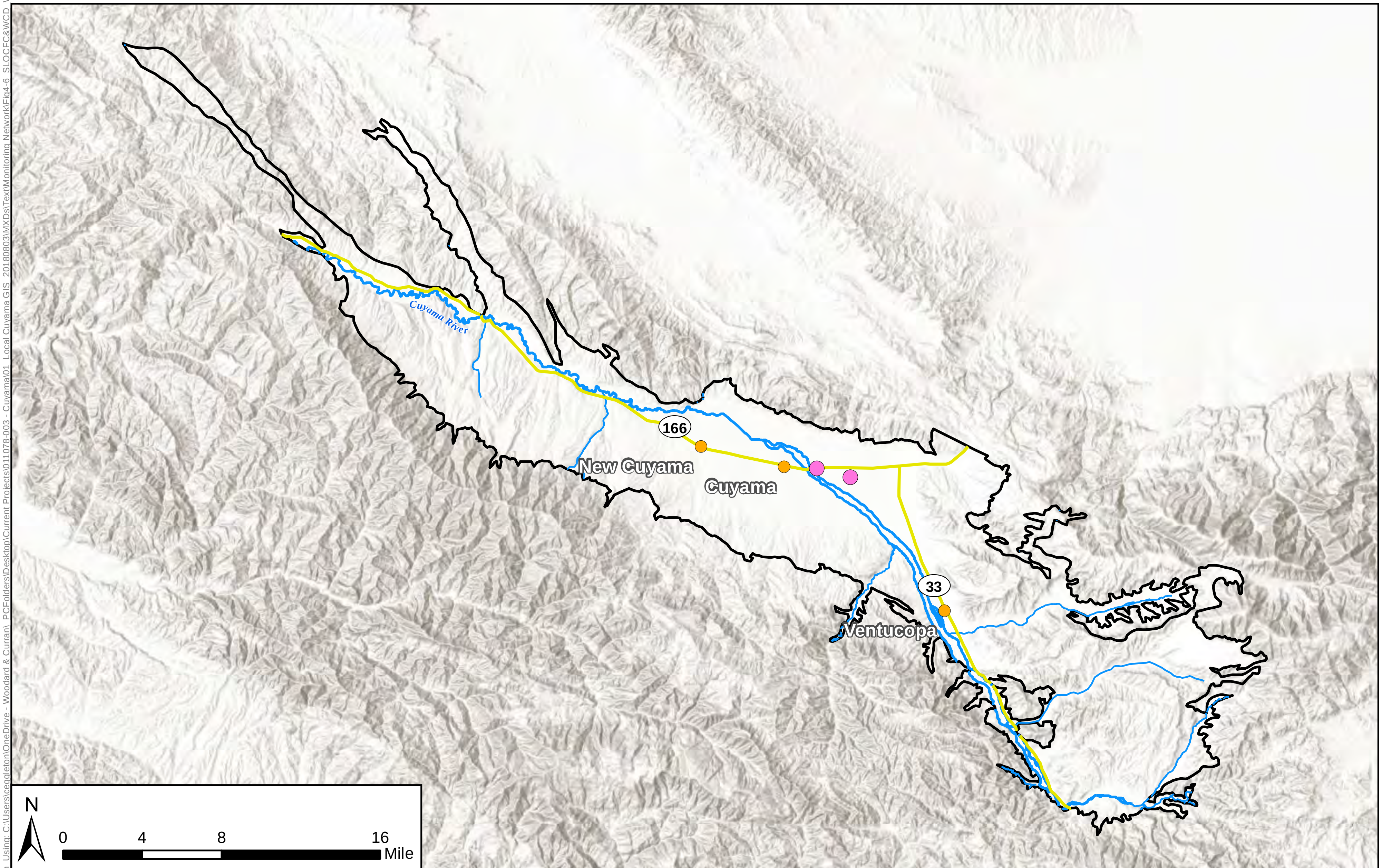

Figure 4-6: Cuyama GW Basin Wells with Monitoring Data Provided by SLOCFC&WCD

Cuyama Basin Groundwater Sustainability Agency

Cuyama Valley Groundwater Basin Groundwater Sustainability Plan

December 2019

WOODARD & CURRAN

Legend

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

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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.

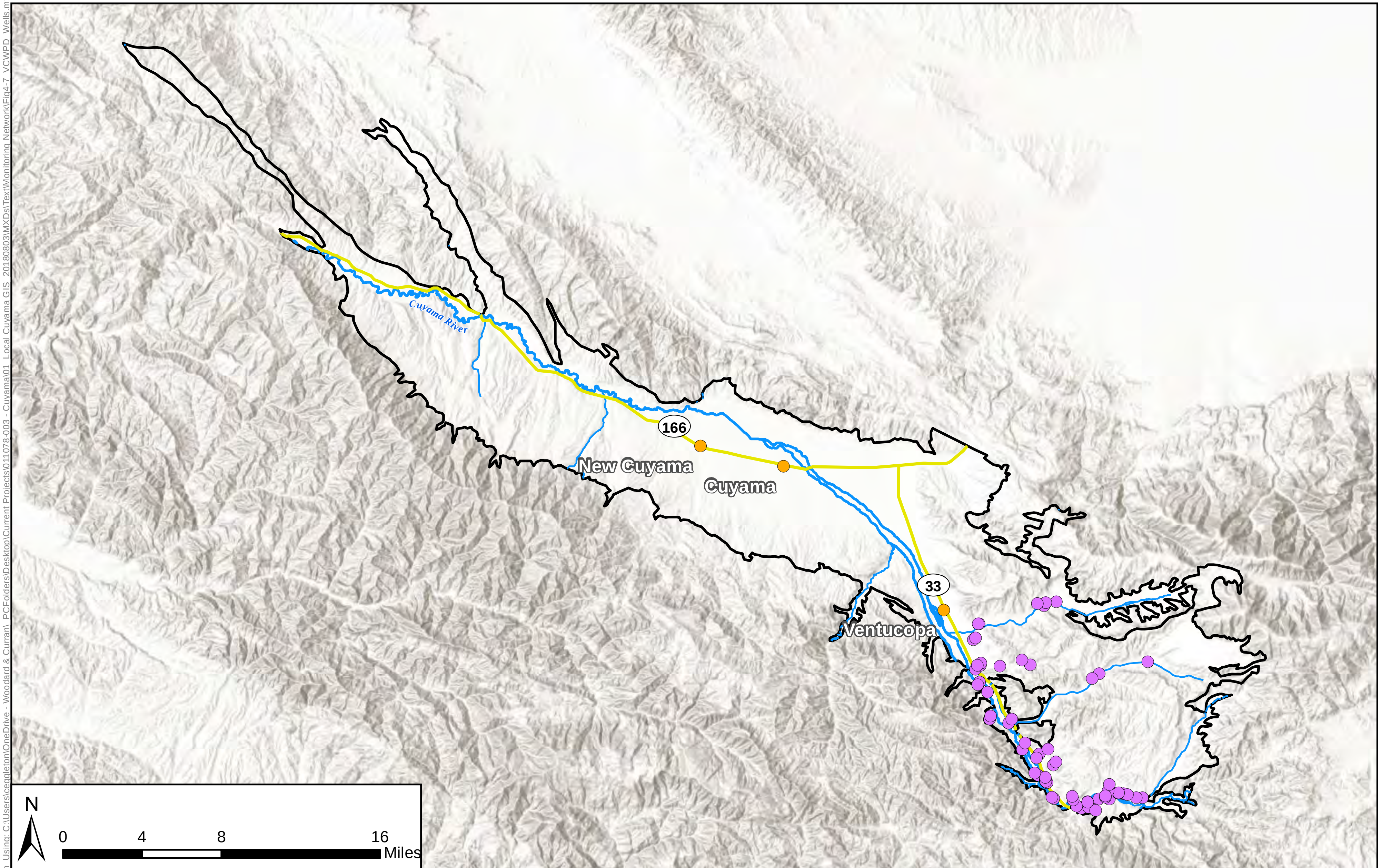

Figure 4-7: Cuyama GW Basin Wells with Monitoring Data Provided by VCWPD

Cuyama Basin Groundwater Sustainability Agency

Cuyama Valley Groundwater Basin Groundwater Sustainability Plan

December 2019

WOODARD & CURRAN

Legend

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

Cuyama Community Services District

The 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

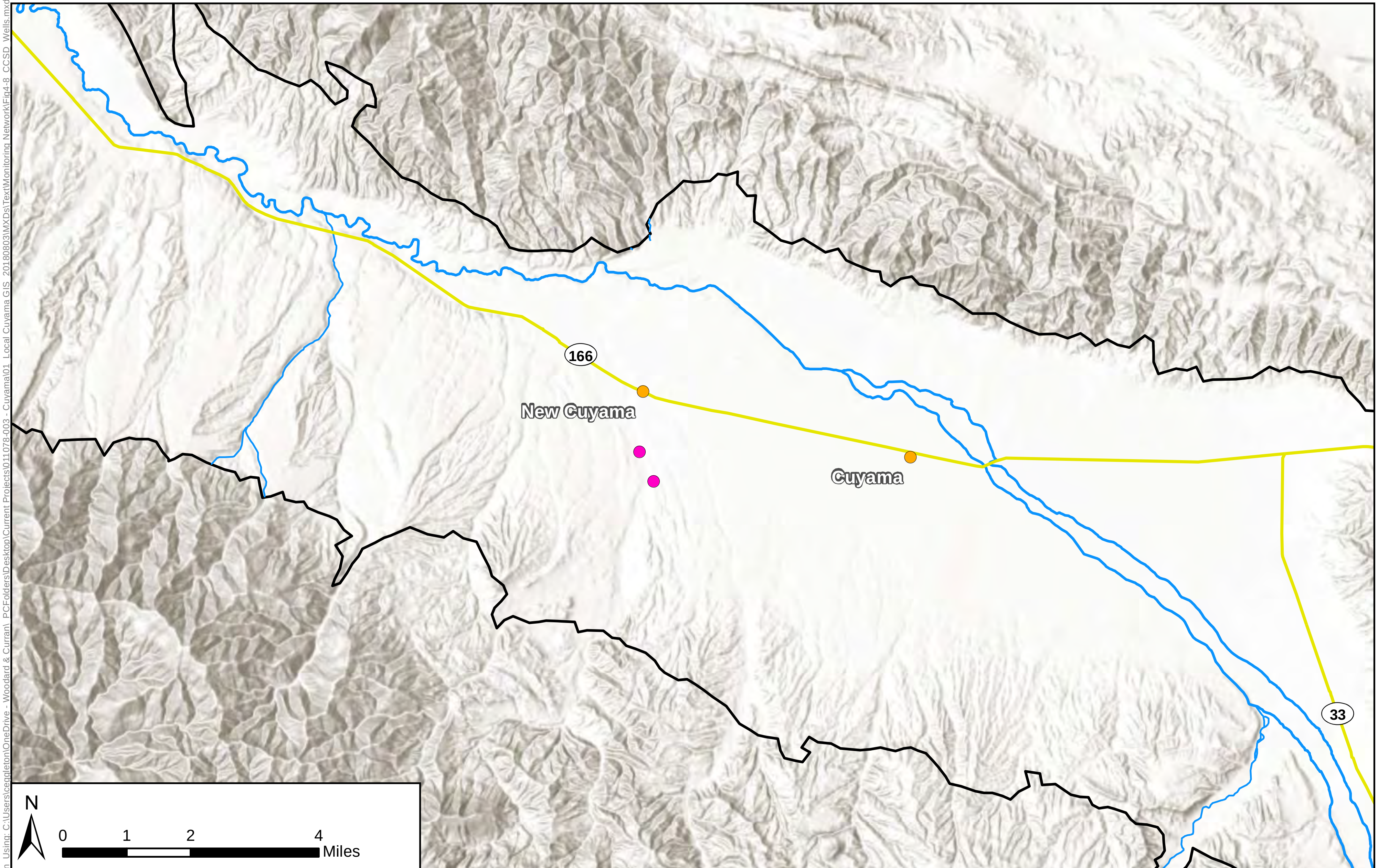

Figure 4-8: Cuyama GW Basin Wells with Data Provided by CCSD

Cuyama Basin Groundwater Sustainability Agency

Cuyama Valley Groundwater Basin Groundwater Sustainability Plan

December 2019

WOODARD & CURRAN

Legend

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

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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.

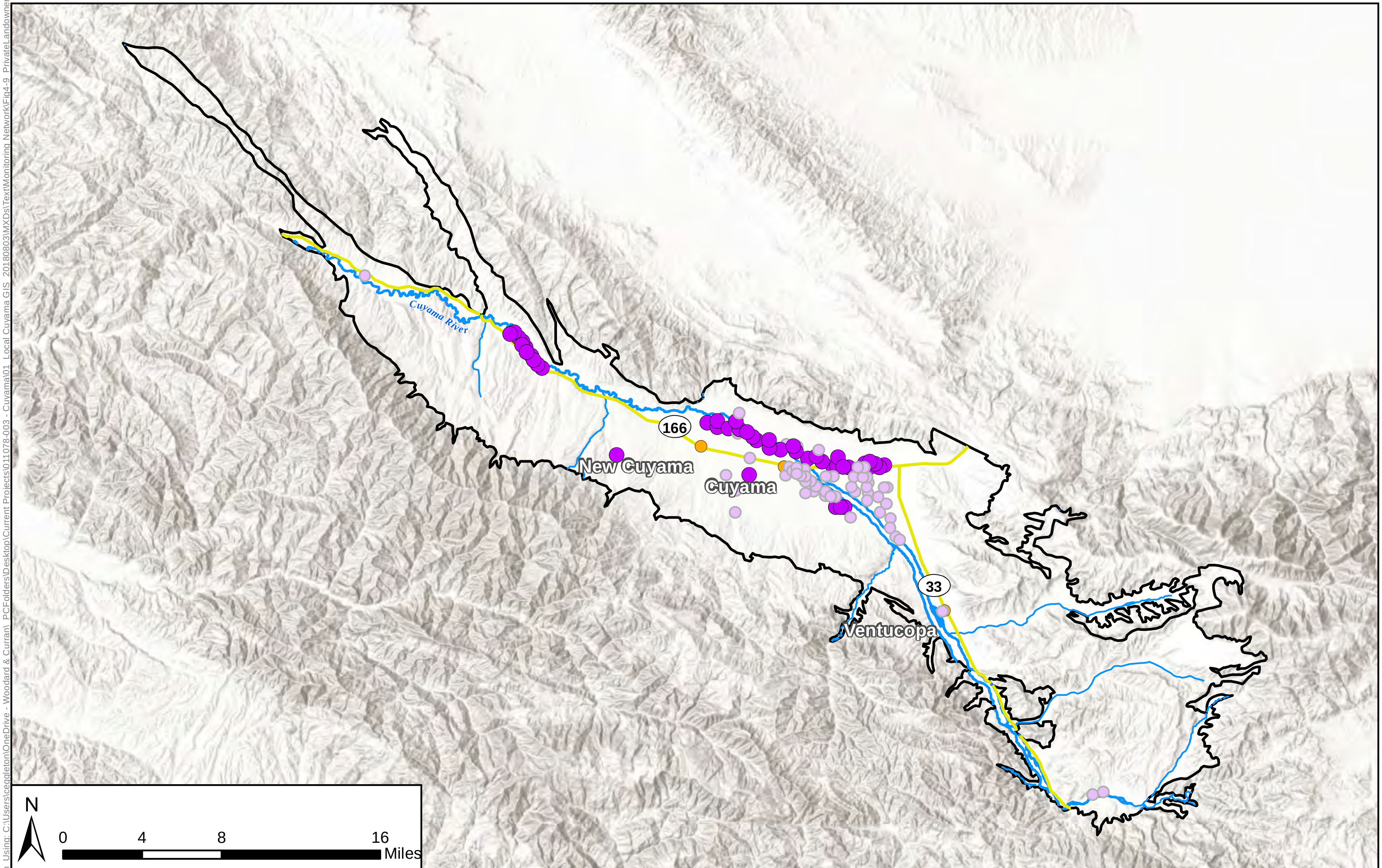

Figure 4-9: Cuyama GW Basin Wells with Monitoring Data Provided by Private Landowners

Cuyama Basin Groundwater Sustainability Agency

Cuyama Valley Groundwater Basin Groundwater Sustainability Plan

December 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

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	✓ (green)	✓ (green)		✓ (green)		
USGS	✓ (black)		✓ (green)		✓ (red)	
SLOCFC&WCD	✓ (green)					
SBCWA	✓ (black)		✓ (red)		✓ (black)	
VCWPD	✓ (green)					
Private Landowners					✓ (black)	✓ (green)

✓ (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 incorporate 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.

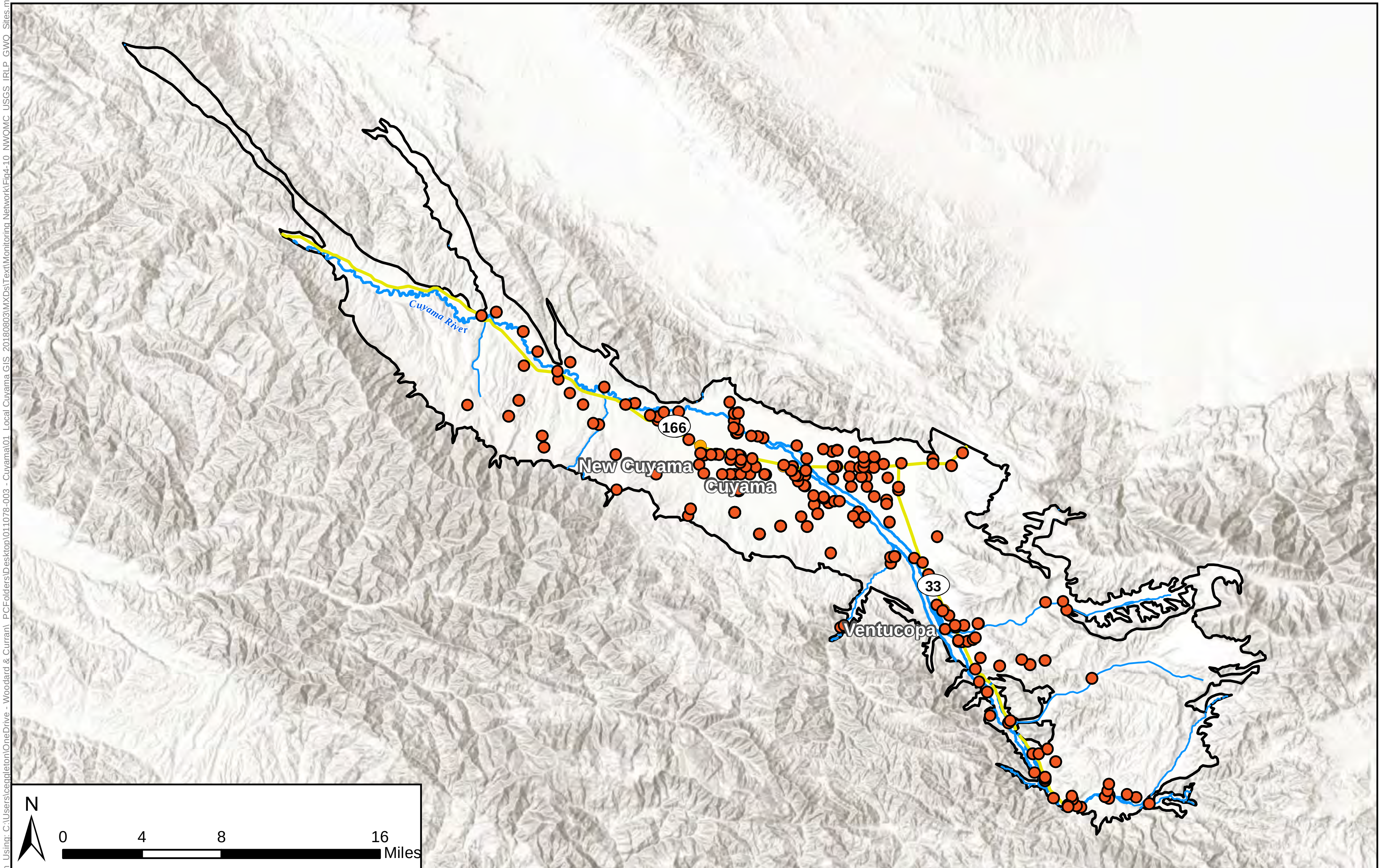

Figure 4-10: Cuyama GW Basin USGS/NWQMC/ IRLP Groundwater Quality Monitoring Sites

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December 2019

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

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 is 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.

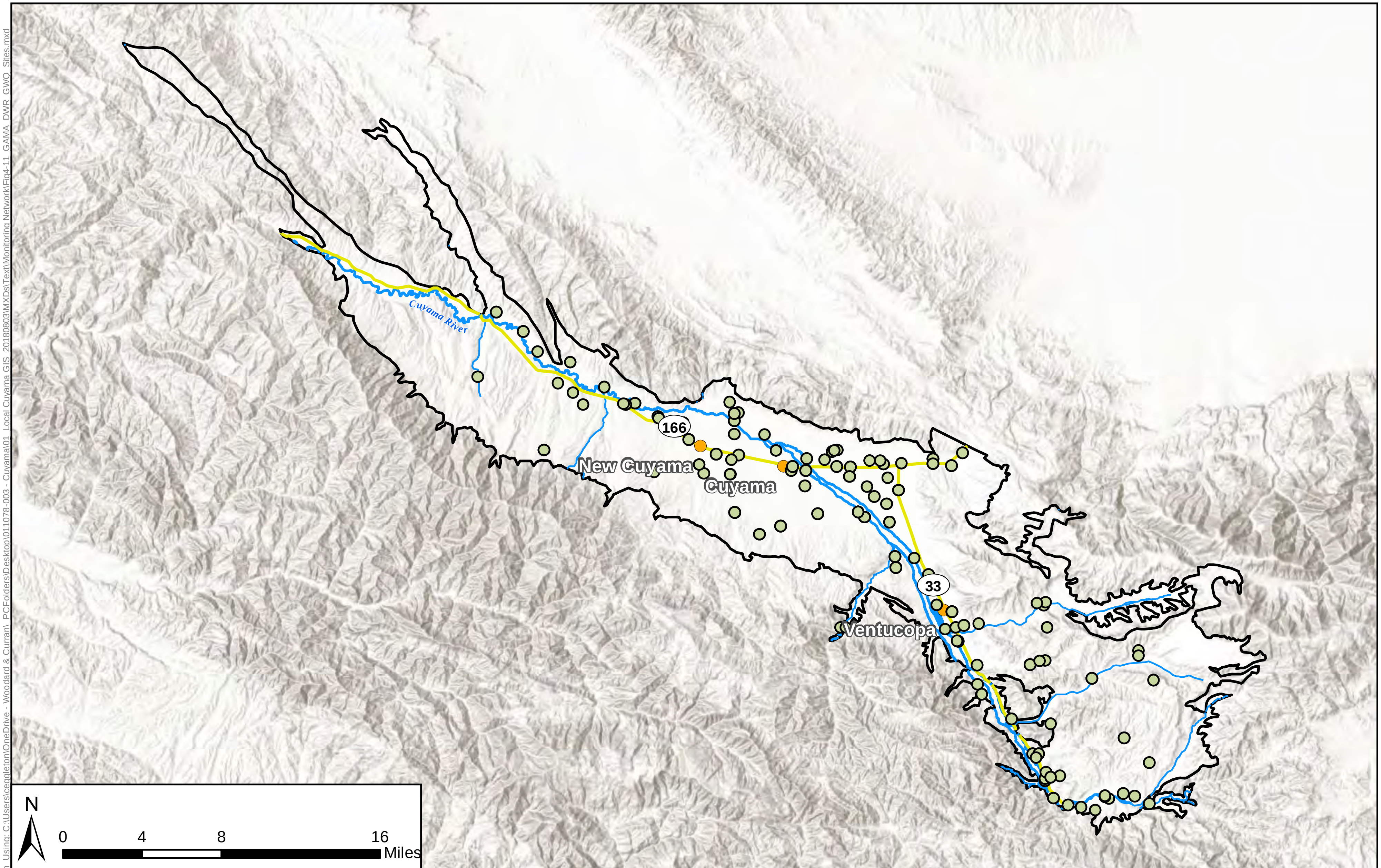

Figure 4-11: Cuyama GW Basin GAMA/DWR Groundwater Quality Monitoring Sites

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Cuyama Valley Groundwater Basin Groundwater Sustainability Plan

December 2019

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

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

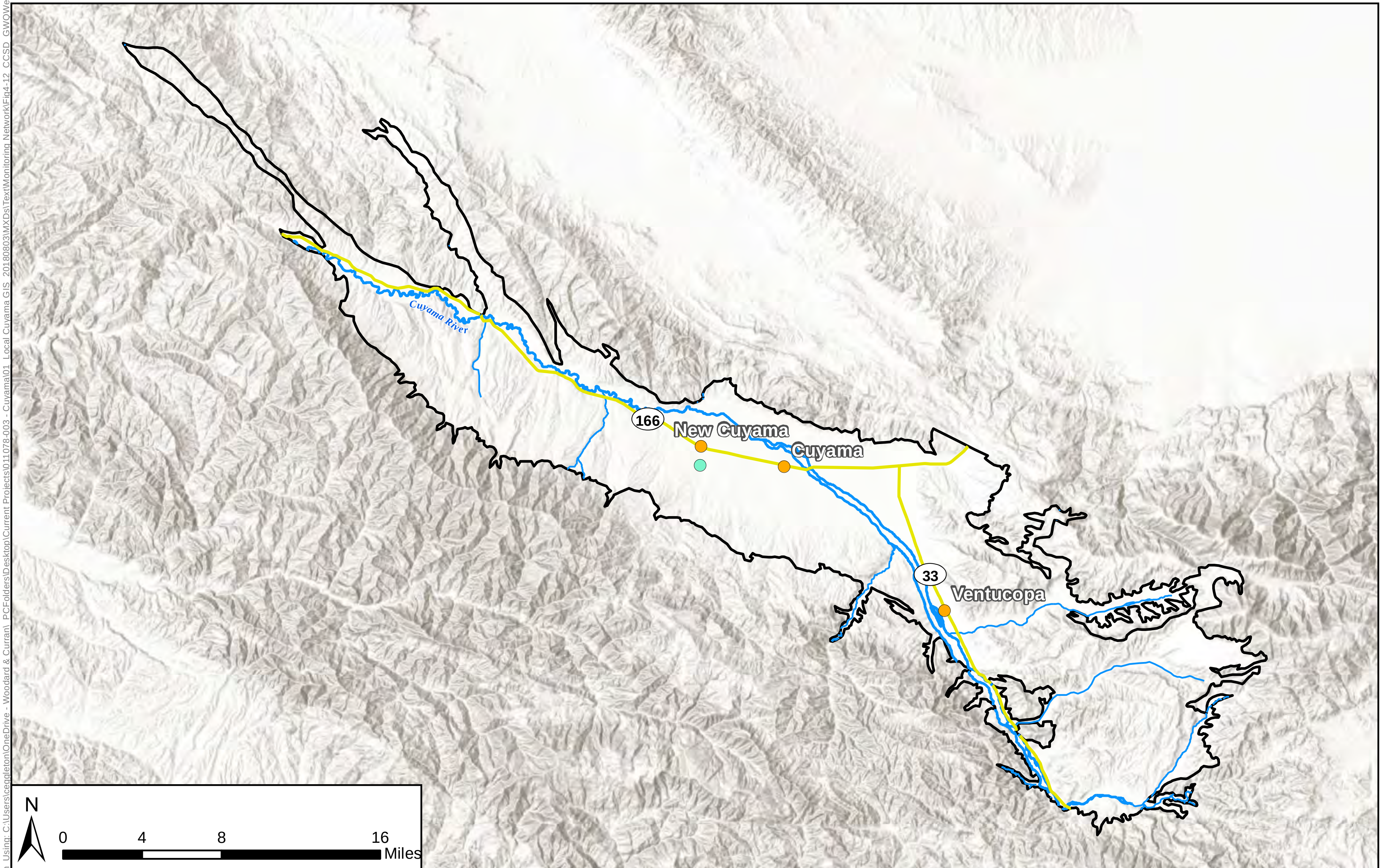

Figure 4-12: Cuyama GW Basin
CCSD Groundwater Quality Well

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December 2019

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

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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

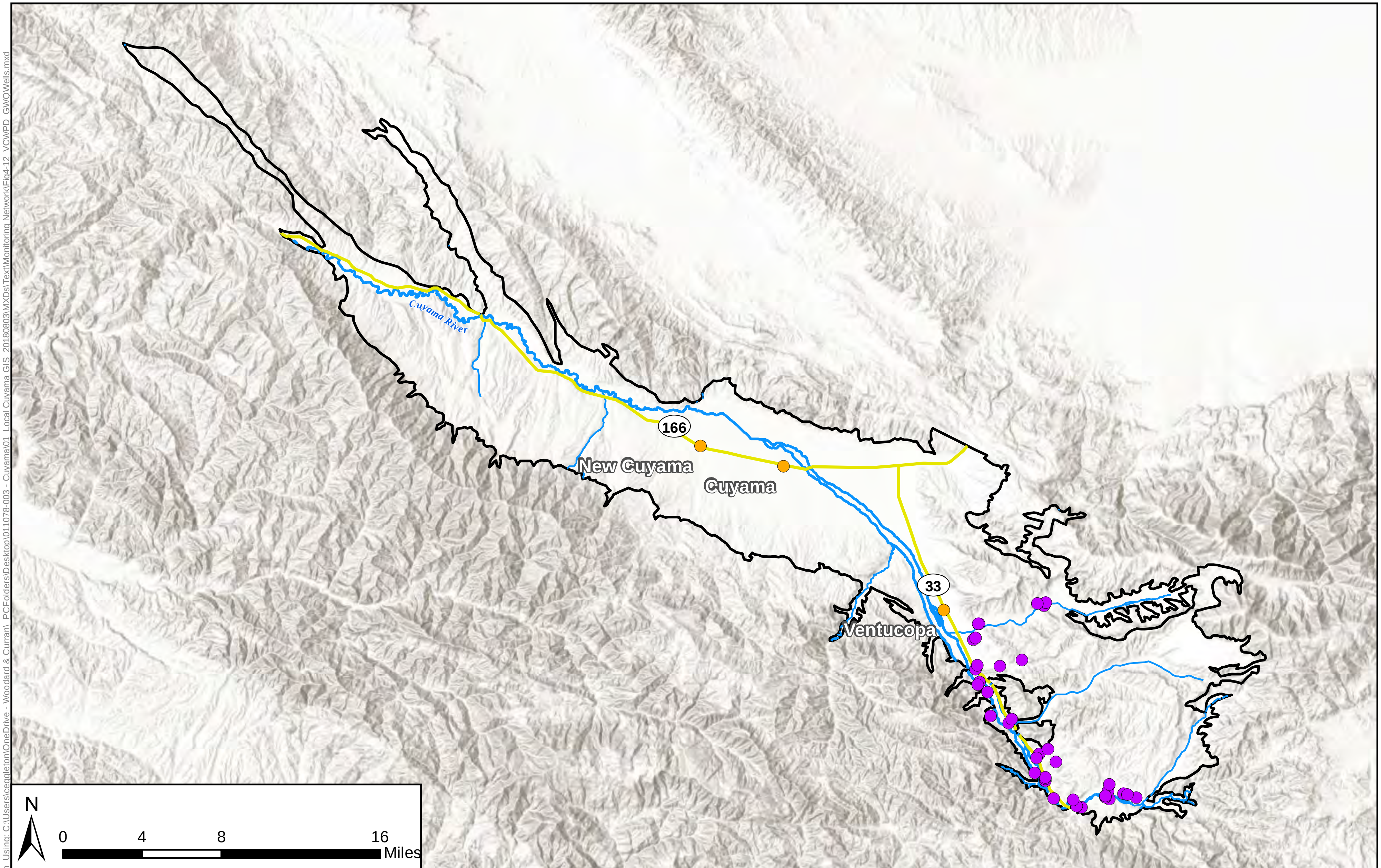

Figure 4-13: Cuyama GW Basin
VCWPD Groundwater Quality Wells

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December 2019

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

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

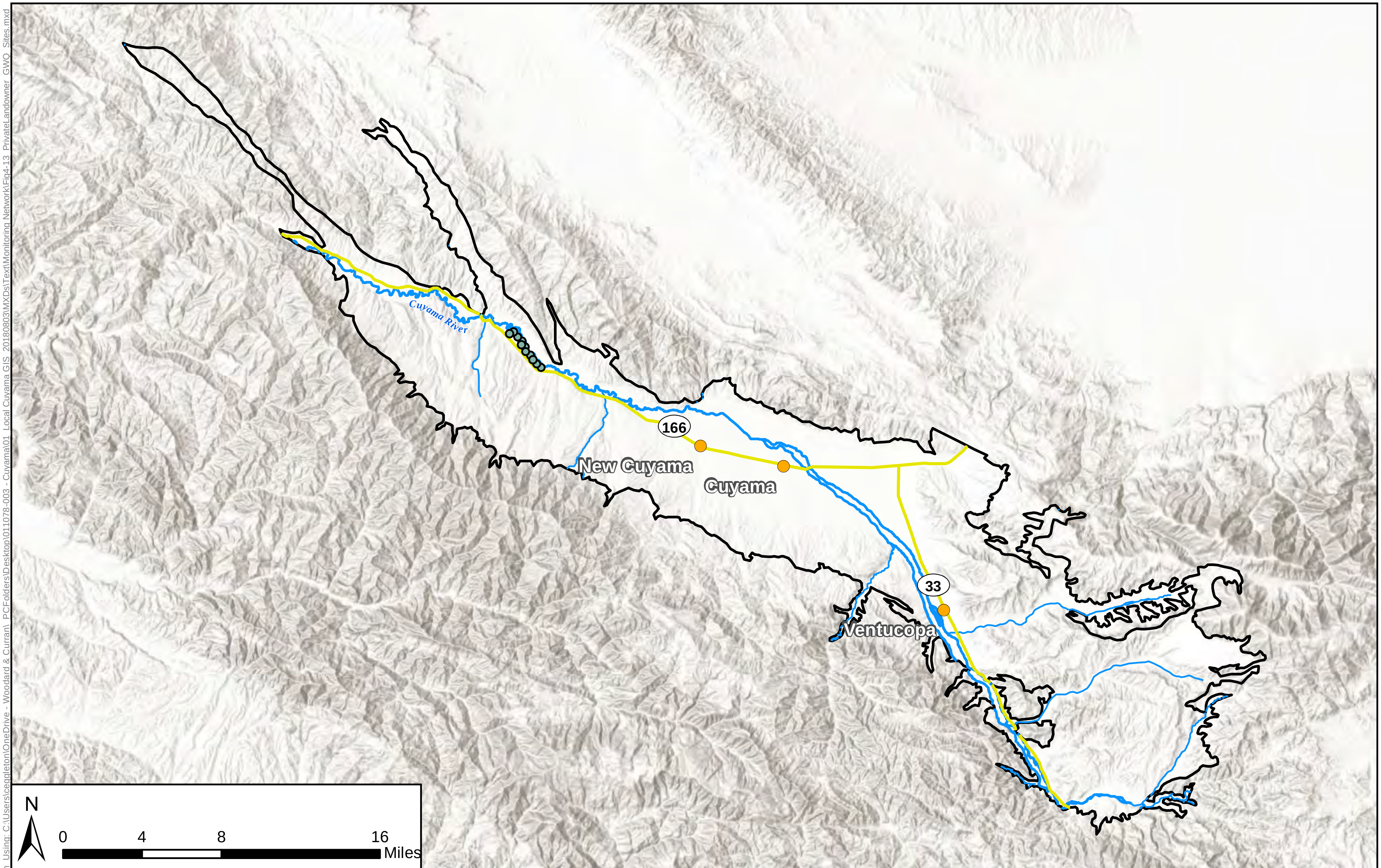

Figure 4-14: Cuyama GW Basin Private Landowner Groundwater Quality Monitoring Sites

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Cuyama Valley Groundwater Basin Groundwater Sustainability Plan

December 2019

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

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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), InSAR, 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, as shown in Figure 2-51. 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 other 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 an additional 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. Data for surface flow gages are obtained through the NWIS Mapping portal (USGS NWIS, 2017). Existing and discontinued gages are shown in Figure 4-15.

USGS has operated three additional gages in the Basin; however, two of those gages were discontinued in the 1970s. Gage 1136500 operated from 1945 to 1958 and was brought back into service from 2009 to 2014.

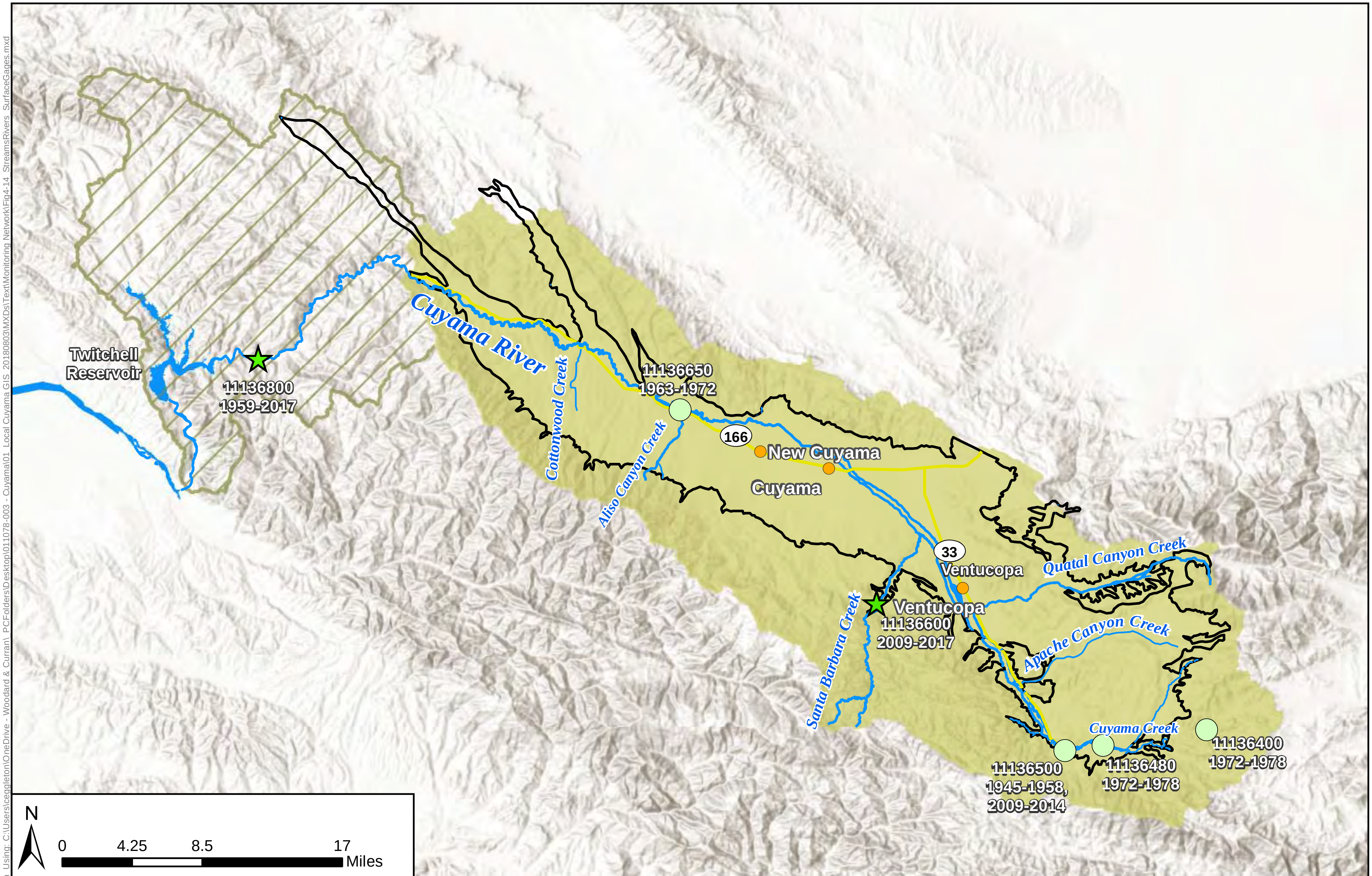

Figure 4-15: Rivers, Streams, and Surface Flow Gages

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Cuyama Valley Groundwater Basin Groundwater Sustainability Plan

December 2019

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Legend

- Cuyama Basin
- Towns
- Highways
- Cuyama River
- Inactive Flow Gages
- Active Flow Gages

Cuyama Watershed

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

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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 will be developed and implemented as individual projects the CBGSA will undertake as part of GSP implementation. The schedule and costs associated with developing and implementing each monitoring network are discussed in the 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, 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

A set of well tiering criteria were created to rank existing groundwater level measuring sites in the Basin, and were arranged into six different tiers, as shown in Figure 4-16.

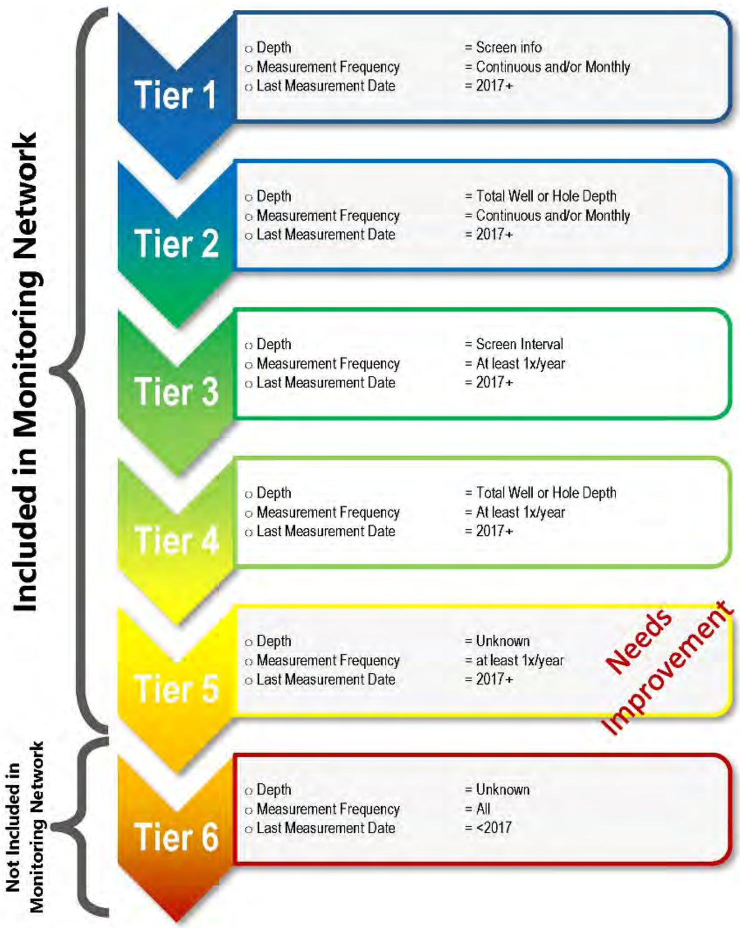

Figure 4-16: Cuyama Well Tiering Criteria

Tier 1 in the figure above shows wells with the most amount of metadata and consistent water elevation data that are still operating and functional. As tiering levels increase, requirements around well metadata and frequency of monitoring decrease; however, all wells are still active and functioning. Tier 5 captures the remaining active wells, but the metadata and/or frequency of monitoring would benefit from improvement.

Tier 6 includes all other wells that are no longer operational, which are categorized as those who do not have recorded data from January 1, 2017 to August 1, 2018 This approximate two-year cut off was determined as a reasonable amount of time for a monitoring agency or organization to obtain, log, and report well information and measurements, and as an indicator of whether a well was currently monitored or not.

Table 4-2 shows the number of monitoring wells selected from each existing monitoring data maintaining entity. Utilization these each wells for monitoring purposes will require consent agreements with each well owner, which will be sought during GSP implementation.

Table 4-2: Number of Wells Selected for Monitoring Network

Monitoring Data Maintaining Entity	Number of Wells Selected for Monitoring Network
CASGEM Program	28
USGS	43
SBCWA	36
SLOCFC&WCD	2
VCWPD	5
CCSD	1
Private Landowner	48
Total	**101**
Note: Total does not equal sum of rows due to duplicate entries in multiple databases	

Figure 4-17 shows the Monitoring Network wells by their tier level.

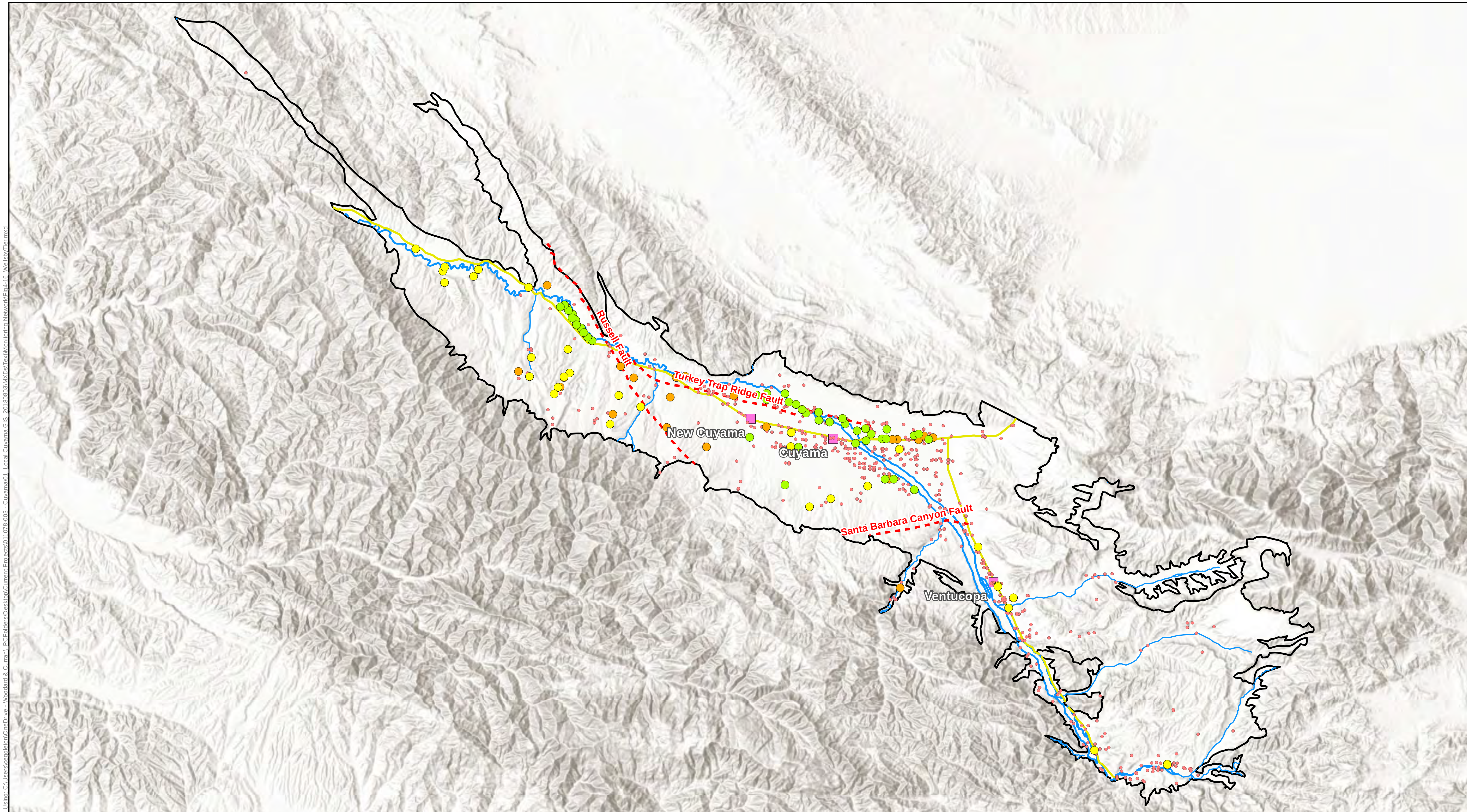

Figure 4-17: Cuyama GW Basin Groundwater Level Wells by Tier

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December 2019

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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 of 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 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 4-3.

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 4-3: 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 Table 4-3, which is provided by DWR, the Basin's groundwater monitoring frequency should be monthly. This GSP recommends monitoring the groundwater level network monthly for the first three years of GSP implementation and consideration of reducing monitoring frequency to quarterly measurements after that. Ideally, the monitoring network would be monitored simultaneously to gain a snapshot of groundwater conditions. As this is not practical currently, monitoring of the level network should be conducted within one week for each measurement period.

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 4-4). 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 rates. Professional judgment is essential when determining final locations.

Table 4-4: 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 AF per year per 100 square miles	4.0
Basins pumping between 1,000 and 10,000 AF per 100 square miles	2.0
Basins pumping between 250 and 1,000 AF per year per 100 square miles	1.0
Basins pumping between 100 and 250 AF 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.

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.
- **Supplemental 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 within each management area 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

The groundwater level monitoring network is comprised of 101 of wells in the Basin. A total of 61 of those wells are representative wells. Overall well density is 26.7 wells per 100 square miles.

Figure 4-18 shows the locations of the groundwater level monitoring network monitoring wells and representative wells.

Table 4-5 lists the wells in the groundwater level monitoring network. Representative wells, those with sufficient data and representative trends within the Basin, are identified with the asterisk (*) next to the OPTI ID and are sorted first. Metadata for the wells are also included.

The proposed monitoring frequency is monthly for the first three years of GSP implementation, with an option to reduce to quarterly monitoring if the CBGSA Board decides that is appropriate. This monitoring frequency captures short-term, seasonal, and long-term trends in groundwater levels. A well density of 26.7 wells per 100 square miles in the 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.

Table 4-5: Wells included in the Groundwater Levels and Storage Monitoring Network

OPTI ID	Data Maintaining Entity as of 2018	Well Construction Date	Well Depth (feet)	Hole Depth (feet)	Screen Interval (feet)	Well Elevation (feet above mean sea level)	Reference Point Elevation (feet above mean sea level)	First Measurement Year	Last Measurement Year	Measurement Period (years)	Measurement Count
2*	Ventura County	--	73.0	--	--	3,720	--	2011	2017	6	17
62*	SBCWA	--	212	--	--	2,921	--	1966	2018	52	65
72*	SBCWA	1/1/1980	790	820	350 – 340	2,171	--	1981	2018	37	114
74*	SBCWA	--	--	--	--	2,193	--	2008	2018	10	45
77*	SBCWA	12/4/2008	980	1,003.5	980 – 960	2,286	--	2009	2018	9	47
84	SBCWA	--	200	--	--	2,923	--	2008	2018	10	28
85*	SBCWA	--	233	--	--	3,047	--	1950	2018	68	282
89*	VWPD	1/1/1965	125	--	--	3,461	--	1965	2017	52	68
91*	SBCWA	9/29/2009	980	1,000	980 – 960	2,474	--	2009	2018	9	47
93*	SBCWA	10/18/1967	151	165	--	2,928	--	1971	2018	47	36
95*	SBCWA	4/9/2009	805.	825	--	2,449	--	2009	2018	9	32
96*	SBCWA	2/1/1980	500	--	--	2,606	--	1983	2018	35	61
98*	SBCWA	--	750	--	--	2,688	--	2008	2018	10	32
99*	SBCWA	9/10/2009	750	906	750 – 730	2,513	--	2009	2018	9	43
100*	SBCWA	11/1/1988	284	302	--	3,004	--	2010	2018	8	28
101*	SBCWA	--	200	220	--	2,741	--	2008	2018	10	42
102*	SBCWA	--	--	--	--	2,046	--	2010	2018	8	22
103*	SBCWA	7/23/2010	1,030	1,040	--	2,289	--	2012	2018	6	25
104	Unknown	--	640	--	638.64 – 478.64	2,299	2301	2008	2017	9	32
105	SLOCF&CWC	--	750	--	--	2,374	2375	1990	2017	27	38
106*	Unknown	--	227.5	--	--	2,327	2327	2016	2018	2	9
107*	Unknown	1/1/1950	200	--	--	2,482	--	1950	2018	68	12
108*	Private Landowner	--	328.75	--	--	2,629	2630	2016	2018	2	8
110	Unknown	1/1/1948	603	--	--	2,046	--	1950	2018	68	17
112*	Unknown	--	441	--	--	2,139	--	1966	2018	52	10
114*	DWR	1/1/1947	58.0	--	--	1,925	--	1967	2017	50	9
115	Private Landowner	--	1200	--	--	2,276	2278	2016	2018	2	4
116	Private Landowner	10/1/1980	700	--	700 – 240	2329	2329	1980	2018	38	6
117*	Private Landowner	--	212	--	--	2,098	2095	2016	2018	2	10

Table 4-5: Wells included in the Groundwater Levels and Storage Monitoring Network

OPTI ID	Data Maintaining Entity as of 2018	Well Construction Date	Well Depth (feet)	Hole Depth (feet)	Screen Interval (feet)	Well Elevation (feet above mean sea level)	Reference Point Elevation (feet above mean sea level)	First Measurement Year	Last Measurement Year	Measurement Period (years)	Measurement Count
118*	Private Landowner	--	500	--	--	2,270	2271	2016	2018	2	11
119	DWR	--	92.0	--	--	1,713	--	1955	2017	62	10
120	Private Landowner	--	15.4	--	--	1,705	1707	2016	2017	1	2
121	Private Landowner	--	98.25	--	--	1,984	1985	2016	2018	2	16
122	Private Landowner	--	63.2	--	--	2,129	2131	2016	2018	2	16
123*	Private Landowner	--	138	--	--	2,165	2167	2016	2018	2	14
124*	Private Landowner	--	160.55	--	--	2,287	2288	1988	2018	30	22
125	Private Landowner	--	26	--	--	2,283	2284	2016	2018	2	9
127*	Private Landowner	--	100.25	--	--	2,364	2365	2016	2018	2	14
128	Unknown	3/15/1990	140	150	--	3,721	--	2014	2017	3	8
316*	Unknown	9/29/2009	830	1,000	--	2,474	--	2009	2018	9	27
317*	Unknown	9/29/2009	700	1,000	--	2,474	--	2009	2018	9	28
322*	Unknown	4/9/2009	850	906	--	2,513	--	2009	2018	9	27
324*	Unknown	9/10/2009	560	906	--	2,513	--	2009	2018	9	26
325*	Unknown	9/10/2009	380	906	--	2,513	--	2009	2018	9	26
420*	Unknown	12/4/2008	780	1,003.5	--	2,286	--	2009	2018	9	29
421*	Unknown	12/4/2008	620	1,003.5	--	2,286	--	2009	2018	9	29
422*	Unknown	12/4/2008	460	1,003.5	--	2,286	--	2009	2018	9	28
467	Unknown	1/1/1963	1,140	1,215	--	2,224	--				
474*	Unknown	--	213	--	--	2,369	--	1955	2017	62	6
564	Unknown	1/1/1920	--	--	--	2,172	--	2017	2017	0	1
566	Unknown	--	500	520	--	2,263	--				
568*	Unknown	1/1/1948	188	188	--	1,905	--	1967	2018	51	22
571*	Private Landowner	1/1/1951	280	--	--	2,307	--	2016	2018	3	14
573*	Unknown	--	404	--	--	2,084	--	1950	2018	68	12
584	Unknown	--	450	606	--	1,753	--	2018	2018	0	1
586	Unknown	--	620	622	--	1,761	--				
587	Unknown	12/29/2014	900	960	--	1,713	--	2018	2018	0	1
591	Unknown	--	720	740	--	1,715	--	2017	2018	1	2

Table 4-5: Wells included in the Groundwater Levels and Storage Monitoring Network

OPTI ID	Data Maintaining Entity as of 2018	Well Construction Date	Well Depth (feet)	Hole Depth (feet)	Screen Interval (feet)	Well Elevation (feet above mean sea level)	Reference Point Elevation (feet above mean sea level)	First Measurement Year	Last Measurement Year	Measurement Period (years)	Measurement Count
597	Unknown	--	390	670	--	1,694	--	2017	2018	1	2
601	Private Landowner	6/14/1905	723	--	723 – 338	2,074	--	1993	2017	24	32
602	Private Landowner	6/12/1905	725	--	725 – 325	2,114	--	1992	2017	25	29
603	Private Landowner	6/15/1905	800	--	800 – 398	2,097	--	1994	2017	23	33
604*	Private Landowner	--	924	--	924 – 454	2,125	--	1995	2017	22	28
608*	Private Landowner	6/10/1905	745	--	745 – 440	2,224	--	1995	2017	22	26
609*	Private Landowner	6/15/1905	970	--	970 – 476	2,167	--	1995	2017	22	31
610*	Private Landowner	--	780	--	780 – 428	2,442	--	1995	2017	22	27
612*	Private Landowner	--	1070	--	1,070 – 657	2,266	--	1995	2017	22	24
613*	Private Landowner	--	830	--	830 – 330	2,330	--	1995	2017	22	24
614	Private Landowner	--	745	--	745 – 405	2,337	--	1995	2017	22	25
615*	Private Landowner	--	865	--	865 – 480	2,327	--	1995	2017	22	22
618	Private Landowner	6/18/1905	927	--	927 – 496	2,163	--	1996	2017	21	31
619	Private Landowner	6/19/1905	1,040	--	1,040 – 569	2,307	--	1997	2017	20	28
620*	Private Landowner	6/19/1905	1,035	--	1,035 – 50	2,432	--	1997	2017	20	25
621	Private Landowner	6/19/1905	974	--	974 – 540	2,126	--	1998	2017	19	30
623	Private Landowner	6/21/1905	1,040	--	1,040 – 530	2,288	--	1999	2017	18	29
627	Private Landowner	6/23/1905	960	--	960 – 460	2,279	--	2001	2017	16	19
628	Private Landowner	5/31/1905	941	--	941 – 593	2,388	--	1978	2017	39	32
629*	Private Landowner	--	1,000	--	1,000 – 500	2,379	--	2005	2017	12	13
630	Private Landowner	--	900	--	900 – 360	2,371	--	1991	2017	26	22
631	Private Landowner	5/31/1905	960	--	960 – 600	2,367	--	1986	2017	31	22
633*	Private Landowner	--	1,000	--	1,000 – 500	2,364	--	1998	2017	19	23
635	Private Landowner	--	1,050	--	1,050 – 549	2,356	--	2003	2017	14	10
636	Private Landowner	5/27/1905	924	--	924 – 474	2,348	--	1975	2017	42	15
637	Private Landowner	6/30/1905	980	--	980 – 540	2110	--	2009	2017	8	10
638	Private Landowner	6/30/1905	1,006	--	1,006 – 526	2,437	--	2008	2017	9	9
640	Private Landowner	6/30/1905	840	--	840 – 400	2,239	--	2008	2017	9	16
641	Private Landowner	7/2/1905	800	--	800 – 360	2,204	--	2010	2017	7	7

Table 4-5: Wells included in the Groundwater Levels and Storage Monitoring Network

OPTI ID	Data Maintaining Entity as of 2018	Well Construction Date	Well Depth (feet)	Hole Depth (feet)	Screen Interval (feet)	Well Elevation (feet above mean sea level)	Reference Point Elevation (feet above mean sea level)	First Measurement Year	Last Measurement Year	Measurement Period (years)	Measurement Count
638	Private Landowner	6/30/1905	1,006	--	1,006 – 526	2,437	--	2008	2017	9	9
640	Private Landowner	6/30/1905	840	--	840 – 400	2,239	--	2008	2017	9	16
641	Private Landowner	7/2/1905	800	--	800 – 360	2,204	--	2010	2017	7	7
642	Private Landowner	7/2/1905	1,000	--	1,000 – 550	2,232	--	2010	2017	7	8
644	Private Landowner	7/5/1905	950	--	950 – 490	2,143	--	2013	2017	4	10
830*	SBCWA	--	77.2	--	--	1,571	--	2017	2018	1	6
831*	SBCWA	--	213.75	--	--	1,557	--	2017	2018	1	6
832*	SBCWA	--	131.8	--	--	1,630	--	2016	2018	2	8
833*	SBCWA	--	503.55	--	--	1,457	--	2017	2018	1	6
834*	SBCWA	--	320	--	--	1,508	--	2017	2018	1	2
835*	SBCWA	--	162.2	--	--	1,555	--	2017	2018	1	6
836*	SBCWA	--	325	--	--	1,486	--	2017	2018	1	6
840*	Private Landowner	11/21/2014	900	--	1,513 – 833	1,713	--	2015	2018	3	7
841*	Private Landowner	12/12/2014	600	--	1,591 – 1,181	1,761	--	2015	2018	3	11
843*	Private Landowner	1/5/2015	620	--	1,701 – 1,161	1,761	--	2015	2018	3	9
845*	Private Landowner	7/12/2015	380	--	1,612 – 1,352	1,712	--	2015	2018	3	8
849*	Private Landowner	6/23/2015	570	--	1,563 – 1,163	1,713	--	2015	2018	3	10

*Denotes a representative well

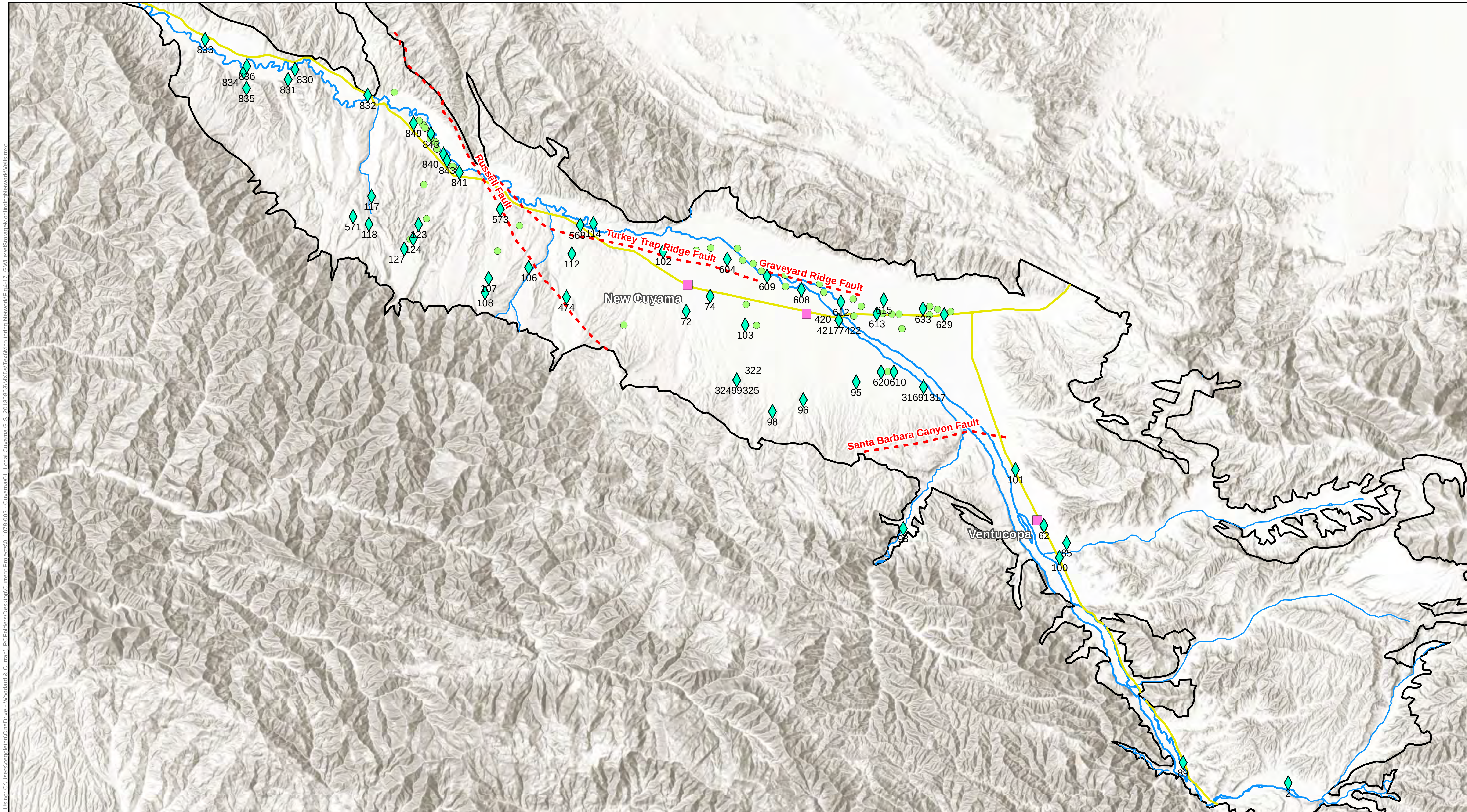

Figure 4-18: Cuyama GW Basin Groundwater Level & Storage Monitoring Network Wells

Cuyama Basin Groundwater Sustainability Agency

Cuyama Valley Groundwater Basin Groundwater Sustainability Plan

December 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

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4.5.6 Monitoring Protocols

For additional monitoring recommended below, the 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

Groundwater level monitoring data gaps are the result of poor spatial distribution among available wells in the Basin, and a lack of well construction information.

The spatial distribution of groundwater level monitoring network wells provides coverage of the majority of the Basin. However, there are several areas, identified by the red ovals in Figure 4-19, that do not have adequate monitoring. If additional monitoring wells were added in these areas, they may provide more information that could be used to detect changes in Basin conditions,

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 a number of ways to refine the groundwater level monitoring network and improve reporting.

The CBGSA has been awarded a Proposition 1 Category 1 Grant, which includes a task to expand the groundwater level monitoring network. This task includes identification of additional monitoring wells for hand measurements and installation of continuous monitoring equipment into 10 existing wells, which could be used to augment the existing monitoring network. This task would both increase the spatial distribution of the monitoring network and temporal coverage in the wells with additional continuous monitoring.

The CBGSA has applied for 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. New wells drilled by DWR's TSS will improve the density and sampling frequency for level monitoring in the Basin. Downhole video logging will provide more well construction information to better utilize well data in the Basin. As of Draft GSP publication, the DWR TSS program has not provided any TSS services for the Cuyama Basin.

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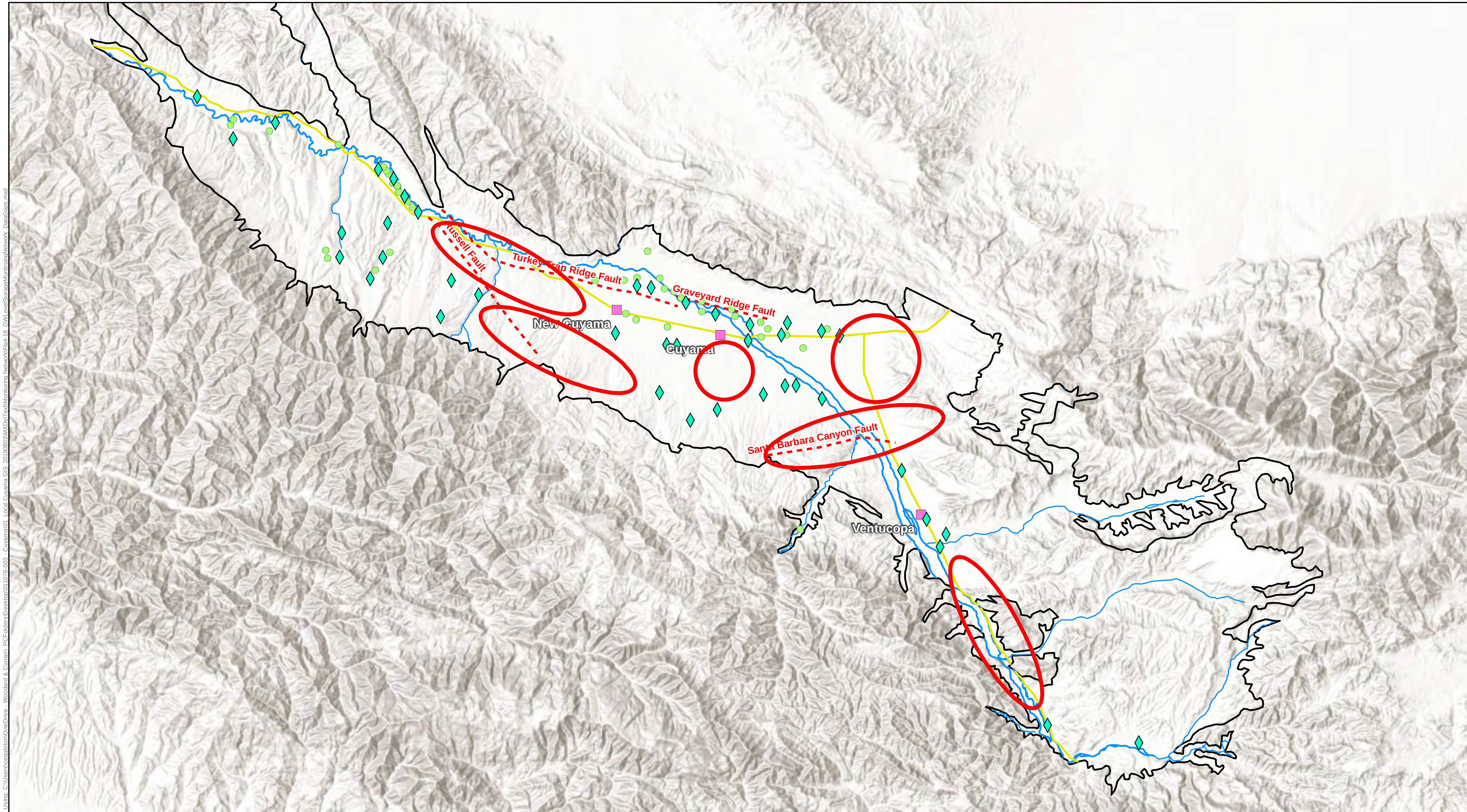

Figure 4-19: Cuyama GW Basin Groundwater Level & Storage Monitoring Network Data Gaps

Cuyama Basin Groundwater Sustainability Agency

Cuyama Valley Groundwater Basin Groundwater Sustainability Plan

April 2018

WOODARD & CURRAN

Legend

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

Monitoring Network Wells

- Representative Wells
- Monitoring Network Wells

N

0 2 4 8 Miles

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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 be 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., TDS) is monitored as part of the groundwater quality network, but seawater intrusion is not a concern for the Basin.

4.8 Degraded 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, as noted in the Groundwater Conditions chapter, there have only been two nitrate measurements and fewer than 10 arsenic measurements in recent years that exceeded maximum contaminant levels. Furthermore, and 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 SWRCB. Therefore, the groundwater quality network has been established to monitor for salinity but does not consider arsenic or nitrates at this time. The CBGSA will cooperate with other agencies that may perform monitoring of other constituents to the extent possible.

4.8.1 Management Areas

Management Areas have not been selected at the time of publishing the Draft GSP. Management Areas may allow flexibility in establishing monitoring networks both spatially and temporally to match conditions and use in the Management Area. Given the scarcity of monitored sites, the CBGSA should use the same monitoring network selection criteria across all management areas in the Basin.

4.8.2 Monitoring Sites Selected for Monitoring Network

Table 4-6 lists the monitoring sites selected for the groundwater quality monitoring network by monitoring group. Monitoring sites selected for inclusion in the network were monitored from 2008 to 2018. It was assumed that wells that had previously been monitored for salinity prior to 2008 are unlikely to be monitored again by that monitoring agency. Due to the overlap of wells in both the USGS and DWR networks, the 64 selected groundwater quality networks wells is less than the sum of wells shown in Table 4-6. Use of these wells for monitoring will require consent agreements with each well owner, which will be sought during GSP implementation.

Table 4-6: Groundwater Quality Monitoring Sites by Source

Monitoring Data Maintaining Entity	Number of Wells Selected for Monitoring Network
NWQC, USGS, ILRP	43
GAMA Program, DWR	20
BCWPD	7
Private Landowner	11
Total	**64**

Note: Total does not equal sum of rows due to duplicate entries in multiple databases

4.8.3 Monitoring Frequency

The Basin, in coordination with partnering agencies, will compile salinity samples once a year. Monitoring agencies such as USGS and DWR were contacted to inquire about when they would monitor their sites for groundwater quality, including salinity. These agencies stated they usually monitor annually, but the timing of that monitoring was not set, and changes from year to year. Additionally, depending on funding and staff availability, there may be years where no groundwater quality monitoring is conducted by an agency.

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.

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.

Any well measured from 2008 to June 2018 was included in the monitoring network. The overall monitoring network was selected as representative monitoring. The selected groundwater quality representative and monitoring wells provide adequate coverage of the Basin's aquifer. The groundwater quality monitoring network is composed of 64 of wells in the Basin, which providing 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 4-4.

4.8.5 Representative Monitoring

Representative monitoring sites were selected 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.

4.8.6 Groundwater Quality Monitoring Network

Figure 4-20 shows the monitoring network, and representative and monitoring sites. The monitoring network is comprised of 64 wells, all of which are representative wells.

Table 4-7 shows the wells in the groundwater quality monitoring network. Metadata for the wells is also included.

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Table 4-7: Wells Included in the Groundwater Quality Monitoring Network

OPTI ID	Managing Agency as of 2018	Well Construction Date	Well Depth (feet)	Hole Depth (feet)	Screen Interval	Well Elevation (feet)	First Measurement Date	Last Measurement Date	Measurement Period (years)	Measurement Count
61*	DWR	--	357		Unknown	3,681	2008-09-25	2008-09-25	0	3
72*	SBCWA	1/1/1980	790	820	340 – 350	2,171	2008-09-15	2017-07-14	9	13
73*	SBCWA	8/26/1982	880	1021.	Unknown	2,252	2010-08-03	2011-07-12	1	2
74*	SBCWA	--			Unknown	2,193	2008-09-17	2017-07-13	9	11
76*	USGS	9/1/1960	720		Unknown	2,277	1960-09-22	2008-09-17	48	10
77*	SBCWA	12/4/2008	980	1003.5	960 – 980	2,286	2009-04-08	2009-04-08	0	1
79*	USGS	--	600	750	Unknown	2,374	2008-07-08	2011-08-11	3	7
81*	USGS	--	155		Unknown	2,698	2011-08-16	2011-08-16	0	1
83*	SBCWA	1/1/1972	198		Unknown	2,858	2011-08-16	2011-08-16	0	1
85*	SBCWA	--	233		Unknown	3,047	1964-02-07	2011-07-12	47	46
86*	USGS	1/1/1995	230		Unknown	3,141	--	--	--	0
87*	USGS	--	232		Unknown	3,546	--	--	--	0
88*	USGS	9/4/2007	400	400.	Unknown	3,549	2011-08-18	2011-08-18	0	1
90*	SBCWA	8/8/2006	800	800	Unknown	2,552	2008-09-17	2012-09-20	4	6
91*	SBCWA	9/29/2009	980	1000	960 – 980	2,474	2009-11-05	2009-11-05	0	1
94*	USGS	--	550	720	Unknown	2,456	2008-07-29	2010-07-29	2	6
95*	SBCWA	4/9/2009	805	825.	Unknown	2,449	2011-08-19	2011-08-19	0	1
96*	SBCWA	2/1/1980	500		Unknown	2,606	2011-08-19	2011-08-19	0	1
98*	SBCWA	--	750		Unknown	2,688	2011-08-16	2011-08-16	0	1
99*	SBCWA	9/10/2009	750	906	73 – 750	2,513	2009-11-04	2009-11-04	0	1
101*	SBCWA	--	200	220	Unknown	2,741	2008-09-25	2008-09-25	0	3
102*	SBCWA	--			Unknown	2,046	2011-08-15	2017-07-13	6	7
130*	USGS	--			Unknown	3,536	2011-08-19	2011-08-19	0	1
131*	USGS	--			Unknown	2,990	2011-08-17	2011-08-17	0	1
157*	USGS	--	71		Unknown	3,755	--	--	--	0
196*	USGS	--	741	755	Unknown	3,117	--	--	--	--
204*	USGS	1/1/1935			Unknown	3,693	2011-08-18	2011-08-18	0	1
226*	USGS	1/1/1971		220.	Unknown	2,945	2011-08-18	2011-08-18	0	1
227*	USGS	--			Unknown	3,002	1966-07-01	2011-08-17	45	2

Table 4-7: Wells Included in the Groundwater Quality Monitoring Network

OPTI ID	Managing Agency as of 2018	Well Construction Date	Well Depth (feet)	Hole Depth (feet)	Screen Interval	Well Elevation (feet)	First Measurement Date	Last Measurement Date	Measurement Period (years)	Measurement Count
242*	USGS	--	155	187	Unknown	2,933	2012-07-18	2012-07-18	0	1
269*	USGS	1/1/1951			Unknown	2,756	2008-09-16	2008-09-16	0	3
309*	USGS	2/2/1980	1,100	1100	Unknown	2,513	2011-08-11	2011-08-11	0	1
316*	USGS	9/29/2009	830	1000	Unknown	2,474	2009-11-05	2009-11-05	0	1
317*	USGS	9/29/2009	700	1000	Unknown	2,474	2009-11-05	2009-11-05	0	1
318*	USGS	9/29/2009	610	1000	Unknown	2,474	2009-11-04	2009-11-04	0	1
322*	USGS	4/9/2009	850	906	Unknown	2,513	2009-11-03	2009-11-03	0	1
324*	USGS	9/10/2009	560	906	Unknown	2,513	2009-11-04	2009-11-04	0	1
325*	USGS	9/10/2009	380	906	Unknown	2,513	2009-11-04	2009-11-04	0	1
400*	USGS	--	2,120	2200.	Unknown	2,298	1958-05-26	2011-08-15	53	8
420*	USGS	12/4/2008	780	1003.5	Unknown	2,286	2009-04-07	2009-04-07	0	1
421*	USGS	12/4/2008	620	1003.5	Unknown	2,286	2009-04-07	2009-04-07	0	1
422*	USGS	12/4/2008	460	1003.5	Unknown	2,286	2009-04-08	2009-04-08	0	1
424*	USGS	--	1,000	1020.	Unknown	2,291	2011-08-15	2011-08-15	0	1
467*	USGS	1/1/1963	1,140	1215.	Unknown	2,224	2012-07-18	2017-07-13	5	6
568*	USGS	1/1/1948	188	188	Unknown	1,905	2008-09-15	2008-09-15	0	3
702*	USGS	--	--		Unknown	3,539	--	--	--	--
703*	USGS	--	--		Unknown	1,613	--	--	--	--
710*	DWR	--	--		Unknown	2,942	--	--	--	--
711*	DWR	--	--		Unknown	1,905	--	--	--	--
712*	DWR	--	--		Unknown	2,171	--	--	--	--
713*	DWR	--	--		Unknown	2,456	--	--	--	--
721*	DWR	--	--		Unknown	2,374	--	--	--	--
758*	DWR	--	--		Unknown	3,537	--	--	--	--
840*	Private Landowner	11/21/2014	900		200 – 880	1,713	--	--	--	--
841*	Private Landowner	12/12/2014	600		170 – 580	1,761	--	--	--	--
842*	Private Landowner	12/19/2014	450		60 – 430	1,759	--	--	--	--
843*	Private Landowner	1/5/2015	620		60 – 600	1,761	--	--	--	--
844*	Private Landowner	7/17/2015	730		100 – 720	1,713	--	--	--	--

Table 4-7: Wells Included in the Groundwater Quality Monitoring Network

OPTI ID	Managing Agency as of 2018	Well Construction Date	Well Depth (feet)	Hole Depth (feet)	Screen Interval	Well Elevation (feet)	First Measurement Date	Last Measurement Date	Measurement Period (years)	Measurement Count
845*	Private Landowner	7/12/2015	380		100 – 360	1,712	--	--	--	--
846*	Private Landowner	6/15/2015	610		130 – 590	1,715	--	--	--	--
847*	Private Landowner	7/26/2015	600		180 – 580	1,733	--	--	--	--
848*	Private Landowner	6/30/2015	390		110 – 370	1,694	--	--	--	--
849*	Private Landowner	6/23/2015	570		150 – 550	1,713	--	--	--	--
850*	Private Landowner	8/13/2015	790		180 – 780	1,759	--	--	--	--

*Denotes a representative well

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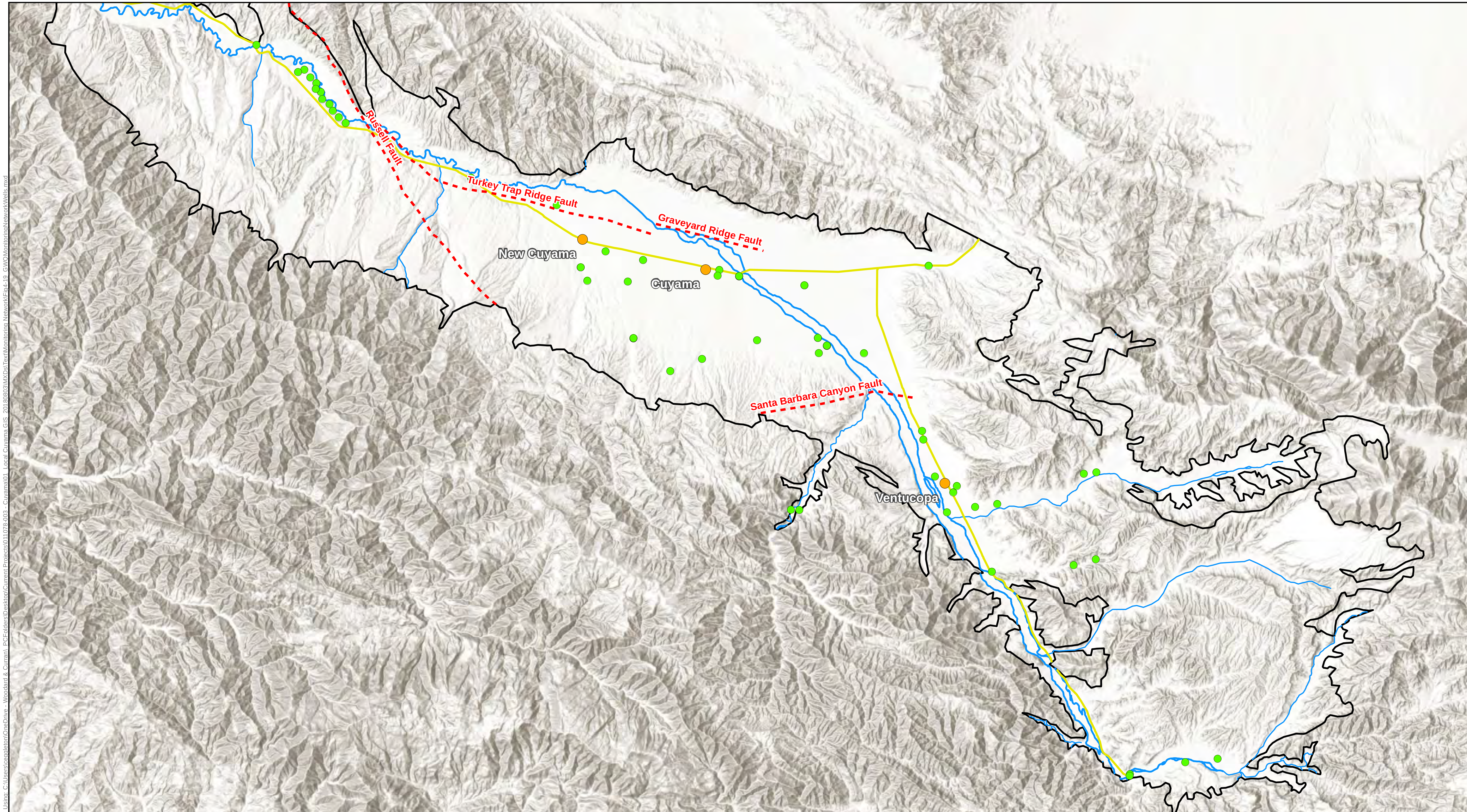

Figure 4-20: Cuyama GW Basin Groundwater Quality Monitoring Network Wells

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Legend

- Cuyama Basin
- Towns
- Highways
- Cuyama River
- Streams
- Faults
- Representative Wells and Groundwater Quality Monitoring Network Wells

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

N

0 1.75 3.5 7 Miles

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4.8.7 Monitoring Protocols

For additional monitoring recommended in Section 4.5.8, 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

The spatial distribution of the groundwater quality monitoring network provides coverage of several portions of the Basin. There are several areas, identified by the red ovals in Figure 4-21, that do not have adequate monitoring. Additional samples taken in these identified areas will provide more information about salinity in the indicated locations.

Well construction for existing salinity sampling efforts is mostly unknown, and the depth of water used for sampling is not known at most monitoring sites. The monitoring network will collect additional information about how salinity may change at different depths in the aquifer, which will require taking samples from wells that have more detailed construction information.

Water quality sampling is inconsistently performed throughout the Basin; as a result, the Basin itself is identified as a groundwater quality monitoring temporal data gap. In September 2018, a CBGSA representative contacted management entities in the Basin responsible for groundwater quality sampling, to help understand the timing of current monitoring schedules, and to determine whether those management entities intended to continue quality monitoring in the future. This GSP assumes all management entities anticipate continuing groundwater quality sampling in the Basin; however, this will need to be confirmed, and the anticipated schedule of sampling by each entity will also need to be confirmed.

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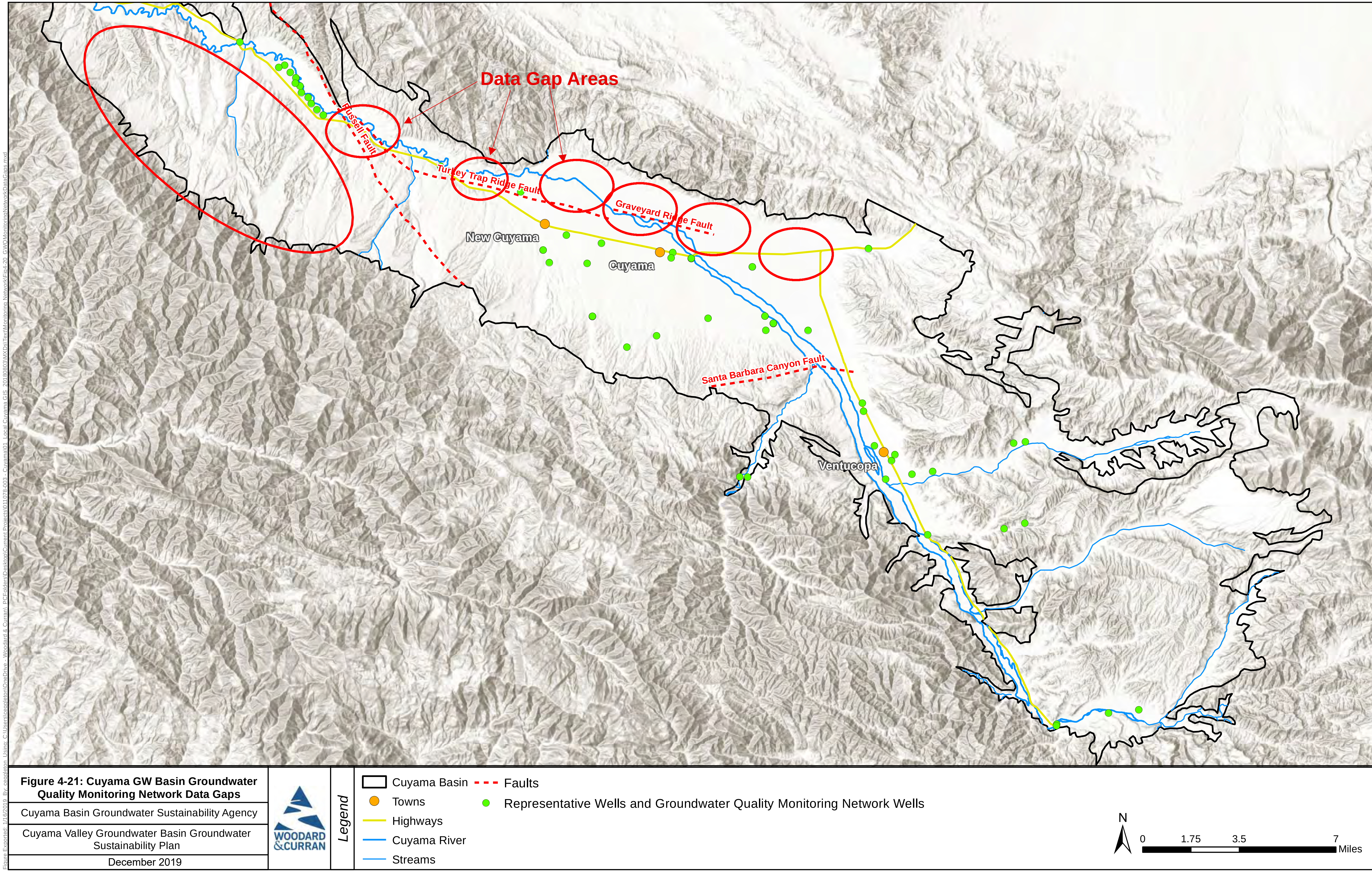

Figure 4-21: Cuyama GW Basin Groundwater Quality Monitoring Network Data Gaps

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4.8.9 Plan to Fill Data Gaps

The CBGSA will fill the temporal and spatial data gaps by implementing its own salinity sampling program, and will fill the well construction knowledge gap at least partially by using DWR's TSS program to perform downhole logging of a subset of wells.

The CBGSA will develop and perform a project to perform annual monitoring of salinity in the Basin. This new monitoring program will focus on using wells that have both construction information and pumps installed. Details of the new monitoring program, such as the targeted number and distribution of sampling sites will be detailed as a project in the projects and management actions section of this GSP (Chapter 6).

DWR's TSS supports GSAs as they develop GSPs. Downhole video logging performed by TSS in existing salinity monitoring wells could provide more well construction information, which may help to better use well data in the Basin.

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 4-22 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. These stations are included in Figure 4-22. 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.

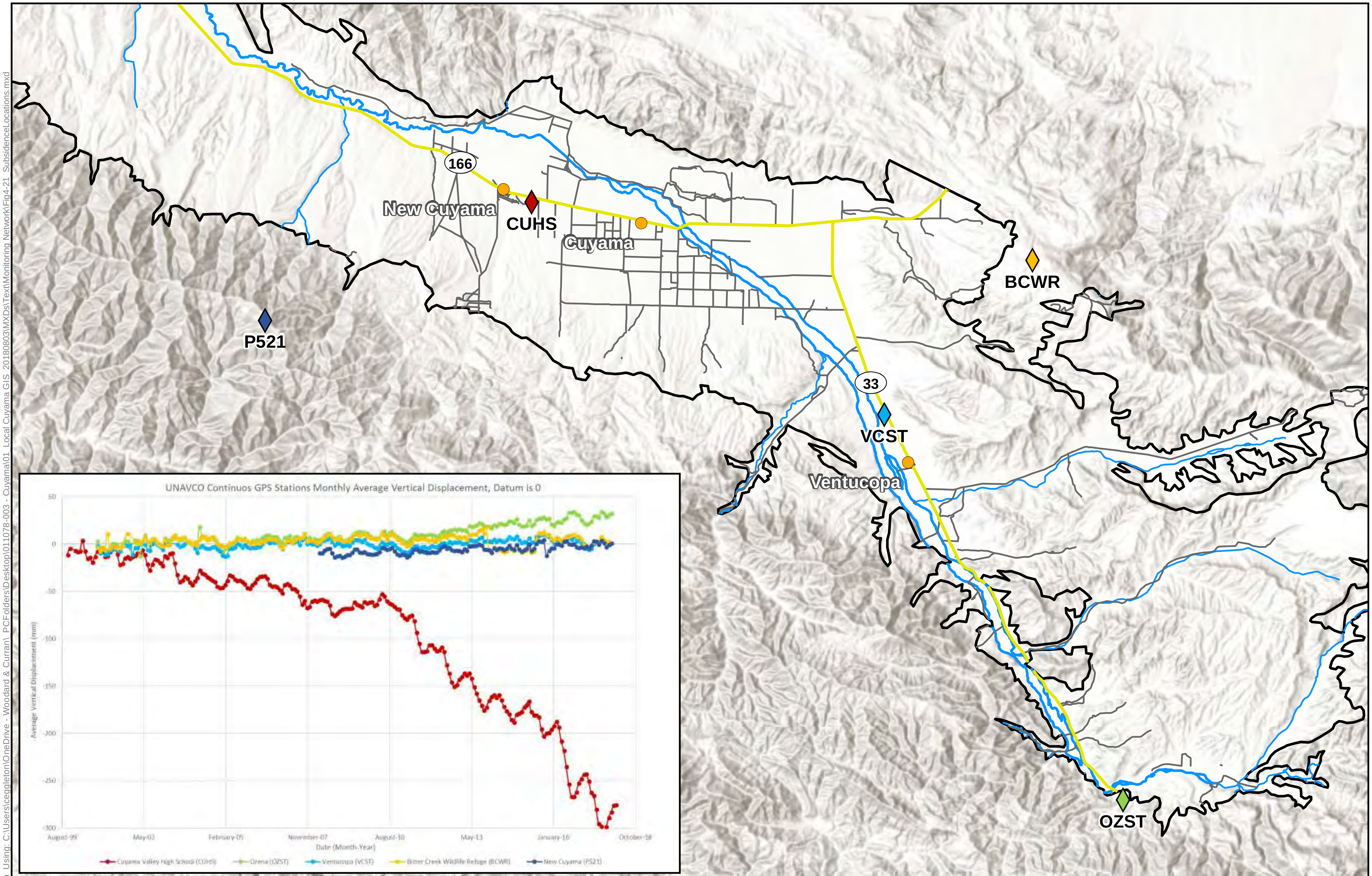

Figure 4-22: Subsidence Stations In and Around the Cuyama Basin

Cuyama Basin Groundwater Sustainability Agency

Cuyama Valley Groundwater Basin Groundwater Sustainability Plan

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Legend

Cuyama Basin
Towns
Highways
Local Roads
Cuyama River
Streams

0 2 4 8 Miles

N

Figure Exported: 9/18/2018 By: ceggleton Using: C:\Users\ceggleton\OneDrive - Woodard & Curran\ PCFolders\Desktop\011078-003 - Cuyama\01 Local Cuyama GIS 20180803\MXDs\Text\Monitoring Network\Fig4-21 SubsidenceLocations.mxd

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 4-23. 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.

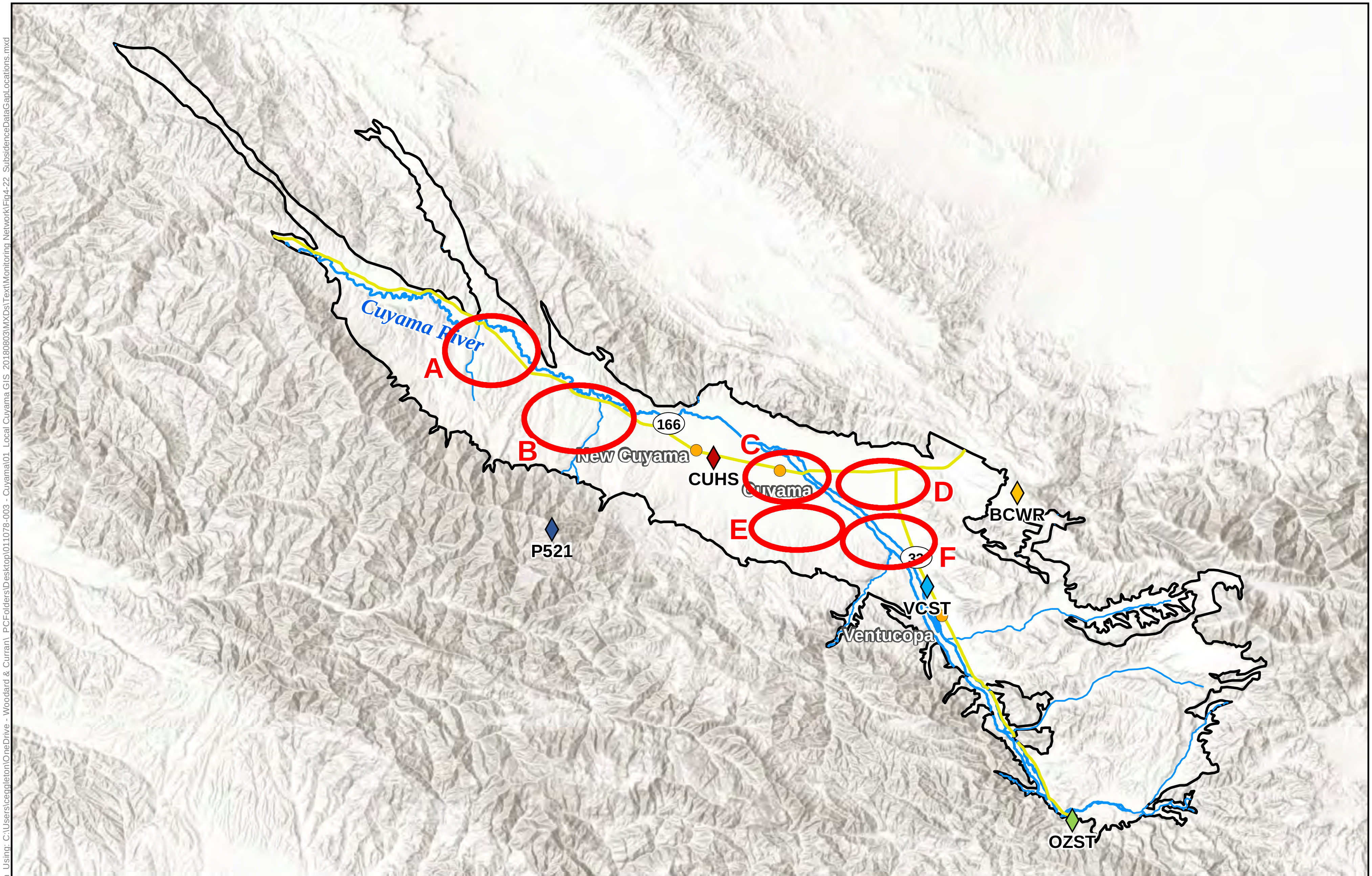

Figure 4-23: Subsidence Monitoring Location Data Gap Areas

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Cuyama Valley Groundwater Basin Groundwater Sustainability Plan

December 2019

4.10 Depletions of Interconnected Surface Water Monitoring Network

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."

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

Because there are currently no operating stream gage stations on the Cuyama River in the Basin, the CBGSA is pursuing installation of three stream gages to assist in filling the data gap.

4.11 References

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4.10 Supplemental Section 4.10: Monitoring Networks, Depletions of Interconnected Surface Water Monitoring Network

The CBGSA believes that identifying a subset of groundwater level representative monitoring wells for use in ISW monitoring, and providing a rationale for their selection, adequately addresses concerns provided in the Letter and provides adequate data collection and monitoring for ISWs.

Summary of Potential Undesirable Results for Interconnected Surface Waters

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. As shown in Figure 4-24, an analysis of the results of the historical simulation of the Cuyama Basin Water Resources Model (CBWRM) reveals that many portions of the stream system in the Basin were already disconnected as of 2015 and therefore ISW flows in these stream reaches would not be affected by further changes in groundwater levels. 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.

Because the Cuyama River does not flow during most days of the year and 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.

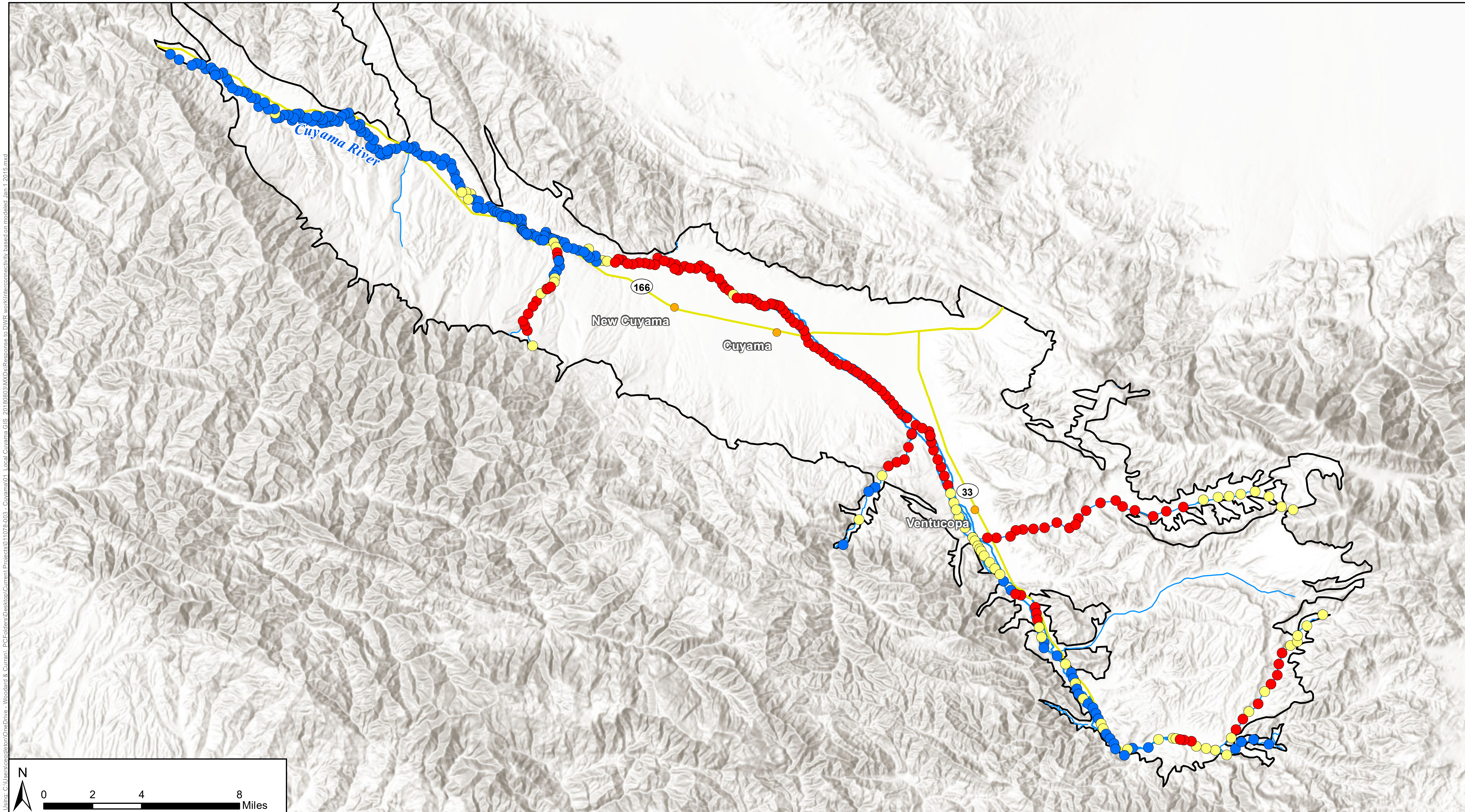

Figure 4-24: Potential Stream Interconnectivity using Modeled Conditions in January 2015

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September 2021

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Legend

- Cuyama Basin
- Cuyama River
- Streams

Gaining or Losing and Connected or Disconnected Determination Based on Modeled GW Levels on Jnauary 1, 2015

- Gaining Stream - Connected
- Losing Stream - Connected
- Losing Stream - Disconnected

Approach for ISW Monitoring and Sustainability Criteria

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.

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).

In addition, depletions of ISWs occur at the interaction of surface and groundwater, which is in the shallow portion of the aquifer. In general, wells with completions or depths within 100 feet bgs are preferable to provide more useful information about this near surface interaction. Common practice is to also only include wells that are in areas of interconnectivity or areas where interconnectivity conditions are close to those that define interconnectivity (for example, areas with groundwater levels between 30 to 50-feet below ground surface). Due to the limited number of available wells in the Cuyama Basin with screen intervals (or where screen interval data is not available, well depth) of less than 100 feet bgs, the proposed ISW network includes only five wells. Additional monitoring locations will need to be identified to fill data gaps in the ISW network as discussed below.

The resulting ISW monitoring network is shown in Table 4-8 and Figure 4-25 below. The 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. While the three non-representative wells in the central portion of the Basin are too deep for direct monitoring of ISW flows, they are included to allow the GSA to monitor potential groundwater level increases that could result in reconnection between the river and aquifer in the central Basin going forward.

Table 4-8: Interconnected Surface Water Monitoring Network

Opti ID	Threshold Region	Well Depth (feet bgs)	Screen Interval	Minimum Threshold (feet bgs)	Measurable Objective (feet bgs)
Representative Wells					
2	Southeastern	73	Unknown	72	55
89	Southeastern	125	Unknown	64	44
114	Central	58	Unknown	47	45
568	Central	188	Unknown	37	36
830	Northwestern	77	Unknown	59	56
832	Northwestern	132	Unknown	45	30
833	Northwestern	504	Unknown	96	24
836	Northwestern	325	Unknown	79	36
906	Northwestern	Unknown	50-70	TBD	TBD
Other Monitoring Network Wells					
101	Central	200	Unknown	n/a	n/a
102	Central	Unknown	Unknown	n/a	n/a
421	Central	620	Unknown	n/a	n/a

The proposed network includes the following data gaps which will need to be filled in the future:

- Due to the shortage of shallow monitoring wells available to include in the network, additional shallow aquifer measurement devices will be needed. As noted above, the CBGSA has called for the installation of piezometers in the vicinity of the streambed.

- A spatial data gap exists along the Cuyama River between Well 89 and Ventucopa. Note that significant stretches of the Cuyama River (particularly in the central area of the Basin) were already disconnected from the groundwater aquifer in 2015 (as discussed in Section 2.2.8).

The CBGSA has requested funding for the installation of six piezometers under the recently awarded DWR SGMA grant. The specific locations for these additional piezometers will be determined through technical analysis and stakeholder and landowner engagement with the goals of filling gaps in the ISW monitoring network and of providing better information regarding the condition of GDEs in the Basin.

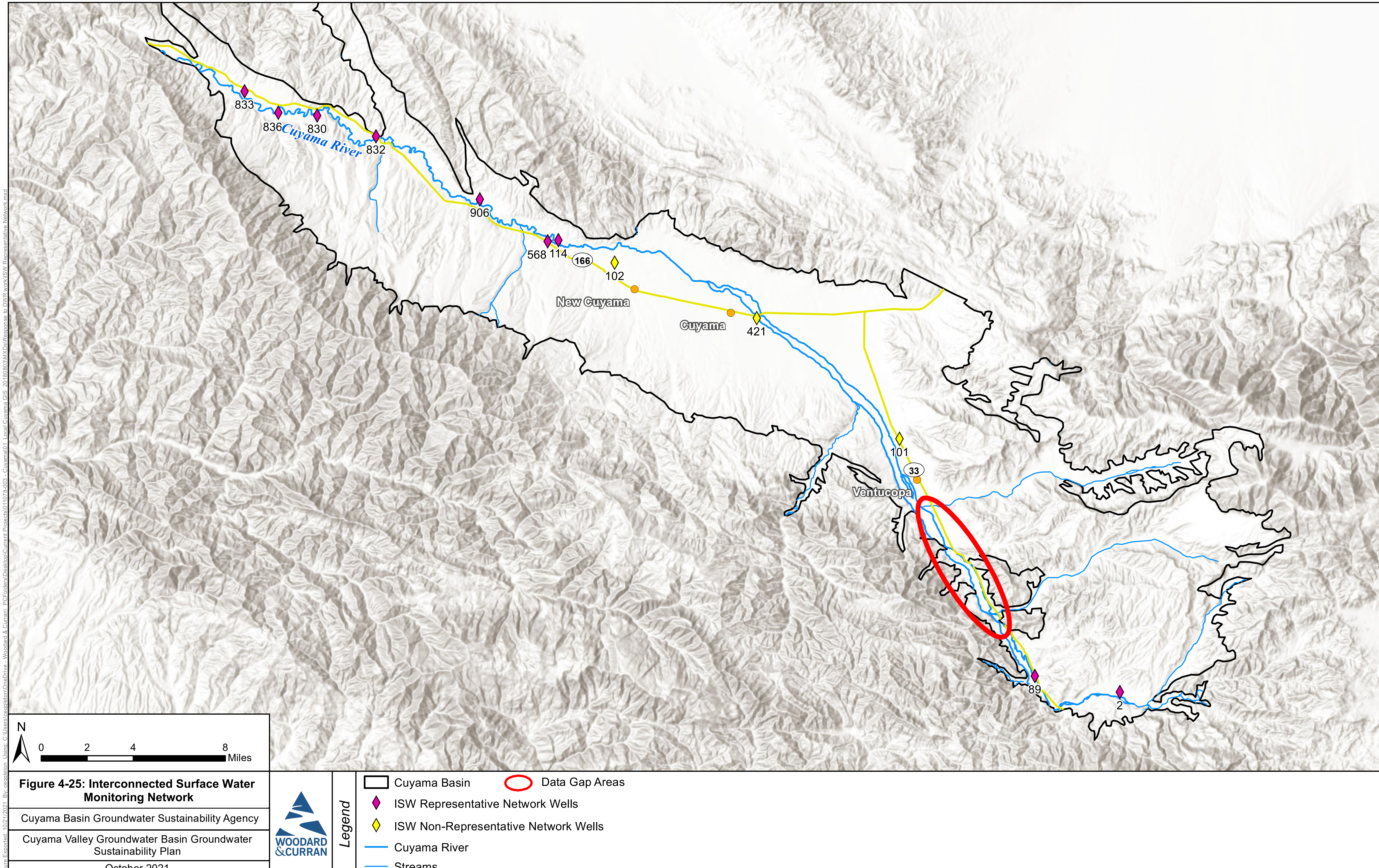

Figure 4-25: Interconnected Surface Water Monitoring Network

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Cuyama Valley Groundwater Basin Groundwater Sustainability Plan

October 2021

5. MINIMUM THRESHOLDS, MEASURABLE OBJECTIVES, AND INTERIM MILESTONES

This chapter defines the sustainability criteria used to avoid undesirable results during GSP implementation. 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 six threshold regions were defined to allow areas with similar conditions to be grouped together for calculation of MOs, MTs, and IMs. These threshold regions are shown in Figure 5-1. The following subsections discuss threshold region characteristics and boundaries.

Southeastern Threshold Region

The Southeastern Threshold Region lies on the southeastern edge of the Basin, and is characterized as having moderate agricultural land use with steep geographic features surrounding the valley. Groundwater is generally high in this area, with recent historical data showing levels around 50 feet or less below ground surface, which indicates that this region is likely currently in a full condition. Groundwater levels in this region are subject to declines during drought periods, but have typically recovered back to previous levels during historically wet periods. The northern boundary of this region is the narrows at the Cuyama River approximately at the boundary with U.S. Forest Service lands, and the eastern boundary is the extent of alluvium. The southern and western extent of this region is defined by the groundwater basin boundary.

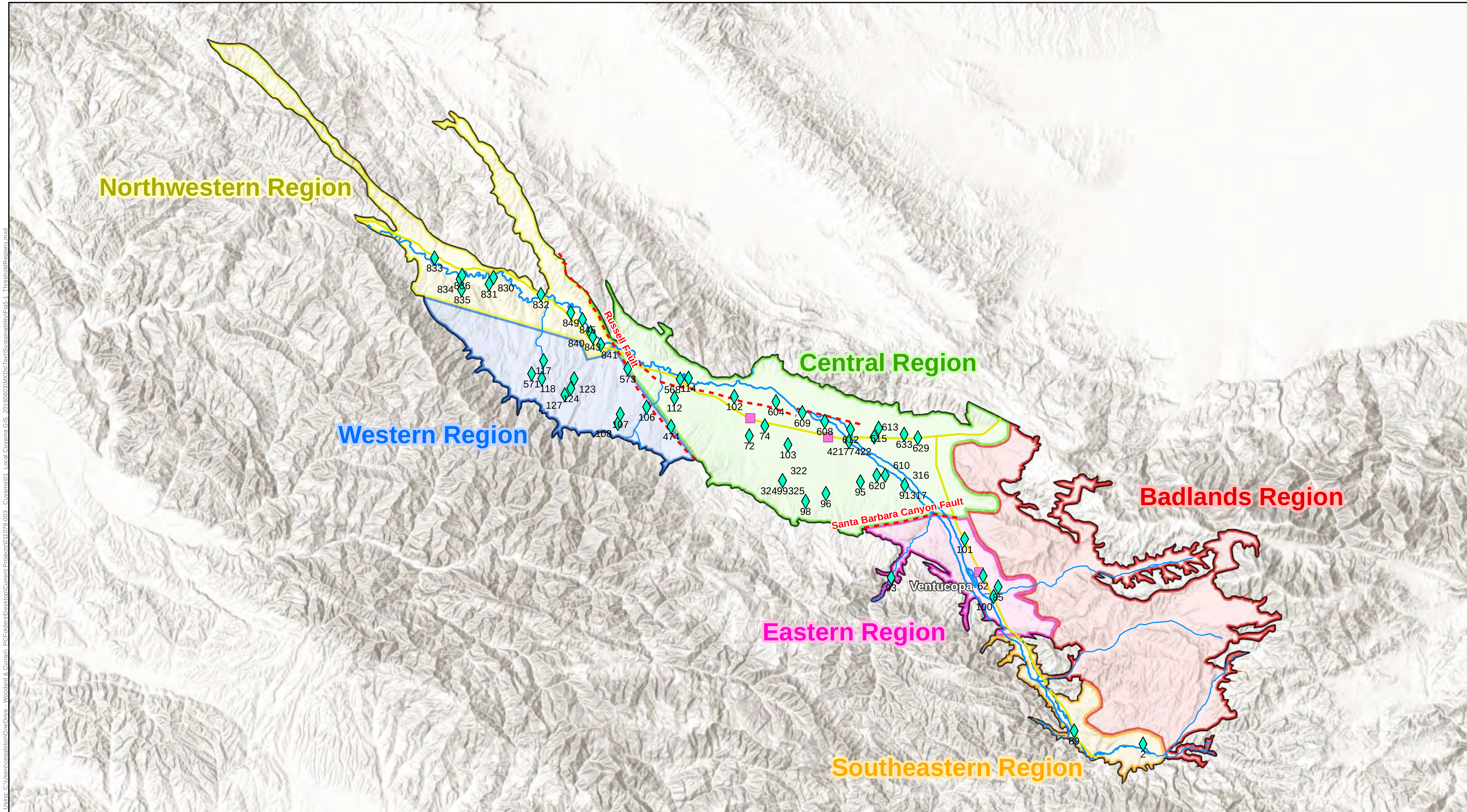

Figure 5-1: Cuyama GW Basin Groundwater Level Representative Wells & Threshold Regions

Cuyama Basin Groundwater Sustainability Agency

Cuyama Valley Groundwater Basin Groundwater Sustainability Plan

December 2019

WOODARD & CURRAN

Legend

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

Threshold Regions

- Badlands Region
- Central Region
- Eastern Region
- Northwestern Region
- Southeastern Region
- Western Region

N

0 2.75 5.5 11 Miles

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Eastern Threshold Region

The Eastern Threshold Region lies southeast of the central part of the Basin and encompasses Ventucopa and much of the surrounding agricultural property. This part of the Basin has agricultural pumping. Hydrographs in this region indicate that groundwater levels have historically ranged widely and repeatedly over the last 50 years, and in general, are declining over the past 20 years. However, these levels are generally higher than those in the Central Threshold Region. The northern boundary of this region is the SBCF, and the southern boundary is where the Cuyama Valley significantly narrows due to geographic changes. The eastern boundary is the extent of the boundary, and the western boundary is defined by the groundwater basin boundary.

Central Threshold Region

The Central Threshold Region incorporates the majority of agricultural land use in the Basin, as well as the towns of Cuyama and New Cuyama. The greatest depths to groundwater are also found in the Central Threshold Region, and groundwater levels have generally been declining in this region since the 1950s. The southeastern boundary is defined by the SBCF, and the western boundary by the Russell Fault. The northern and southern boundary of this region is defined by the Basin boundary.

Western Threshold Region

The Western Threshold Region is characterized by shallow depth to water, and recent historical data and hydrographs in this region indicate that it is likely this portion of the Basin is currently in a full condition. Land uses in this area generally include livestock and small agricultural operations. It lies primarily on the north facing slope of the lower Cuyama Valley. The eastern boundary is defined by the Russell Fault, and the northern boundary was drawn to differentiate distinct land uses. The southwestern boundary is defined by the groundwater basin boundary.

Northwestern Threshold Region

The Northwestern Threshold Region is the bottom of the Cuyama Basin and has undergone changes in land use from small production agricultural and grazing to irrigated crops over the last four years. Recent historical data and hydrographs in this portion of the Basin indicate that this portion is likely currently in a full condition. The southern border was drawn to differentiate between the land uses of the Western and Northwestern Threshold regions, resulting in different kinds of agricultural practices. The rest of the region is defined by the Basin boundary.

Badlands Threshold Region

The Badlands Threshold Region includes the areas east of the Central, East, and Southeast Threshold regions on the west facing slope of the Cuyama Valley. There are no active wells and there is little groundwater use in this area. There is no monitoring in this region, and no sustainability criteria were developed for this region.

5.2.2 Minimum Thresholds, Measurable Objectives, and Interim Milestones

This section describes how MTs, MOs, and IMs were established by threshold region, and explains the rationale behind each selected methodology.

Southeastern Threshold Region

Monitoring in this threshold region indicates groundwater levels are static except during drought conditions from 2013 to 2018. Static groundwater levels indicate this area of the Basin is generally at capacity; therefore, the MT is protective of domestic, private, public, and environmental uses.

The MO for the Southeastern Threshold Region's wells was calculated by finding the measurement taken closest to (but not before) January 1, 2015 and not after April 30, 2015. If no measurement was taken during this four-month period, then a linear trendline was applied to the data and the value for January 1, 2015 was extrapolated.

To provide an operational flexibility range, the MT was calculated by subtracting five years of groundwater storage from the MO. Five years of storage was calculated by finding the decline in groundwater levels from 2013 to 2018, which was considered a period of drought. If measurements were insufficient for this time period, a linear trendline was used to extrapolate the value decline value.

IMs were set to equal the MT in 2025, with a projected improvement to one-third the distance between the MT and MO in 2030 and half the distance between the MT and MO in 2035. As a result, IMs will measure progress toward sustainability over the GSP's planning horizon.

Groundwater levels will be measured using the protocols documented in Chapter 4's Appendix A.

Eastern Threshold Region

Monitoring in this threshold region indicates a downward trend in groundwater levels. However, much of this downward trend is due to hydrologic variability and may be recovered in the future. Therefore, MTs have been set to allow for greater flexibility as compared to other regions. The MT for wells in this region intends to protect domestic, private, public and environmental uses of the groundwater by allowing for managed extraction in areas that have beneficial uses and protecting those with at risk infrastructure.

Stakeholders reported concern about the dewatering of domestic wells in this region, and groundwater levels have been declining in monitoring wells. Both the MT and MO consider the sustainability of water levels in regard to both domestic and agricultural users.

The MT was calculated by taking the total historical range of recorded groundwater levels and used 35 percent of the range. This 35 percent was then added below the value closest to January 1, 2015 (as described above).

MOs were calculated by subtracting five years of groundwater storage from the MT. Five years of storage was found by calculating the decline in groundwater levels from 2013 to 2018 (a drought period). If measurements were insufficient for this time period, a linear trendline was used to extrapolate the value.

IMs were set to equal the MT in 2025, with a projected improvement to one-third the distance between the MT and MO in 2030 and half the distance between the MT and MO in 2035. As a result, IMs will measure progress toward sustainability over the GSP's planning horizon.

Groundwater levels will be measured using the protocols documented in Chapter 4's Appendix A.

Central Threshold Region

Monitoring in this threshold region indicates a decline in groundwater levels, indicating an extraction rate that exceeds recharge rates. The MT for this region is set to allow current beneficial uses of groundwater while reducing extraction rates over the planning horizon to meet sustainable yield. The MO is intended to allow sufficient operational flexibility for future drought conditions.

The MT for representative wells in the Central Threshold Region was calculated by finding the maximum and minimum groundwater levels for each representative well, and calculating 20 percent of the historical range. This 20 percent was then added to the depth to water measurement closest to, but not before, January 1, 2015, and no later than April 30, 2015. If no measurement was taken during this four-month period, then a linear trendline was applied to the wells data, and the value for January 1, 2015 was extrapolated.

The MO was calculated by subtracting five years of groundwater storage from the MT. Five years of storage was found by calculating the decline in groundwater levels from 2013 to 2018 (a drought period). If measurements were insufficient for this time period, a linear trendline was used to extrapolate the value.

For Opti Wells 74, 103, 114, 568, 609, and 615, a modified MO calculation was used where the MO used the linear trendline of the full range of measurements to extrapolate a January 1, 2015 value. This modification was made because measurements from 2013 to 2018 in these wells did not provide sufficient data to provide an adequate trendline for calculating the MO.

IMs were set to equal the in 2025, with a projected improvement to one-third the distance between the MT and MO in 2030 and half the distance between the MT and MO in 2035. As a result, IMs will measure progress toward sustainability over the GSP's planning horizon.

Groundwater levels will be measured using the protocols documented in Chapter 4's Appendix A.

Western Threshold Region

Monitoring in this threshold region indicates groundwater levels are stable, and levels varied significantly depending on where representative wells were in the region. The most common use of groundwater in this region is for domestic use. Due to these hydrologic conditions, the MT was set to protect the water levels from declining significantly, while allowing beneficial land surface uses of the groundwater and protection of current well infrastructure. The MT was calculated by taking the difference between the total well depth and the value closest to mid-February, 2018, and calculating 15 percent of that depth. Values from 2018 are used because data collected during this time represent a full basin condition. That value was then subtracted from the mid-February, 2018 measurement to calculate the MT. This allows users in this region to use their groundwater supply without increasing the risk of running a well beyond acceptable limits, and this methodology is responsive to the variety of conditions and well depths in this region.

The MO was then calculated by finding the measurement closest to mid-February, 2018, which monitoring indicates is likely a full condition.

Opti Well 474 uses a modified MO calculation where the historical high elevation measurement was used as the MO. This was done to allow for a sufficient operational flexibility based on historical data for the well.

IMs were set to equal the in 2025, with a projected improvement to one-third the distance between the MT and MO in 2030 and half the distance between the MT and MO in 2035. As a result, IMs will measure progress toward sustainability over the GSP's planning horizon.

Groundwater levels will be measured using the protocols documented in Chapter 4's Appendix A.

Northwestern Threshold Region

Monitoring in this threshold region indicates levels are stable, with some declines in the area where new agriculture is established. Due to these hydrologic conditions, the MT was set to protect the water levels from declining significantly, while allowing beneficial land surface uses (including domestic and agricultural uses) and using the storage capacity of this region. The MT for the this region was found by determining the region's total average saturated thickness for the primary storage area, and calculating 15 percent of that depth. This value was then set as the MT.

The MO for this region was calculated using 5 years of storage. Because historical data reflecting new operations in this region are limited, 50 feet was used as 5 years of storage based on local landowner input.

There are several representative wells in this region that were reclassified as far-west northwestern wells, and include Opti Wells 830, 831, 832, 833, 834, 835, and 836. These wells have total depths that are shallower, and they use the same strategies as the Western Threshold Region for their MOs and MTs to be more protective of these wells and ensure levels do not drop below the total well depth.

IMs were set to equal the MT in 2025, with a projected improvement to one-third the distance between the MT and MO in 2030 and half the distance between the MT and MO in 2035. As a result, IMs will measure progress toward sustainability over the GSP's planning horizon.

Groundwater levels will be measured using the protocols documented in Chapter 4's Appendix A.

Badlands Threshold Region

This threshold region has no groundwater use or active wells. As a result, no MO, MT, or IM was calculated.

5.2.3 Selected MT, MO, and IM Graphs, Figures, and Tables

Figure 5-2 shows an example hydrograph with indicators for the MT, MO, and IM over the hydrograph. The left axis shows elevation above mean sea level, the right axis shows depth to water below ground surface. The brown line shows the ground surface elevation, and time in years is shown on the bottom axis. Each measurement taken at the monitoring well is shown as a blue dot, with blue lines connecting between the blue dots indicating the interpolated groundwater level between measurements. The MT and IM are shown as a red line, and the MO is shown as a green line. Appendix A includes hydrographs with MT, MO and IM for each representative monitoring well.

Table 5-1 shows the representative monitoring network and the numerical values for the MT, MO, and IM.

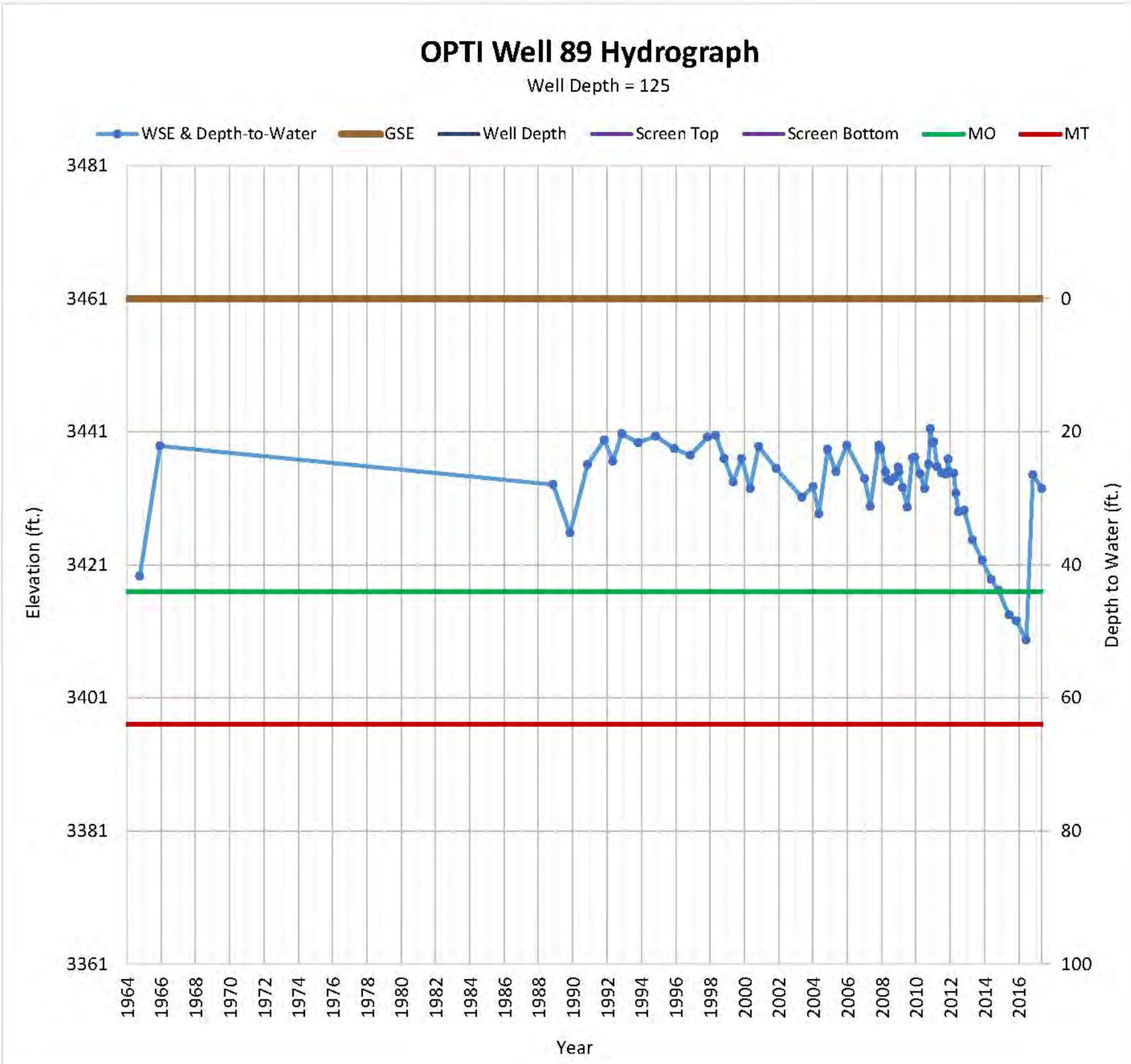

Figure 5-2: Example Hydrograph

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	169	124	169	154	147	790	340	350	2,171
74	Central	256	243	256	252	250	--	--	--	2,193
77	Central	450	400	450	433	425	980	960	980	2,286
91	Central	625	576	625	609	601	980	960	980	2,474
95	Central	573	538	573	561	556	805	--	--	2,449
96	Central	333	325	333	330	329	500	--	--	2,606
98	Central	450	439	450	446	445	750	--	--	2,688
99	Central	311	300	311	307	306	750	730	750	2,513
102	Central	235	197	235	222	216	--	--	--	2,046
103	Central	290	235	290	272	263	1,030	--	--	2,289
112	Central	87	85	87	86	86	441	--	--	2,139
114	Central	47	45	47	46	46	58	--	--	1,925
316	Central	623	574	623	607	599	830	--	--	2,474
317	Central	623	573	623	606	598	700	--	--	2,474
322	Central	307	298	307	304	303	850	--	--	2,513
324	Central	311	299	311	307	305	560	--	--	2,513
325	Central	300	292	300	297	296	380	--	--	2,513
420	Central	450	400	450	433	425	780	--	--	2,286

Table 5-1: Representative Monitoring Network and Sustainability Criteria

OPTI Well	Region	Final MT	Final MO	2025 IM	2030 IM	2035 IM	Well Depth (feet)	Screen Top (feet)	Screen Bottom (feet)	GSE (feet)
421	Central	446	398	446	430	422	620	--	--	2,286
422	Central	444	397	444	428	421	460	--	--	2,286
474	Central	188	169	188	182	179	213	--	--	2,369
568	Central	37	36	37	37	37	188	--	--	1,905
604	Central	526	487	526	513	507	924	454	924	2,125
608	Central	436	407	436	426	422	745	440	745	2,224
609	Central	458	421	458	446	440	970	476	970	2,167
610	Central	621	591	621	611	606	780	428	780	2,442
612	Central	463	440	463	455	452	1,070	657	1070	2,266
613	Central	503	475	503	494	489	830	330	830	2,330
615	Central	500	468	500	489	484	865	480	865	2,327
620	Central	606	566	606	593	586	1,035	550	1035	2,432
629	Central	559	527	559	548	543	1,000	500	1000	2,379
633	Central	547	493	547	529	520	1,000	500	1000	2,364
62	Eastern	182	157	182	169	170	212	--	--	2,921
85	Eastern	233	209	233	204	221	233	--	--	3,047
100	Eastern	181	152	181	162	167	284	--	--	3,004
101	Eastern	111	88	111	101	100	200	--	--	2,741
840	Northwestern	203	153	203	186	178	900	200	880	1,713

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)
841	Northwestern	203	153	203	186	178	600	170	580	1,761
843	Northwestern	203	153	203	186	178	620	60	600	1,761
845	Northwestern	203	153	203	186	178	380	100	360	1,712
849	Northwestern	203	153	203	186	178	570	150	550	1,713
2	Southeastern	72	55	72	66	64	73	--	--	3,720
89	Southeastern	64	44	64	57	54	125	--	--	3,461
106	Western	154	141.4	154	150	148	227.5	--	--	2,327
107	Western	91	72.23	91	85	82	200	--	--	2,482
108	Western	165	135.62	165	155	150	328.75	--	--	2,629
117	Western	160	150.82	160	157	155	212	--	--	2,098
118	Western	124	57.22	124	102	91	500	--	--	2,270
123	Western	31	12.59	31	25	22	138	--	--	2,165
124	Western	73	57.12	73	68	65	160.55	--	--	2,287
127	Western	42	31.74	42	39	37	100.25	--	--	2,364
571	Western	144	120.5	144	136	132	280	--	--	2,307
573	Western	118	67.5	118	101	93	404	--	--	2,084
830	Far-West Northwestern	59	56	59	58	58	77.2	--	--	1,571
831	Far-West Northwestern	77	52	77	69	65	213.75	--	--	1,557
832	Far-West Northwestern	45	30	45	40	38	131.8	--	--	1,630

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)
833	Far-West Northwestern	96	24	96	72	60	503.55	--	--	1,457
834	Far-West Northwestern	84	42	84	70	63	320	--	--	1,508
835	Far-West Northwestern	55	36	55	49	46	162.2	--	--	1,555
836	Far-West Northwestern	79	36	79	65	58	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 Threshold Regions

Groundwater storage is measured by proxy using groundwater level thresholds, and thus uses the same methodology and threshold regions as groundwater levels.

5.3.2 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 TDS), arsenic, and nitrates have all been identified as potentially being of concern for water quality in the Basin. However, as noted in the Groundwater Conditions section, there have only been two nitrate measurements and three arsenic measurements in recent years that exceeded MCLs. In the case of arsenic, all of the high concentration measurements have been taken at groundwater depths of greater than 700 feet, outside of the range of pumping. Furthermore, unlike with salinity, there is no evidence to suggest a causal nexus between potential GSP actions and arsenic or salinity. Therefore, the groundwater quality network has been established to monitor for salinity (measured as TDS) but does not include arsenic or nitrates at this time.

TDS is being monitored by the CBGSA for several reasons. Local stakeholders identified TDS as one of the constituents of concerns in the GSP development processes, and TDS has had several exceedance measurements near domestic and public supply wells. Although high TDS concentrations are naturally occurring within the Basin, it is believed that management of groundwater levels may help improve TDS concentration levels towards levels reflective of the natural condition.

5.5.1 Threshold Regions

Groundwater quality monitoring does not use threshold regions. because the same approach is used for all wells in the Basin. Figure 5-3 shows groundwater quality representative well locations in the Basin.

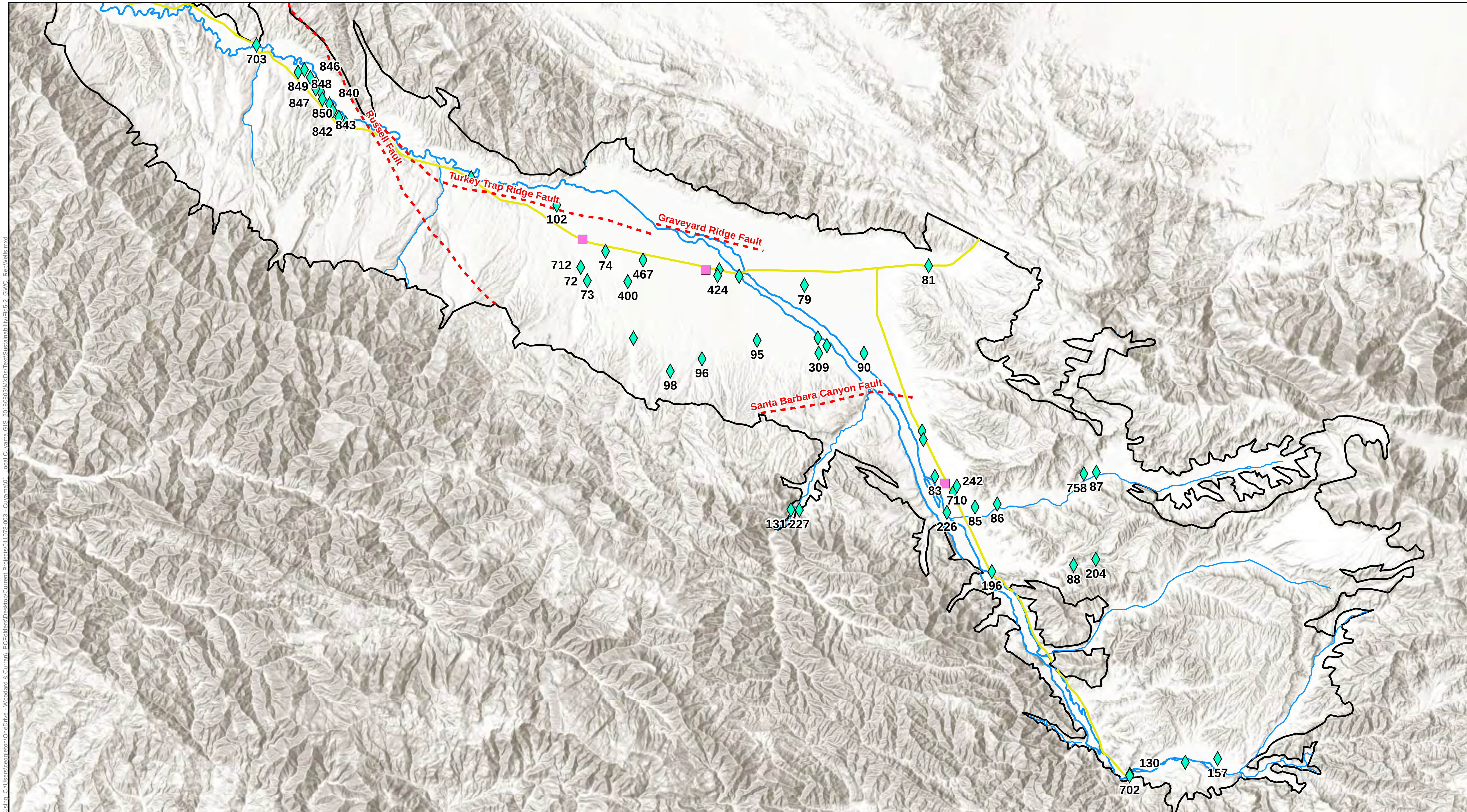

Figure 5-3: Cuyama GW Basin Groundwater Quality Representative Wells

Cuyama Basin Groundwater Sustainability Agency

Cuyama Valley Groundwater Basin Groundwater Sustainability Plan

December 2019

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Legend

- Cuyama Basin
- Towns
- Faults
- Highways
- Cuyama River
- Streams
- Representative Groundwater Quality Wells

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5.5.2 Proxy Monitoring

Proxy monitoring is not used for groundwater quality monitoring in the Basin.

5.5.3 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 (MCL, but does have both a California Division of Drinking Water and U.S. Environmental Protection Agency. Secondary standard of 500 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 will 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 has been set as the same value as the MT, with a projected improvement to one-third of the distance between the MT and MO in 2030 and one-half of the distance between the MT and MO in 2035.

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Table 5-2: MOs, MTs, and Interim Milestones for Groundwater Quality Representative Sites - TDS

Opti Well	Well Depth (feet below GSE)	Screen Interval (feet below GSE)	Well Elevation (feet above MSL)	Most Recent Measurement (feet)	Minimum Value (mg/L)	Maximum Measurement Value (mg/L)	20% of Range (mg/L)	90th Percentile (mg/L)	MO (mg/L)	MT (mg/L)	2025 IM (mg/L)	2030 IM (mg/L)	2035 IM (mg/L)
61	357	Unknown	3,681	585	468	602	26.8	588.4	585	615.2	615	605	600
72	790	340 – 350	2,171	996	955	1020	13	1010	996	1,023	1023	1014	1010
73	880	Unknown	2,252	805	777	844	13.4	842.5	805	855.9	856	839	830
74	--	Unknown	2,193	1,550	1,530	1,820	58	1775	1,500	1,833	1833	1722	1667
76	720	Unknown	2,277	1,700	1,280	2,190	182	2,124.9	1,500	2,306.9	2307	2038	1903
77	980	960 – 980	2,286	1,520	1,520	1,580	12	1580	1,500	1,592	1592	1561	1546
79	600	Unknown	2,374	2,140	1,810	2,280	94	2226	1,500	2,320	2320	2047	1910
81	155	Unknown	2,698	2,620	2,620	2,760	28	2760	1,500	2,788	2788	2359	2144
83	198	Unknown	2,858	1,660	1,660	1,720	12	1714	1,500	1,726	1726	1651	1613
85	233	Unknown	3,047	618	491	1,500	201.8	1,189.4	618	1,391.2	1391	1133	1005
86	230	Unknown	3,141	969	912	969	11.4	963.3	969	974.7	975	973	972
87	232	Unknown	3,546	1,090	891	1,160	53.8	1,111	1,090	1,164.8	1165	1140	1127
88	400	Unknown	3,549	302	302	302	0	302	302	302	302	302	302
90	800	Unknown	2,552	1,530	1,440	1,580	28	1,565	1,500	1,593	1593	1562	1547
91	980	960 – 980	2,474	1,410	1,410	1,480	14	1,473	1,410	1,487	1487	1461	1449
94	550	Unknown	2,456	1,050	1,050	1,230	36	1,209	1,050	1,245	1245	1180	1148
95	805	Unknown	2,449	1,710	1,710	1,840	26	1,840	1,500	1,866	1866	1744	1683
96	500	Unknown	2,606	1,500	1,500	1,620	24	1,608	1,500	1,632	1632	1588	1566
98	750	Unknown	2,688	2,220	2,220	2,370	30	2,370	1,500	2,400	2400	2100	1950
99	750	730 – 750	2,513	1,490	1,490	1,550	12	1,550	1,490	1,562	1562	1538	1526
101	200	Unknown	2,741	1,550	1,550	1,680	26	1,667	1,500	1,693	1693	1629	1597
102	--	Unknown	2,046	1,970	1,920	2,290	74	2,277	1,500	2,351	2351	2067	1926
130	--	Unknown	3,536	1,800	1,800	1,850	10	1,845	1,500	1,855	1855	1737	1678
131	--	Unknown	2,990	1,850	1,850	1,970	24	1,958	1,500	1,982	1982	1821	1741
157	71	Unknown	3,755	1,930	1,910	2,320	82	2,278	1,500	2,360	2360	2073	1930

Table 5-2: MOs, MTs, and Interim Milestones for Groundwater Quality Representative Sites - TDS

Opti Well	Well Depth (feet below GSE)	Screen Interval (feet below GSE)	Well Elevation (feet above MSL)	Most Recent Measurement (feet)	Minimum Value (mg/L)	Maximum Measurement Value (mg/L)	20% of Range (mg/L)	90th Percentile (mg/L)	MO (mg/L)	MT (mg/L)	2025 IM (mg/L)	2030 IM (mg/L)	2035 IM (mg/L)
196	741	Unknown	3,117	851	682	868	37.2	866.5	851	903.7	904	886	877
204	--	Unknown	3,693	253	253	266	2.6	266	253	268.6	269	263	261
226	--	Unknown	2,945	1,760	1,760	1,830	14	1,830	1,500	1,844	1844	1729	1672
227	--	Unknown	3,002	1,780	1,780	2,200	84	2,146	1,500	2,230	2230	1987	1865
242	155	Unknown	2,933	1,470	1,470	1,510	8	1,510	1,470	1,518	1518	1502	1494
269	--	Unknown	2,756	1,570	1,570	1,690	24	1,678	1,500	1,702	1702	1635	1601
309	1,100	Unknown	2,513	1,410	1,410	1,500	18	1,491	1,410	1,509	1509	1476	1460
316	830	Unknown	2,474	1,380	1,380	1,460	16	1,452	1,380	1,468	1468	1439	1424
317	700	Unknown	2,474	1,260	1,260	1,330	14	1,323	1,260	1,337	1337	1311	1299
318	610	Unknown	2,474	1,080	1,080	1,140	12	1,140	1,080	1,152	1152	1128	1116
322	850	Unknown	2,513	1,350	1,350	1,380	6	1,380	1,350	1,386	1386	1374	1368
324	560	Unknown	2,513	746	746	772	5.2	772	746	777.2	777	767	762
325	380	Unknown	2,513	1,470	1,470	1,560	18	1,551	1,470	1,569	1569	1536	1520
400	2,120	Unknown	2,298	918	680	948	53.6	922	918	975.6	976	956	947
420	780	Unknown	2,286	1,430	1,430	1,480	10	1,480	1,430	1,490	1490	1470	1460
421	620	Unknown	2,286	1,520	1,520	1,600	16	1,600	1,500	1,616	1616	1577	1558
422	460	Unknown	2,286	1,810	1,810	1,930	24	1,918	1,500	1,942	1942	1795	1721
424	1,000	Unknown	2,291	1,540	1,540	1,580	8	1,580	1,500	1,588	1588	1559	1544
467	1,140	Unknown	2,224	1,630	1,530	1,730	40	1,724	1,500	1,764	1764	1676	1632
568	188	Unknown	1,905	871	871	1,180	61.8	1,129.6	871	1,191.4	1191	1085	1031
702	--	Unknown	3,539	110	48	1,900	370.4	1,704	110	2,074.4	2074	1420	1092
703	--	Unknown	1,613	400	16	4,500	896.8	3,200	400	4,096.8	4097	2865	2248
710	--	Unknown	2,942	1,040	1,040	1,040	0	1,040	1,040	1,040	1040	1040	1040
711	--	Unknown	1,905	928	928	928	0	928	928	928	928	928	928
712	--	Unknown	2,171	977	972	977	1	9,76.5	977	977.5	978	977	977

Table 5-2: MOs, MTs, and Interim Milestones for Groundwater Quality Representative Sites - TDS

Opti Well	Well Depth (feet below GSE)	Screen Interval (feet below GSE)	Well Elevation (feet above MSL)	Most Recent Measurement (feet)	Minimum Value (mg/L)	Maximum Measurement Value (mg/L)	20% of Range (mg/L)	90th Percentile (mg/L)	MO (mg/L)	MT (mg/L)	2025 IM (mg/L)	2030 IM (mg/L)	2035 IM (mg/L)
713	--	Unknown	2,456	1,200	1,200	1,200	0	1,200	1,200	1,200	1200	1200	1200
721	--	Unknown	2,374	2,170	2,170	2,170	0	2,170	1,500	2,170	2170	1947	1835
758	--	Unknown	3,537	900	760	923	32.6	9,21.7	900	954.3	954	936	927
840	900	200 – 880	1,713	559	559	559	0	559	559	559	559	559	559
841	600	170 – 580	1,761	561	561	561	0	561	561	561	561	561	561
842	450	60 – 430	1,759	547	547	547	0	547	547	547	547	547	547
843	620	60 – 600	1,761	569	569	569	0	569	569	569	569	569	569
844	730	100 – 720	1,713	481	481	481	0	481	481	481	481	481	481
845	380	100 – 360	1,712	1,250	1,250	1,250	0	1,250	1,250	1,250	1250	1250	1250
846	610	130 – 590	1,715	918	918	918	0	918	918	918	918	918	918
847	600	180 – 580	1,733	480	480	480	0	480	480	480	480	480	480
848	390	110 – 370	1,694	674	674	674	0	674	674	674	674	674	674
849	570	150 – 550	1,713	1,780	1,780	1,780	0	1,780	1,500	1,780	1780	1687	1640
850	790	180 – 780	1,759	472	472	472	0	472	472	472	472	472	472

GSE = ground surface elevation

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5.6 Subsidence

The undesirable result for land subsidence is a result that causes significant and unreasonable reduction in the viability of the use of infrastructure over the planning and implementation horizon of this GSP.

5.6.1 Threshold Regions

Subsidence monitoring does not use threshold regions. because the same approach is used for all wells in the Basin. Figure 5-4 shows representative locations of subsidence in the Basin.

5.6.2 Representative Monitoring

As discussed in Chapter 4, Section 4.9, all monitoring network subsidence monitoring stations in the Basin, and three additional sites outside of the Basin are designated as representative monitoring sites (Figure 5-4). Detrimental impacts of subsidence include groundwater storage reductions and potential damage to infrastructure, such as large pipelines, roads, bridges and canals. However, the Basin does not currently have infrastructure of this type, and storage losses are small enough they are unlikely to have a meaningful effect on the Basin water budget.

Subsidence in the central portion of the Basin is approximately 0.5 inches per year, as shown in Chapter 2, Section 2.2. Currently, there are no state, federal, or local standards that regulate subsidence rates.

5.6.3 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 0.8 inches per year) are not significant and unreasonable, the MT rate for subsidence was set at 2 inches per year to allow for flexibility as the Basin works toward sustainability in 2040. This rate is applied primarily to the two stations in the Basin (CUHS and VCST), as the other stations in the monitoring network represent ambient changes in vertical displacement, primarily due to geological influences. This level of subsidence is considered unlikely to cause a significant and unreasonable reduction in the viability of the use of infrastructure over the planning and implementation horizon of this GSP.

Subsidence is expected to be influenced through the management of groundwater pumping through the groundwater level MOs, MTs, and IMs. Thus, the MO for subsidence is set for zero lowering of ground surface elevations.

IMs are not needed for the subsidence sustainability indicator because the current rate of subsidence is above the MT.

Subsidence rates will be measured in the frequency of measurement and monitoring protocols documented in Section 4’s Appendix A.

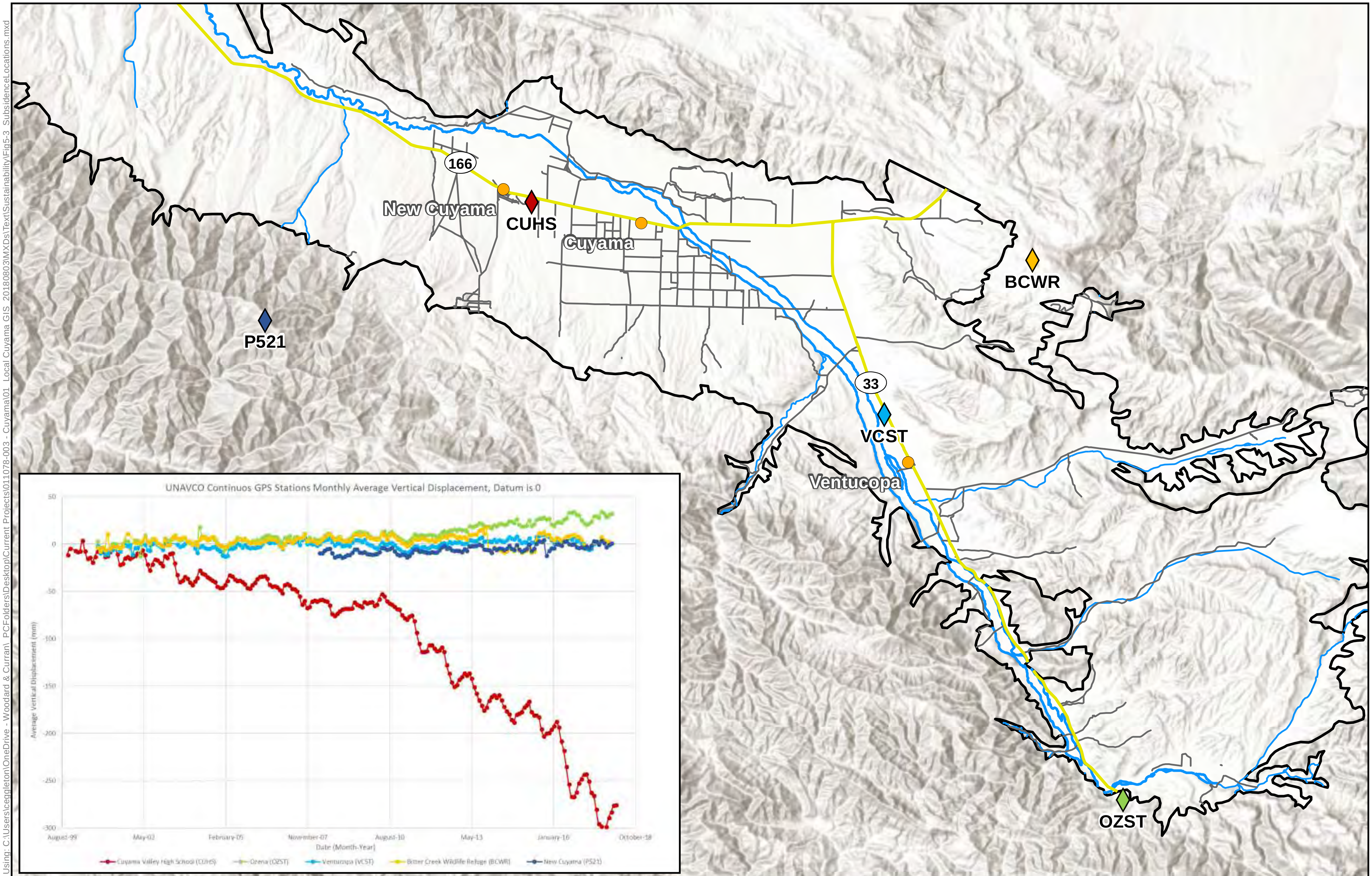

Figure 5-4: Cuyama GW Basin Subsidence Monitoring Locations

Cuyama Basin Groundwater Sustainability Agency

Cuyama Valley Groundwater Basin Groundwater Sustainability Plan

December 2019

WOODARD & CURRAN

Legend

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

0 2 4 8 Miles

N

Figure Exported: 2/1/2019 By: ceggleton Using: C:\Users\ceggleton\OneDrive - Woodard & Curran_PCFolders\Desktop\Current Projects\011078-003 - Cuyama\01_Local Cuyama GIS_20180803\MXDs\Text\Sustainability\Fig5-3_SubsidenceLocations.mxd

5.7 Depletions of Interconnected Surface Water

The undesirable result for depletions of interconnected surface water is a result that causes significant and unreasonable reductions in the viability of agriculture or riparian habitat in the Basin over the planning and implementation horizon of this GSP.

SGMA regulations define the MT for interconnected surface water as "…the rate or volume of surface water depletions caused by groundwater use that has adverse impacts on the beneficial uses of the surface water and may lead to undesirable results." Under normal surface water conditions in the Basin as of January 1, 2015, surface flows infiltrate into the groundwater system and are used by phreatophytes, except in the most extreme flash flood events, when surface water flows out of the Basin. Historically, these flash flood events flow for less than one week of the year. Conditions have not changed since January 1, 2015, and surface flows continue to infiltrate into the groundwater system for use by local phreatophytes.

Because current Basin conditions have not varied from January 1, 2015 conditions, the groundwater level thresholds established in Section 5.2 will act to maintain depletions of interconnected surface water at similar levels to those that existed in January 1, 2015. Therefore, groundwater level thresholds are used by proxy to protect the Basin from undesirable results related to depletion of interconnected surface water.

5.8 References

California Water Boards Irrigated Land Regulatory Program (ILRP) website. https://www.waterboards.ca.gov/centralvalley/water_issues/irrigated_lands/. Accessed January 11, 2019.

5.2 Supplemental Section 5.2: Minimum Thresholds, Measurable Objectives, and Interim Milestones, Chronic Lowering of Groundwater Levels

The groundwater levels MTs included in the GSP were developed with the intention of avoiding the URs of excessive drawdowns in the Basin while minimizing the number of domestic wells that could go dry and the potential impacts on GDEs in the Basin. Following receipt of DWR's letter, two technical analyses were performed to provide additional information related to the effects of the GSP's groundwater levels MTs and URs definitions on well infrastructure (i.e., domestic, public, and other production wells) and on environmental uses of groundwater (i.e., GDEs).

The results of these analyses demonstrate that the MTs included in the GSP achieve the goals of avoiding URs in the Basin. In particular, the following conclusions can be made:

- The sustainability criteria are protective of production wells (including domestic wells) in the Basin. Only five wells (two percent of all wells in the Basin) are at risk of going dry if MTs are reached throughout the Basin (i.e., at all representative wells). The CBGSA will strive to prevent domestic wells in the Basin from going dry through the Adaptive Management approach included in the GSP (Section 7.6) which calls for an investigation of the potential causes of groundwater level declines and the development of appropriate response strategies. Therefore, the potential for a small number of domestic wells to be at risk is not considered to be a significant and unreasonable result.
- A numerical modeling analysis of proposed MTs at Wells 841 and 845 show that these thresholds would have no negative impact on local domestic wells and only minimal impact at a single GDE location. Stream depletions could potentially increase by a small amount.

The results of these technical analyses demonstrate that the MTs included in the GSP are protective against significant and unreasonable results for production wells and GDEs in the Basin. The approach and results of each technical analysis are described below.

Assessment of Minimum Thresholds as Compared to Domestic and Production Well Screen Intervals

An assessment was performed of the MT levels included in the GSP as compared to the well screen intervals of production wells throughout the Basin to try to determine how many production wells may be at risk of going dry if the groundwater levels were to fall to MT levels at monitoring well locations throughout the Basin. This assessment scenario is conservative, as groundwater levels throughout the Basin are unlikely to fall to MT levels simultaneously. The assessment was performed using well location and construction information provided by the counties that overlie the Basin, including Santa Barbara, San Luis Obispo, Ventura, and Kern. To accomplish this, the CBGSA collected all available well data from public sources and the four counties in tabular formats. In the Northwestern Region, well completion reports were also individually collected, processed, and included in the analysis.

Since pump depth data was not available, wells were processed in GIS by utilizing their screen interval (or well depth if screen interval data was unavailable) to compare those values with MTs at monitoring wells located throughout for the Basin. Some basic filtering criteria were applied to the analysis to remove wells from consideration, including those wells that are destroyed or non-compliant in the county datasets, wells that are far away from active groundwater management and monitoring (e.g., the Badlands region), and wells that were already dry as of January 1, 2015.

The results of the analysis are shown in Table 5-3 and Figure 5-5. Out of a total of 250 production wells that were evaluated, a total of five (two percent of the total) are at risk of going dry if MTs are reached. Three of these five wells are domestic wells. As noted above, the CBGSA will strive to use adaptive management to prevent these domestic wells from going dry.

The CBGSA conducted an investigation to determine the potential impacts if these wells were to go dry. The three domestic wells appear to serve approximately four or five households between them. The two production wells serve vineyards with a total irrigated acreage of approximately two acres. Given that the entire basin encompasses about 18,000 irrigated acres, two acres represents about 0.01 percent and would appear to be a less than significant impact. Based on data developed for the direct economic impact analysis conducted for the Cuyama Basin, it is estimated that loss of production in these acres would represent a loss of about $10,000-15,000 per year.

Table 5-3: Domestic and Production Wells and MT Summary Statistics

Threshold Region	Total Number of Production Wells	Domestic Wells at Risk to Go Dry if GWLs reach MTs	Total Production Wells at Risk to Go Dry if GWLs reach MTs	Percentage of Wells at Risk of Going Dry
Northwestern	16	0	0	0%
Western	40	0	0	0%
Central	89	0	0	0%
Eastern	39	2	4	10%
Southeastern	66	1	1	2%
Whole Basin	***250***	***3***	***5***	***2%***

As shown in Figures 2-79 and 2-80, most wells with nitrate and arsenic concentrations exceeding MCLs are located in the central threshold region. The locations in the Basin of high arsenic concentrations are focused to the south of the town of New Cuyama near the existing Cuyama Community Services District (CCSD) well. This is a known issue for the CCSD that will be mitigated by the construction of a replacement well for the district, which was included as a project in the GSP (see Section 7.4.4).

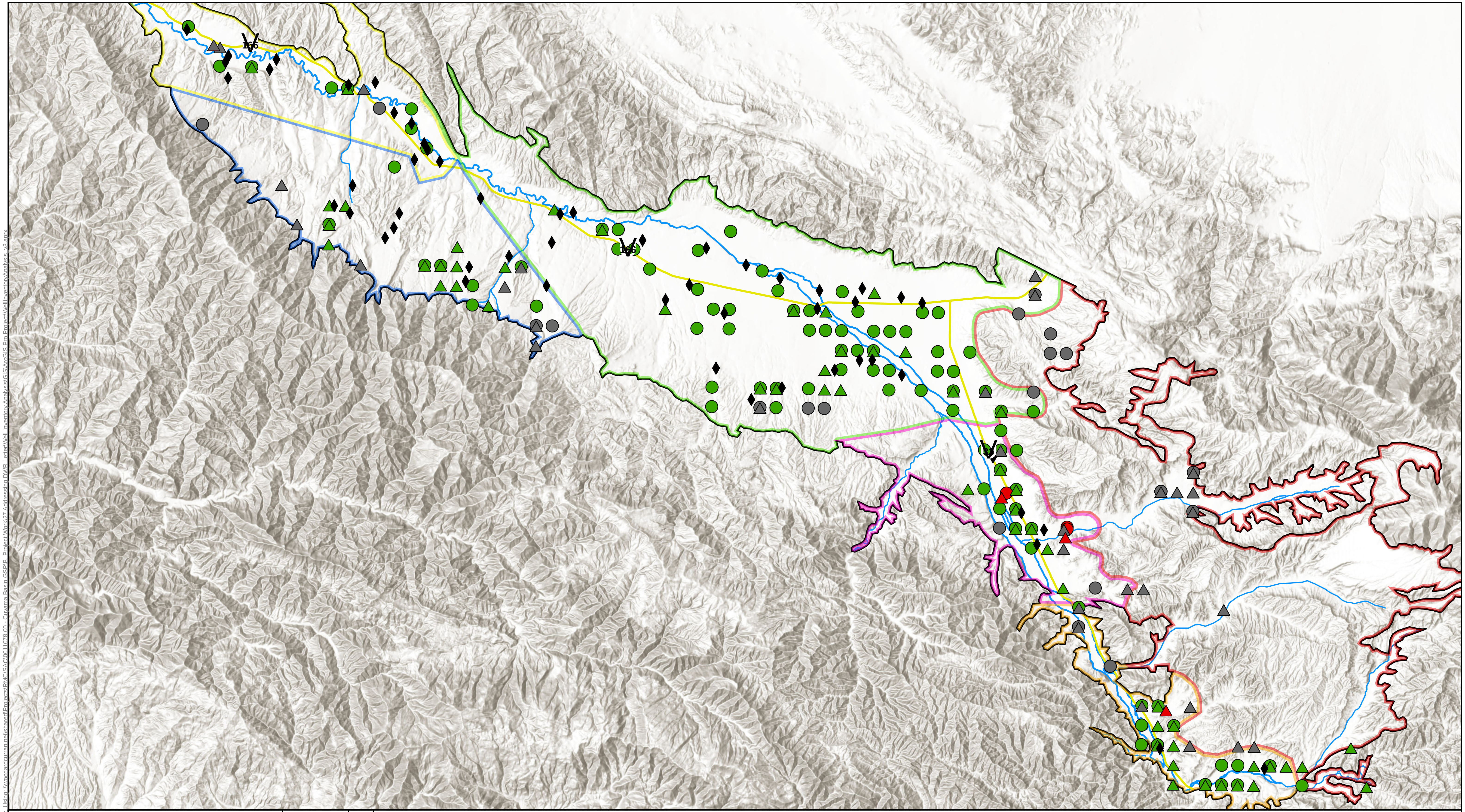

Figure 5-5: Well Status Based on Minimum Threshold Analysis

Cuyama Basin Groundwater Sustainability Agency

Cuyama Valley Groundwater Basin Groundwater Sustainability Plan

April 2022

WOODARD & CURRAN

Legend

- Cuyama Basin
- Cuyama River
- Representative Monitoring Well

Threshold Region

- Badlands Region
- Central Region
- Eastern Region
- Northwestern Region
- Southeastern Region
- Western Region

Well Status

- At Risk of Going Dry
- Not At Risk of Going Dry
- Filtered from analysis

Minimum thresholds were extrapolated from representative monitoring wells to extend coverage throughout the Cuyama Basin. The extrapolated MTs were then compared to the screen depths of domestic and production wells (if screen depth data was unavailable, total well depth was used). Note: Some wells shown are approximate locations extracted from DWR WCR reports.

N

0 2 4 8 Miles

Modeling Analysis of Northwestern Threshold Groundwater Levels Minimum Thresholds

Concern was presented in DWR's Letter about whether the thresholds established in the Northwestern Threshold Region at Opti wells 841 and 845 are protective of nearby beneficial users of water. Specifically, DWR questioned what impact(s) may occur to nearby domestic wells and GDEs if groundwater levels were to reach MTs in representative wells. To address this, the Cuyama Basin Water Resources Model (CBWRM) was used to simulate groundwater level conditions by artificially dropping groundwater levels near Opti Wells 841 and 845 to the set MTs. This was done by assigning specified head boundary conditions at the MT levels for the model nodes near these well locations. The simulation was run for 10 years over the historical period between water years (WY) 2011 to 2020 during which the specified head boundary conditions at the MT levels were continuously active.

Figure 5-6 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 the 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. 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.

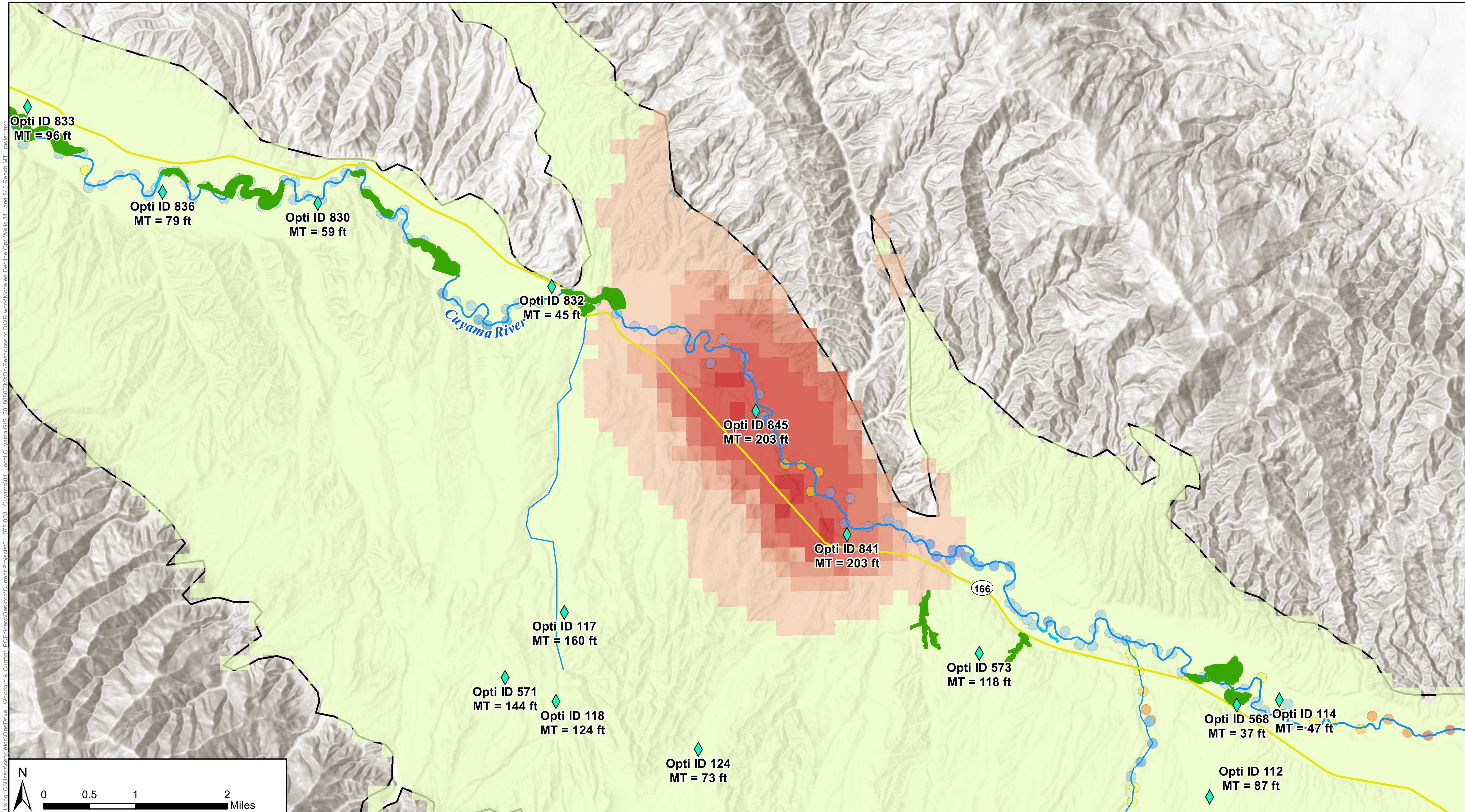

Figure 5-6: Change in GWLs in Northwestern Region from CBWRM Test Simulation

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.

5.5 Supplemental Section 5.5: Minimum Thresholds, Measurable Objectives, and Interim Milestones, Degraded Water Quality

Why Groundwater Management is Unlikely to Affect Nitrate and Arsenic Concentrations

As discussed in the submitted GSP, 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 Program (ILP). 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 Basin due to the reduction in pumping allocations that were included in the GSP. This will likely reduce the application of fertilizers in the central part of the Basin as agricultural production in the Basin is reduced over time.

Similarly, because arsenic is naturally occurring, the CBGSA does not believe the establishment of thresholds for arsenic is appropriate. As shown in Figure 2-79, wells with high arsenic concentrations are located in a relatively small area of the Basin south of New Cuyama. A review of production well data provided by the counties (discussed in Section 2) indicates that there are no active private domestic wells located in this part of the Basin. The only operational public well that that is located in this part of the Basin serves the Cuyama Community Services District (CCSD). As noted above, 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 intends to leverage and make use of existing monitoring programs for nitrates and arsenic, in particular ILP for nitrates and USGS for arsenic. Wells in the Basin where recent monitoring data is available for these constituents are shown in Figures 2-79 and 2-80. The CBGSA intends to collect data from the ILP and USGS and perform analysis at each 5-year GSP update to monitor constituent level changes and reassess their impacts on the Basin and its beneficial uses and users. In addition to the planned data collection and analysis efforts, the CBGSA plans to collect water quality data for nitrate and arsenic at each water quality well identified in the GSP (Figure 4-20) during calendar year 2022. This will provide a baseline constituent level in all groundwater quality representative monitoring network locations that can be utilized for future Basin planning. Additional measurements may be considered by the GSA in the future in anticipation of five-year updates.

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.

Although nitrate and arsenic concentrations in groundwater do not currently fall within the regulatory authority of the CBGSA, as stated above, nitrates are regulated by ILP. In addition, the CBGSA will reevaluate nitrate and arsenic concentrations at each 5-year GSP update. 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.

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.

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 SGMA regulations.

6.1 DMS Overview

The Cuyama Basin DMS uses the Opti platform, which is a flexible and open software platform that uses familiar Google maps and charting tools for analysis and visualization. The DMS serves as a data-sharing portal that enables use of the same data and tools for visualization and analysis. These tools support sustainable groundwater management and create transparent reporting on collected data and analysis results. Figure 6-1 is a screenshot of the Opti platform.

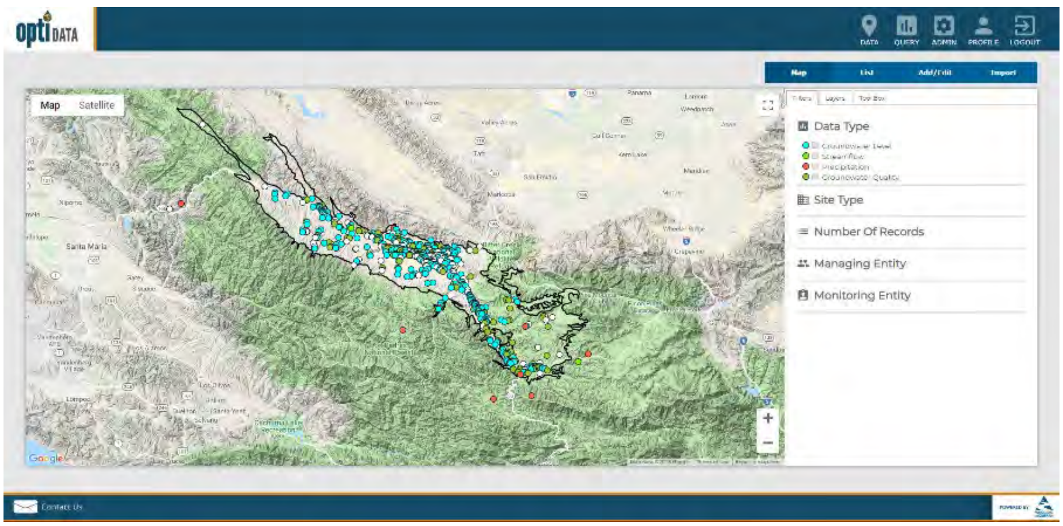

Figure 6-1: Screenshot of Opti Platform

The Cuyama Basin DMS is a web-based publicly accessible portal that may be viewed using common web browsers such as Google Chrome, Firefox, and Microsoft Edge. The DMS utilizes Google maps and other charting tools for analysis and visualization. The site may be accessed at http://opti.woodardcurran.com/cuyama.

6.2 DMS Functionality

The DMS is a modular system that includes numerous tools to support GSP development and ongoing implementation, including the following:

- User and data access permissions
- Data entry and validation
- Visualization and analysis
- Query and reporting

As the needs of the Cuyama Basin Groundwater Sustainability Agency (CBGSA) change over time, the DMS can be configured for additional tools and functionality. The following sections describe the DMS's currently configured tools. For more detailed instructions about how to use the DMS, refer to the Cuyama Basin Data Management System Opti Data Public User Guide (Appendix A).

6.2.1 User and Data Access Permissions

DMS user access permissions are controlled through several user types. These user types have different roles in the DMS as summarized in Table 6-1 below. These user types are broken into three high-level categories as follows:

- **System Administrator** – System administrators manage information at a system-wide level, with access to all user accounts and entity information. System administrators can set and modify user access permissions when an entity is unable to do so.
- **Managing Entity (Administrator, Power User, User)** – Managing entity users are responsible for managing their entity's site/monitoring data, and can independently control access to these data. Entity users can view and edit their entity's data and view (but not edit) shared or published data supplied by other entities. An entity's site information (i.e., wells, gages, etc.) and associated data may only be edited by system administrators and power users associated with the entity. The CBGSA is currently configured as the managing entity for all datasets in the DMS.
- **Public** – Public users may view data that are published, but may not edit any information. Public users may access the DMS using the guest login feature on the DMS login screen (Figure 6-2).

Table 6-1: Data Management System User Types/Access

Modules/ Submodules	System Administrators	Managing Entity			Public
		Admin	Power User	User	
Data: Map	Access to all functionality	Access to all functionality	Access to all functionality	Access to all functionality	Access to partial functionality
Data: List	Access to all functionality	Access to all functionality	Access to all functionality	Access to all functionality	Access to partial functionality
Data: Add/Edit	Access to all functionality	Access to all functionality	Access to all functionality	--	--
Data: Import	Access to all functionality	Access to all functionality	Access to all functionality	--	--
Query	Access to all functionality	Access to all functionality	Access to all functionality	Access to all functionality	Access to partial functionality
Admin	Access to all functionality	--	--	--	--
Profile	Access to all functionality	Access to all functionality	Access to partial functionality	Access to partial functionality	Access to partial functionality

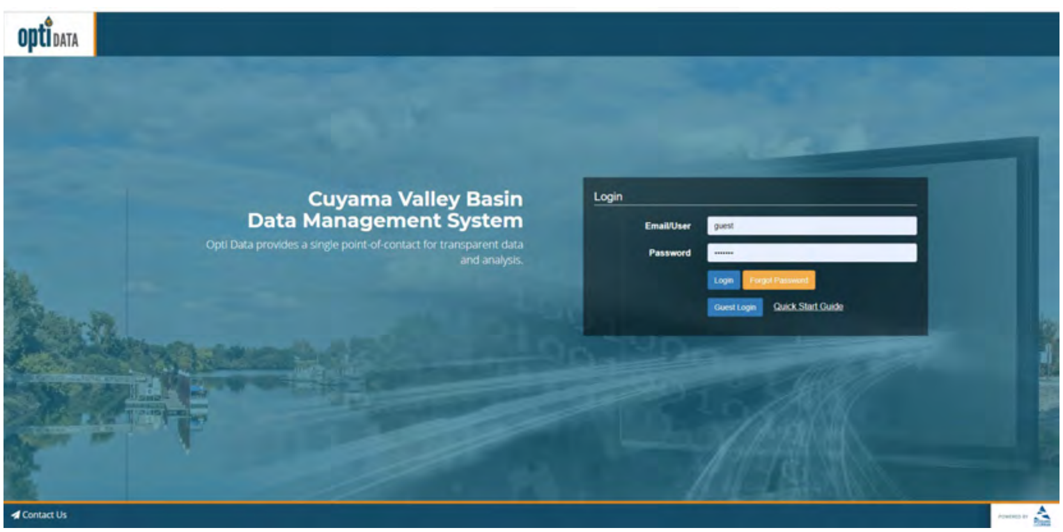

Figure 6-2: Screenshot of Opti Login Screen

Monitoring sites and their associated datasets are added to the DMS by managing entity administrators or power users. In addition to user permissions, access to the monitoring datasets is controlled through assigning one of three options to the data type as follows:

- **Private data** – Private data are monitoring datasets only available for viewing, depending on user type, by the entity's associated users in the DMS.
- **Shared data** – Shared data are monitoring datasets available for viewing by all users in the DMS, except for public users.
- **Public data** – Public data are monitoring datasets that are available publicly that can be viewed by all user types in the DMS; public datasets may also be published to other websites or DMSs as needed.

Managing entity administrators can set and maintain data access options for each data type associated with their entity.

6.2.2 Data Entry and Validation

To encourage agency and user participation in the DMS, data entry and import tools are designed to be easy to use, are accessible over the web, and help maintain data consistency and standardization. The DMS allows entity administrators and power users to enter data either manually via easy-to-use interfaces, or through an import tool using Microsoft Excel templates, so that data may be entered into the DMS as soon as possible after collection. The data records are validated by a managing entity's administrators or power users using a number of quality control checks prior to inclusion in the DMS.

Data Collection Sites

Users can input site information about groundwater wells, stream gages, and precipitation meters manually either through the data entry tool or when prompted in the import tool. Using the data entry tool, new sites may be added by clicking on "New Site." Existing sites may be updated using the "Edit Site" tool. During data import, the sites associated with imported data are checked by the DMS against an existing site list. If the site is not in the existing site list, the user is prompted to enter the information via the new site tool before the data import can proceed.

Table 6-2 lists the information that is collected for sites. Required information is indicated with an asterisk; all other information is considered optional.

Table 6-2: Data Collection Site Information

Basic Information	Well Information	Construction Information
Site Type* Opti Site Name* Local Site Name* Additional Name Latitude/Longitude* Description County Managing Entity* Monitoring Entity* Type of Monitoring Type of Measurement Monitoring Frequency	State Well ID MSC (Master State Well Code) USGS Code CASGEM ID Ground Surface Elevation (feet) Reference Point Elevation (feet) Reference Point Location Reference Point Description Well Use Well Status Well Type Aquifers Monitored Groundwater Basin Name/Code Groundwater Elevation Begin/End Date Groundwater Elevation Measurement Count Water Level Measurement Method Groundwater Quality Begin/End Date Groundwater Quality Measurement Count Comments	Total Well Depth Borehole Depth Casing Perforations Top/Bottom Elevation Casing Diameter Casing Modifications Well Capacity Well Completion Report Number Comments

Notes:
ID = identification number
MSC = Master State Well Code
USGS = United States Geological Survey
CASGEM = California Statewide Groundwater Elevation Monitoring Program